THE PROSPECTIVE EVOLUTION OF SOCIAL NETWORKS FROM THE PERSPECTIVE OF NEUROPHENOMENOLOGY

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ABSTRACT

The purpose of the present article is to identify neurophenomenological aspects that influence the future development of social networks and to develop a corresponding concept of regulatory policy. The following methods are used in the article: collection and analysis of information, modeling of a conditional social network, systematization and separation of neurophenomenological factors, determination of functional dependencies, development of analytical conclusions and proposals. It was established that instigators and a favorable environment of social networks form prerequisites for the spread of negative information campaigns (conditional attacks). At the same time, it is mathematically proven that with minimal development of resistance to information attacks among users of social media platforms, the potential for stabilizing the information environment of social networks and promoting sustainable advancement of natural society was determined. Based on the research results, it was

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determined that fostering critical thinking skills, maintaining information stability, and practicing sound personal digital hygiene among users are key factors in upholding the overall stability of social networks. Additionally, these practices promote sustainable development of a psychologically healthy community. Additional investigations are focused on elaborating the notion of regulatory policy to facilitate the prospective advancement of social networks.

Keywords: Information attack, information hygiene, mental health, psycho-emotional factors, resistance.

La evolución prospectiva de las redes sociales desde la perspectiva de la neurofenomenología

RESUMEN

El propósito del presente artículo es identificar aspectos neurofenomenológicos que influyen en el desarrollo futuro de las redes sociales y desarrollar un concepto correspondiente de política regulatoria. En el artículo se utilizan los siguientes métodos: recopilación y análisis de información, modelado de una red social condicional, sistematización y separación de factores neurofenomenológicos, determinación de dependencias funcionales, desarrollo de conclusiones y propuestas analíticas. Se ha establecido que los instigadores y un entorno favorable en las redes sociales son condiciones previas para la difusión de campañas de información negativa (ataques condicionales). Al mismo tiempo, está matemáticamente demostrado que con un mínimo desarrollo de la resistencia a los ataques informativos entre los usuarios de las plataformas de medios sociales, se determinó el potencial para estabilizar el entorno informativo de las redes sociales y promover el avance sostenible de la sociedad natural. Con base en los resultados de la investigación, se determinó que fomentar las habilidades de pensamiento crítico, mantener la estabilidad de la información y practicar una sana higiene digital personal entre los usuarios son factores clave para mantener la estabilidad general de las redes sociales. Además, estas prácticas promueven el desarrollo sostenible de una comunidad psicológicamente sana que, en última instancia, contribuye al avance de la civilización en su conjunto. Investigaciones adicionales se centran en elaborar la noción de política regulatoria para facilitar el avance prospectivo de las redes sociales.

Palabras Clave: Ataque informativo, higiene informativa, salud mental, factores psicoemocionales, resistencia.

Introduction

Probing into the future evolution of social networks in the context of neurophenomenology is an innovative field of study that relies on the synergy of phenomenology

and neuroscience to understand and predict the evolution of social networks. The current study draws upon several key points (Laughlin, 2023):

Consumer adaptation: Social networks are constantly changing and adapting to the users' needs. Neurophenomenology can aid in identifying the specific components of interface and functionality that impact users' cerebral activity, enabling platforms to tailor their offerings accordingly (Smolla & Akcay, 2023).

Emotional impact: Communication in social networks often triggers affective responses. Neurophenomenology research can reveal how these responses arise in users and how platforms can utilize such information to enhance interaction and user engagement (Benrouba & Boudour, 2023).

Effectiveness of algorithms: Recommendation and filtering algorithms are pivotal in the functioning of social networks. Research in neurophenomenology can help improve these algorithms, taking into account the specificity of users' brain responses to different types of content (Bouyer et al., 2023).

Impact on mental health: Social networks have a significant impact on the mental health of users. Neurophenomenology enables us to delve deeper into this impact, unveiling the brain mechanisms correlated with stress, anxiety, as well as other psychological states (Popat & Tarrant, 2023).

Ethical issues and privacy: Comprehending the mechanisms by which platforms employ user data to affect cognitive processes is of significant importance to address ethical issues regarding privacy, manipulation, and impact on freedom of choice (Dhiman, 2023).

Thus, exploring the forthcoming development of social networks through the lens of neurophenomenology holds significant value in comprehending how these networks may potentially influence our cognition, behavior as well as affective states in the future. This makes it possible to develop more effective and ethical social networks that take into account the users' needs and well-being.

Currently, there is a vast scope of scientific inquiry into the prospective advancement of social networks. In particular, social networks are perceived as an environment for the development of economic activity and business (Benrouba & Boudour, 2023), for the development of a multicultural space and cultural exchange (Wood, Kleinbaum & Wheatley, 2023), for the development of an educational environment and the formation of professional skills (Heidari, Salimi & Mehrvarz, 2023), etc. Nonetheless, there is a scarcity of scientific research delving into the impact of social networks on the maturation of consciousness, self-identification, psycho-emotional perception and associated biological indicators. Taking into account the ubiquitousness and integration of social networks and social media, it is expedient to undertake a thorough study into the principles of neurophenomenology, both within the realm of public information and within the mental and emotional realm of individuals.

The purpose of the article is to identify neurophenomenological aspects of the future development of social networks. Ensuring that all relevant aspects are covered and addressed, the research objectives are defined as follows. To establish a solid groundwork in the field of scientometrics as regