PROTOCOOPERATIVE NETWORKS: the new architecture of informational power and its technical and cognitive impacts

REDES PROTOCOOPERATIVAS: a nova arquitetura do poder informacional e seus impactos técnicos e cognitivos

Tatiana de Carvalho Duarte[1]
Rodrigo César Paes Fumes[2]

Abstract
This article analyzes the phenomenon of protocooperative social networks, in which digital platforms, although formally competing, cooperate indirectly through the massive replication of content, the action of recommendation algorithms, and the growing use of generative artificial intelligence. Interplatform replication transforms communication flows into redundant structures, concentrating informational power in a few intermediaries and reducing the diversity of voices and perspectives. The study also discusses the cognitive, social, and democratic impacts of this model: information overload, reinforcement of bubbles, algorithmic manipulation, and systemic vulnerability. It also addresses the technical and energy implications of this expansion, such as the exponential growth of data storage and the increase in electricity consumption. It concludes that protocooperative networks are not a deviation, but a new form of communication organization, requiring regulatory and social responses commensurate with their complexity. The study proposes ways to mitigate these risks, focusing on algorithmic transparency, decentralization, media literacy, ethical AI, and incentives for original production.
Keywords: Social networks; Protocooperation; Artificial intelligence; Algorithms; Misinformation; Attention economy.

Resumo
Este artigo analisa o fenômeno das redes sociais protocooperativas, no qual plataformas digitais, embora formalmente concorrentes, cooperam de maneira indireta por meio da replicação massiva de conteúdos, da ação de algoritmos de recomendação e do uso crescente de inteligência artificial generativa. A replicação interplataforma transforma fluxos comunicacionais em estruturas redundantes, concentrando poder informacional em poucos intermediários e reduzindo a diversidade de vozes e perspectivas. O estudo discute ainda os impactos cognitivos, sociais e democráticos desse modelo: sobrecarga informacional, reforço de bolhas, manipulação algorítmica e vulnerabilidade sistêmica. Também aborda as implicações técnicas e energéticas dessa expansão, como o crescimento exponencial do armazenamento de dados e o aumento do consumo elétrico. Conclui-se que as redes

[1] Doutora em Desenvolvimento Humano e Tecnologias. Mestre em Comunicação Midiática. Jornalista (IFSULDEMINAS - Campus Muzambinho), Muzambinho/MG, Brasil. E-mail: tatiana.duarte@muz.ifsuldeminas.edu.br. Lattes: http://lattes.cnpq.br/7850117826865549. ORCID: https://orcid.org/0000-0002-1035-9661.
[2] Mestre em Ciências. Bacharel e Licenciado em Geografia. Professor EBTT (IFSULDEMINAS - Campus Muzambinho), Muzambinho/MG, Brasil. E-mail: rodrigo.fumes@ifsuldeminas.edu.br. Lattes: http://lattes.cnpq.br/1889472198558506. ORCID: https://orcid.org/0000-0002-9511-2923.

protocooperativas não são um desvio, mas uma nova forma de organização comunicacional, exigindo respostas regulatórias e sociais à altura de sua complexidade. Com a proposição de caminhos para mitigar tais riscos, com foco em transparência algorítmica, descentralização, educação midiática, IA ética e incentivos à produção original.
Palavras-chave: Redes sociais; protocooperação; Inteligência artificial; Algoritmos; Desinformação; Economia da atenção.

1 INTRODUCTION

Over the last twenty years, social networks have radically transformed the way individuals, institutions, and companies communicate. They have ceased to be mere spaces for personal interaction and have become fundamental infrastructures for the circulation of information, culture, and symbolic capital. Platforms such as Instagram, Facebook, TikTok, YouTube, and X dominate the global online communication landscape (at least in the West), shaping behaviors, mediating emotions, and influencing political and economic decisions. In this scenario, the dynamic of content replication has become a central practice: content creators, influencers, institutional communicators, or common users produce a single piece of material and share it across various platforms, minimally adjusting the format or keeping it identical. This practice, while efficient in terms of reach, creates a phenomenon of interdependence between platforms, which appear to compete but operate in a feedback loop. This phenomenon is described by the concept of "protocooperative social networks": independent digital structures that cooperate indirectly through the actions of content creators and the functioning of recommendation algorithms themselves. Just as species coexist in ecological balance without formal collaboration, these networks coexist in communicative balance, even without direct institutional agreements.

> In this sense, the term Protocooperation Social Network is being coined in order to explain the dependency relationship between social networks, especially network Facebook, and other social media such as blogs, microblogs, bookmarks and content aggregators. And therefore demonstrate evidence of interspecific harmonic relations, without ignoring the fact that homotypic or intraspecific relationships are also a phenomenon existent (Duarte, 2013. p.114).

The emergence of this phenomenon is amplified by other structural factors of the digital ecosystem: the attention economy, recommendation algorithms, the logic of virality, and, more recently, the advancement of generative Artificial Intelligence

technologies, which exponentially expand the capacity for content creation and replication. At the same time, this scenario produces serious side effects such as: cognitive emptying resulting from the repetition of messages across different platforms; the collapse of informational diversity; the reinforcement of informational bubbles; in addition to the risks of algorithmic manipulation, saturation of the informational environment, and systemic vulnerability in case of technical failures. The objective of this article is to deepen the analysis of the concept of protocooperative social networks, discussing their theoretical bases, contemporary problems, and their social, cultural, and cognitive impacts, proposing ways to mitigate the risks of this model. In particular, we highlight that one of the most underestimated effects of the expansion of protocooperative social networks is how data production and storage are becoming structurally unsustainable. Although the dominant narrative presents data growth figures as a reflection of an explosion of creativity and digital innovation, the reality is much more redundant: a significant portion of this volume consists of the same content being replicated multiple times across platforms.

2 DEVELOPMENT

The analysis of protocooperative social networks is based on a series of contemporary debates about technology, communication, and society. Manuel Castells (2016) defines the "network society" as a social structure built around information networks, mediated by digital technologies. Social networks thus become central spaces for the circulation of symbolic and political power.

> The emergence of a new technological paradigm organized around new, more flexible and powerful information technologies makes it possible for information itself to become the product of the productive process. To be more precise: the products of the new information technology industries are information processing devices or the processing of information itself. By transforming information processing processes, new information technologies act on all domains of human activity and enable the establishment of infinite connections between different domains, as well as between the elements and agents of such activities. A deeply interdependent networked economy emerges that becomes increasingly capable of applying its progress in technology, knowledge, and management to technology, knowledge, and management itself. Such a virtuous circle should lead to greater productivity and efficiency, considering the correct conditions for equally drastic organizational and institutional transformations (Castells, 2016, p. 135).

In this society, information is power, and digital networks, controlled by a limited number of global corporations, act as privileged mediators of these flows. In other words, whoever controls the networks controls informational flows and, by extension, has influence over social, economic, and political decisions. In the context of protocooperative networks, this logic intensifies: even if companies compete with each other, they share a similar user base, habits, and consumption practices. The same individual can move from one platform to another consuming practically identical content, generating an interconnected network, but without rigid boundaries. Thus, competition between platforms paradoxically converts into indirect structural cooperation, reinforcing the interest of media conglomerates in the dissemination of content, regardless of its source. Castells (2016) also highlights that networks have the capacity to reconfigure the public sphere. Unlike traditional, centralized, and unidirectional media, digital networks have a rhizomatic and decentralized nature. This characteristic, however, does not necessarily mean plurality: large platforms impose rules and algorithms that limit, filter, and prioritize certain content, influencing the formation of public opinion and social debate. Complementarily, Henry Jenkins (2008) presents the concept of "convergence culture," according to which different media and platforms interact, sharing content flows and cultural practices. This convergence occurs not only through corporate agreements but also through the actions of users themselves, who transfer content between distinct environments. For the author, convergence is not just a technological process, but a cultural and behavioral one: consumers and creators actively work to transfer information and narratives from one environment to another.

> Convergence culture is highly productive: some ideas spread from the top down, starting in commercial media and then adopted and appropriated by a range of different audiences as they spread throughout culture. Others emerge from the bottom up, from various points of participatory culture, and are swept into mainstream culture if media industries glimpse some way to profit from them (Jenkins, 2008, p.325).

Jenkins also highlights the role of "active consumers" and participatory culture, central elements for understanding how viral content transcends the boundaries of individual platforms. Today, this participatory culture is amplified by automation and AI, which accelerates and expands convergence - but also reduces diversity. The daily practice of replicating the same content across different platforms is a concrete form of cultural convergence - a video created on TikTok can become a global trend by

being replicated on Instagram, YouTube, and X, or have greater relevance on one platform than on others, depending on institutional interests and user engagement.

2.1 Attention Economy and Surveillance Capitalism

The Attention Economy, a concept formulated by Herbert Simon (1971), is based on the premise that human attention constitutes a scarce resource, capable of being managed, disputed, and capitalized. In communication ecosystems saturated with stimuli, digital platforms organize their business models around capturing and retaining attention, converting it into economic value. As Bentes (2019) observes, this dynamic is anchored in the massive collection of data and the application of predictive algorithmic systems capable of monitoring, classifying, and modulating behaviors, maximizing user exposure time and engagement. Thus, attention becomes the central variable of a feedback loop: the more attention is captured, the more data is generated; the more data available, the more effective the capture mechanisms become, intensifying the concentration of communication flows.

This process is intrinsically related to what Zuboff (2019) calls surveillance capitalism, an economic model structured on the large-scale extraction, analysis, and commercialization of behavioral data. Digital platforms operate as algorithmic surveillance infrastructures, where every action, like, click, or viewing time is converted into economic input.

The logic of protocooperative networks is deeply immersed in this economy. By replicating content across platforms, creators maximize their chances of "capturing" the attention of the same individual multiple times, in different environments. For companies, this means increased screen time, greater exposure to advertisements, and more intense collection of behavioral data.

However, there is a significant side effect: informational saturation. When the same messages are continuously repeated, attention ceases to be diversely distributed and instead concentrates on a few dominant contents. Competition transforms into redundancy, reducing plurality and impoverishing the informational space. Not to mention the confirmation of users' viewpoints who, when inundated with information from the same angle, corroborate their thinking without allowing for other opinions and openness to new ideas, also summarized as "information bubbles".

> The phenomenon of information bubbles is a global effect that occurs in social networks, bringing various social and emotional problems to modern society, such as addictions, intellectual impoverishment, and, in more severe cases, risks to physical and mental health. These bubbles are caused by the metrics of algorithms within social networks, which analyze users' digital footprints to direct content of interest (Silva, Rocha, Baluz, 2025).

This cycle closes the bubbles and hinders users' contact with divergent content, reinforcing cognitive biases and ideological polarizations. Extreme personalization, driven by AI systems, further aggravates this process: each user sees a tailor-made world that does not necessarily correspond to shared reality. Nicholas Carr (2010) warns that the internet shapes a scattered and superficial brain. The repetition of information across multiple networks intensifies this superficiality, as it reduces the variety of cognitive stimuli and reinforces already internalized messages. That is, constant exposure to fragmented and repetitive information diminishes cognitive depth, making users more dispersed and less critical.

Francisco Rudiger (2012, p. 201) analyzes this scenario by stating that Carr believes

> that the internet is not important for the content it conveys, but for the material processes it orchestrates. McLuhan, in short, was right to state that the medium is the message, but this, the author concludes, is not a maxim to be viewed favorably. Despite being a self-confessed addict to communication gadgets, Carr warns us of the danger the net poses to the way of thinking that helped create our greatness. After centuries of print media hegemony, competently recapitulated by the author, its baton passed to electronic media, where the internet increasingly stands out. With this, however, there is a transition from a concentrated, linear, and focal way of thinking to another, superficial, disjointed, and fast (p. 10), whose meaning tends to be harmful to humanity.

In the environment of protocooperative networks, this superficiality is accentuated. When users receive the same information on different platforms, they have the impression of being "updated", but in reality, they are merely exposed to repetition. This creates a phenomenon of mental emptying, in which the excess of stimuli no longer generates knowledge, but only noise.

In this context, protocooperative networks can be understood as superimposed infrastructures: they function autonomously but feed each other through communication and economic flows. Connectivity, therefore, transcends technical and legal barriers, consolidating a hybrid ecosystem. We live in a culture of connectivity, where digital platforms shape social structures, daily practices, and public narratives.

It is not just about social networks as tools, but about sociotechnical infrastructures that organize social life.

2.2 New Technologies and Artificial Intelligence

The rise of generative AI technologies has exponentially expanded content production capacity and profoundly transformed the digital communication ecology. Tools like ChatGPT, Midjourney, Sora, and Gemini allow for the creation of texts, images, and videos on an industrial scale, favoring the automated replication of materials across multiple platforms and simultaneous circulation in different ecosystems, which feeds algorithms and multiplies views. If, until the mid-2010s, social network dynamics were primarily shaped by human actions mediated by recommendation algorithms, from 2020 onwards, the massive automation of creative and content distribution processes began to play a central role in how platforms function and how users behave.

However, this scenario brings risks such as: content homogenization and loss of cultural diversity; algorithmic manipulation of political and economic trends; the automation of disinformation, empowered by generative AI; the risk of synchronized blackouts affecting multiple platforms simultaneously; production scale: the amount of content generated by creators has exploded, contributing to informational overload; replication speed: content is published simultaneously across various networks, without the need for careful adaptation to each one; aesthetic and narrative standardization: as many use the same prompts and tools, AI ends up standardizing styles and formats; generative redundancy: the same content being presented in different ways on multiple platforms (recorded and replicated live streams, cuts, reacts, etc.).

AI, however, is not an external element to the communication ecosystem: it acts as a structuring force, expanding, accelerating, and, in some cases, distorting informational flows. Within the phenomenon of protocooperative social networks, AI is a catalytic agent that makes the content replication process faster, cheaper, and more uniform.

Generative AI tools allow any user to produce large quantities of text, images, audio, or video in a matter of minutes, tasks that previously required time, technical skills, or specialized teams. This ease creates a new profile of content creator, much

more productive and less dependent on traditional production resources. A single individual can schedule a series of daily posts and publish them on multiple platforms with a few clicks.

2.3 Recommendation Algorithms and Automatic Replication

One of the main technical elements driving the phenomenon of protocooperative networks are recommendation algorithms. Each platform has its own content prioritization systems, based on variables such as engagement, dwell time, likes, shares, and user history.

It is also common for the same platform to have different algorithms. As Mosseri (2025) states,

> With the growth of Instagram, people found it difficult to find all the content they were interested in. There was too much content. That's why we created algorithms to show you what you want, when you want it. But there's a misunderstood fact: there isn't a single algorithm that decides what you see. Each part of the app (feed, Explore, and Reels) has its own ranking system based on how you use it (Mosseri, 2025).

Across Instagram, the algorithm uses "signals" based on how you interact with the app and how others interact with you. According to Instagram's Creator website, "how often people see your content is based on what they like, what they comment on, and even how you tag or format posts". Thus, by engaging with certain content, the informational sphere in which it is inserted will become your sphere, whether you want diversity of opinions or not.

However, there are convergent mechanisms: content that performs well on one platform can perform equally well on others. This algorithmic convergence is not the result of agreements between companies, but of structural similarities in the design of these platforms. This means that algorithms themselves "reward" replication: instead of producing personalized messages for each platform, many creators choose to simply republish the same content, maximizing results with minimal effort. AI, by automating part of this process (including post scheduling), makes this practice even more frequent. Platforms like Zapier, Hootsuite, Buffer, and Later allow the same content to be published simultaneously on multiple social networks.

These tools, originally designed to facilitate digital marketing management, help blur the lines between platforms. A single dashboard allows control of digital presence

across five or more networks, transforming vertical videos into multiple formats and automatically republishing the same material at strategic times. This technological integration, combined with generative AI, creates a hybrid human-machine ecosystem, where the distinction between human authorship and automation becomes blurred. The user becomes a "flow manager" and AI performs repetitive tasks, feeding different platforms in a synchronized manner.

In addition to accelerating replication, AI also deepens content personalization. Platforms use predictive models based on machine learning to micro-segment audiences, defining which content each individual will see on their timeline. This micro-segmentation creates an illusion of diversity: although the content is the same, replicated across platforms, each user receives it at different times and in different formats, adjusted to their profile. This intensifies the cognitive and emotional impact of messages, contributing to reinforce pre-existing beliefs.

The same news or video, appearing in slightly different forms on different platforms, amplifies the perception of truth. The user has the sensation that multiple sources are confirming information, when in reality it is the same content replicated and repackaged. This phenomenon is especially relevant in the context of disinformation and political polarization.

2.4 AI and Disinformation on an Industrial Scale

The relationship between AI and disinformation is one of the greatest contemporary challenges. If creating fake news once required human time and coordination, today a well-crafted prompt is enough to produce dozens of false pieces in minutes. This capability, combined with the protocooperative logic, means that AI-generated disinformation circulates rapidly across platforms, often escaping traditional verification systems. A deepfake or fabricated text can be posted on one platform, automatically replicated on others, and shared by thousands of users before any fact-checking can be done.

Documented cases during recent electoral processes show that coordinated disinformation networks benefit from speed and repetition. The presence of the same content on multiple platforms increases the perceived credibility by users, a phenomenon known as the social validation effect. When a message is seen repeatedly in different places, even if it is false, it tends to be considered true.

This vulnerability is especially dangerous in polarized societies, where trust in traditional institutions is already eroded. Algorithmic manipulation can shape political perceptions, influence electoral decisions, and weaken plural public debate. Recent cases highlight this risk: during elections in several countries, AI-generated videos were widely replicated across platforms to manipulate public opinion; disinformation related to the pandemic spread with speed intensified by automation; and platforms faced technical difficulties in containing content disseminated simultaneously across multiple digital environments.

This scenario creates significant democratic risks: such as the manipulation of public opinion, erosion of trust in legitimate sources, and the difficulty of distinguishing authentic from fabricated content. This corrodes the credibility of the digital environment and causes the amplification of extremist discourses. Furthermore, it poses major ethical challenges due to the lack of algorithmic transparency, as users do not know how their data is used or how their feeds are shaped.

Power asymmetry is also an important issue, as large technology companies concentrate control over global informational infrastructure and traffic. This increases the risk of political manipulation, with AI being used to amplify disinformation campaigns across multiple platforms simultaneously.

Thus, Artificial Intelligence does not, by itself, create protocooperative social networks, but it accelerates and intensifies them. It expands the scale of production, speeds up replication, strengthens integration between platforms, and deepens personalization and algorithmic manipulation. At the heart of this phenomenon is a paradox: AI offers creators unprecedented power and productive autonomy, but it also makes them more dependent on a few centralized platforms, contributing to the homogenization and systemic vulnerability of the digital ecosystem.

3 RESULTS AND DISCUSSION - CURRENT PROBLEMS

The phenomenon of protocooperative social networks brings not only gains in scale and engagement but also complex, multifactorial, and interconnected problems. These issues are not limited to technical aspects but traverse cognitive, political, economic, and social dimensions, with effects ranging from the homogenization of public discourse to profound democratic vulnerabilities. Among the main problems are: bugs and technical failures, where much content is replicated across platforms and a

single blackout has a chain effect; mental emptying and informational obsolescence, where the same news or video reaches the user through different channels, generating cognitive saturation and a sense of informational loop; informational bubbles, caused by algorithms that reinforce similar content, reducing the diversity of perspectives; in addition to democratic vulnerability, where the concentration of communication flows in a few companies creates risks for elections, social movements, and freedom of expression.

3.1. Effects of Mental Emptying

The excessive repetition of content across different networks impacts not only the quality of information but also users' mental health. Research on information overload (Sweller, 1988) and digital fatigue shows that constant exposure to redundant messages can generate: anxiety and a constant sense of urgency; mental fatigue and difficulty concentrating; loss of trust in information sources; reduction of critical and analytical capacity; cognitive saturation, with difficulty processing new information; and cultural homogenization, as few contents dominate the digital ecosystem.

This phenomenon, which can be described as mental emptying, occurs when the user feels saturated by information that seems new but is actually reformulations of the same core content. This weakens selective attention and the ability to identify manipulative narratives. Another central problem lies in the opacity of algorithmic systems. Platforms do not offer clear information about recommendation, visibility, or monetization criteria. Users are thus subjected to automatic decisions without knowing how or why they are affected.

This lack of transparency amplifies a power asymmetry between users and large technology companies. While platforms accumulate data and control, creators and consumers remain vulnerable, unable to understand or challenge automated decisions that shape their access to information. In the context of protocooperative networks, the asymmetry is even greater: decisions made by one platform reverberate across all others, through content replication and the convergence of informational flows. The power of information mediation is thus concentrated in very few economic agents, raising profound ethical and political questions.

3.2. Informational Obsolescence and Narrative Superficiality

Finally, there is a less debated but equally relevant problem: the accelerated obsolescence of content. In an environment of constant replication, content circulates rapidly but loses relevance at the same speed. This creates a cycle of instant consumption, where analytical depth and critical reflection give way to superficial, ephemeral, and highly polarized narratives.

This phenomenon discourages the production of complex content, as it is harder to go viral, and encourages discursive homogenization, further reinforcing the protocooperative structure. Algorithms also tend to prioritize the reach of content that has a higher percentage of viewing time. Thus, a 30-second content with a viewing time of around 15 seconds (50%) has a greater chance of going viral than a 1-minute content with the same 15 seconds of average viewing time (25%).

3.3 Bugs and Technical Failures

In addition to clinical and cognitive issues, structural aspects and technical bugs are already on the radar of various scientists, enthusiasts, and scholars of current technologies. Issues such as the slowdown in the development of storage technologies and new energy sources concern developers who understand that systems like Artificial Intelligence demand large quantities of space and energy to remain active.

According to recent estimates, the world already produces more than 402 million terabytes of data per day, which is equivalent to about 147 zettabytes annually (Duarte, 2025). Projections indicate that this number will reach 181 zettabytes by the end of 2025, representing an approximate growth of 23% per year (Demand Sage, 2025).

However, a large part of this informational mass does not correspond to original creations: it consists of replicated or slightly modified content circulating between platforms. This occurs because, within the protocooperative logic, content creators produce a single piece - text, video, or image - and publish it simultaneously on multiple networks. A video published on TikTok is immediately replicated on Instagram, YouTube, and X, often without any substantial alteration. Thus, a single piece of content generates multiple stored instances, consuming computational and storage resources disproportionately to its informational value. This logic inflates global data figures but does not reflect a real diversification or expansion of the digital knowledge

base. What we have, therefore, is not organic growth of the ecosystem, but an intensification of its structural redundancy.

Furthermore, AI allows for the generation of minimal variations of the same base content, artificially multiplying the volume of data without substantially increasing informational diversity. In a protocooperative scenario, where each variation is replicated across multiple platforms, redundancy grows exponentially. This dynamic creates a spiral of overload. While data grows exponentially, physical storage capacity does not advance at the same pace. Conventional technologies have physical and logistical limits. More innovative solutions are still in the experimental phase and are not yet applicable on a commercial scale.

This gap increases the probability of technical failures, slowdowns, and synchronized outages. As protocooperative social networks share creators and informational flows, a congestion in a central data center can trigger cascading failures across different platforms.

3.4 The Energy Cost of Redundancy

The problem of storage is directly linked to that of electricity. According to the International Energy Agency, data centers already consume between 240 and 340 TWh per year, representing 1 to 1.3% of global electricity demand (INTERNATIONAL ENERGY AGENCY, 2025a). This number is projected to more than double by 2030, exceeding 945 TWh annually (INTERNATIONAL ENERGY AGENCY, 2025b).

Alex de Vries (2023), a data scientist at the Dutch National Bank, published an article in the sustainable energy journal Joule titled "The growing energy footprint of artificial intelligence". In it, he warned about AI's energy consumption, which could surpass the annual consumption of many countries by 2027.

Throughout 2022 and 2023, artificial intelligence (AI) has witnessed a period of rapid expansion and extensive, large-scale application. Prominent tech companies such as Alphabet and Microsoft significantly increased their support for AI in 2023, influenced by the successful launch of OpenAI’s ChatGPT, a conversational generative AI chatbot that reached 100 million users in an unprecedented 2 months. In response, Microsoft and Alphabet introduced their own chatbots, Bing Chat and Bard, respectively. This accelerated development raises concerns about the electricity consumption and potential environmental impact of AI and data centers. In recent

years, data center electricity consumption has accounted for a relatively stable 1% of global electricity use, excluding cryptocurrency mining (De Vries, 2023, p. 2191).

This escalation in energy consumption does not keep pace with the expansion of renewable sources, which makes the system even more vulnerable. The paradox is clear: we are consuming increasing energy to store increasingly repetitive content.

In addition to the environmental impact, this means that any failure in the global energy infrastructure, such as demand peaks or interruptions, can lead to coordinated digital blackouts, compromising multiple platforms simultaneously. Furthermore, high data redundancy increases vulnerability to synchronized failures and bugs. The system becomes heavy, slow, and energetically inefficient - a fertile ground for large-scale digital blackouts.

The practical consequence of this scenario is the weakening of the global informational infrastructure. Only large corporations with sufficient capital to maintain energy-intensive data centers will be able to sustain the pace. This leads to an even greater centralization of informational and technological power, reinforcing asymmetries between a few dominant agents and a vast base of dependent users.

An emblematic example occurred in October 2021, when Meta Platforms suffered a global outage that left Facebook, Instagram, and WhatsApp offline for about six hours. Companies lost revenue, journalists were unable to publish in real-time, and millions of creators saw their content paralyzed. As many used automations to distribute content on other networks, such as X and YouTube, the interruption also affected the flow of posts on those platforms.

The failure was the result of a configuration change made by the company itself in its backbone network, which connects its data centers. According to a news report published on the BBC website (2021), a command issued by engineers with the intention of assessing network capacity ended up inadvertently removing all connections, disconnecting Facebook's data centers globally. A bug in an internal auditing tool prevented this command from being blocked, resulting in the service outage. The problem was exacerbated because the company's internal tools and its DNS (domain name system) services also became inaccessible, hindering the team's efforts to resolve the situation remotely.

This event revealed a structural vulnerability: although each network functions independently, the interdependence created by the practice of content replication means that an isolated problem can destabilize the informational ecosystem as a

whole. This vulnerability becomes even more dangerous when considered in scenarios of electoral campaigns, natural disasters, or health emergencies, where real-time communication is vital.

In addition to blackouts, more subtle bugs such as failures in recommendation systems, server instabilities, or undue account blocks can break entire chains of digital communication. Platforms that do not experience direct failures still suffer indirect effects, as they depend on the same base of creators and the continuous flow of automated publishing. When centralized platforms fail or restrict content, the negative effects spread rapidly throughout the entire digital distribution ecosystem.

4 CONCLUSION

Protocooperative social networks expose a structural paradox: platforms that promised to amplify the voice of many have ended up establishing a regime of concentrated, repetitive, and vulnerable circulation. In practice, interplatform replication, empowered by recommendation algorithms, transforms competition into indirect cooperation, reducing the effective diversity of content and creating a false plurality: the same statement reappears in multiple environments, reinforced by the social validation effect.

As highlighted by the literature on network society and convergence culture, informational flows organize power. Today, this power is exercised by a few intermediaries who define what circulates, when, and to whom. Generative AI acts as a paradoxical accelerator: on one hand, it cheapens and massifies production; on the other, it concentrates data and processing, standardizes formats, and increases dependence on centralized infrastructures. The ecosystem becomes faster, broader, and more fragile.

The consequences span two levels. At the collective level, opaque replication favors disinformation, polarization, and strategic intervention in electoral cycles, raising democratic risks. At the individual level, redundant exposure fuels cognitive emptying and informational anxiety, replacing in-depth understanding with a mere sensation of "being informed."

Responding to this scenario requires an integrated agenda:

- (I) Transparency and algorithmic auditing for curation, classification, and moderation;

- (II) Decentralization and open standards, reducing dependence on a few critical nodes;
- (III) Media literacy aimed at recognizing redundancy, checking sources, and breaking confirmation cycles;
- (IV) AI oriented towards plurality, with metrics that reward diversity of sources and decouple reach from pure replication;
- (V) Incentives for originality (remuneration and distribution models that value informational novelty).

In summary, protocooperative networks are not a deviation, but the very contemporary form of communication organization: interconnected, accelerated, and fragile. Recognizing the mechanism - replication + algorithms + AI - is a necessary step for public policies and professional practices that restore plurality, resilience, and autonomy to the informational space. Without this, we will continue to expand reach at the expense of diversity and robustness. A bad deal for democracy and for people's cognitive health.

REFERENCES

BENTES, A. **A gestão algorítmica da atenção**: enginchar, conhecer e persuadir. Rio de Janeiro: MediaLab.UFRJ, 2019. Disponível em: https://medialabufrj.net/wp-content/uploads/2019/08/BENTES-GESTAO-ALGORITMICA-politicas-internet-e-sociedade.pdf. Acesso em: 18 out. 2025.

CARR, N. **The Shallows**: What the Internet Is Doing to Our Brains. Paperback edition. Nova York: Norton, 2011.

CASTELLS, M. **A sociedade em rede**. 18. ed. São Paulo: Paz e Terra, 2016. p. 135.

DE VRIES, A. The growing energy footprint of artificial intelligence. **Joule**, v. 7, p. 2191–2194, 18 out. 2023. Elsevier Inc.

DEMAND SAGE. Big **Data Statistics 2025** (Growth & Market Data). Disponível em: https://www.demandsage.com/big-data-statistics. Acesso em: 18 out. 2025.

DUARTE, F. Amount of Data Created Daily**. Exploding Topics**, 24 abr. 2025. Disponível em: https://explodingtopics.com/blog/data-generated-per-day. Acesso em: 18 out. 2025.

DUARTE, T. de C. Protocooperative Social Networks. **Fonseca – Journal of Communication**, n. 7 (jul.–dez. 2013), p. 100–115.

EXAME. ChatGPT consome 17 mil vezes mais eletricidade do que a média das casas nos EUA. **Exame**, 11 mar. 2024. Disponível em: https://exame.com/inteligencia-artificial/chatgpt-consome-17-mil-vezes-mais-eletricidade-do-que-a-media-das-casas-nos-eua/?utm_source=copiaecola&utm_medium=compartilhamento. Acesso em: 18 out. 2025.

INTERNATIONAL ENERGY AGENCY. **Data centres and data transmission networks – Energy and digitalisation**. Disponível em: https://www.iea.org/energy-system/buildings/data-centres-and-data-transmission-networks. Acesso em: 18 out. 2025.

INTERNATIONAL ENERGY AGENCY. **AI is set to drive surging electricity demand from data centres while offering the potential to transform how the energy sector works**. Disponível em: https://www.iea.org/news/ai-is-set-to-drive-surging-electricity-demand-from-data-centres-while-offering-the-potential-to-transform-how-the-energy-sector-works. Acesso em: 18 out. 2025.

JENKINS, H. **Cultura da convergência**. 2. ed. São Paulo: Aleph, 2008. p. 325.

MOSSERI, A. Algoritmos e classificação (Algorithms & Ranking). **Instagram for Creators**, 2025. Disponível em: https://creators.instagram.com/grow/algorithms-and-ranking?locale=pt_BR. Acesso em: 18 out. 2025.

RÜDIGER, F. Uma análise de The shallows: what the internet is doing to our brains. **Comunicação, mídia e consumo**, São Paulo, v. 9, n. 24, p. 201–205, maio 2012.

SILVA, L. S. da; ROCHA, F. das C.; BALUZ, R. A. R. S. A formação das bolhas informacionais na comunicação digital: uma revisão bibliográfica sobre as métricas algorítmicas dentro das redes sociais Facebook, Twitter e TikTok. **Revista Eletrônica de Iniciação Científica em Computação**, v. 23, n. 1, p. 16–23, 2025. DOI: https://doi.org/10.5753/reic.2025.5402.

SIMON, H. A. Designing organizations for an information-rich world. In: GREENBERGER, M. (Ed.). **Computers, communications, and the public interest**. Baltimore: Johns Hopkins University Press, 1971. p. 37–72.

SWELLER, J. Cognitive load during problem solving. **Cognitive Science**, v. 12, n. 2, p. 257–285, 1988.

USP – Agência Universitária de Notícias. **Economia da atenção e universo das telas: entenda por que é tão difícil se desconectar**. São Paulo: Universidade de São Paulo, 2 set. 2021. Disponível em: https://aun.webhostusp.sti.usp.br/index.php/2021/09/02/economia-da-atencao-e-universo-das-telas-entenda-por-que-e-tao-dificil-se-desconectar/. Acesso em: 18 out. 2025.

ZUBOFF, S. **The age of surveillance capitalism**: the fight for a human future at the new frontier of power. New York: PublicAffairs, 2019.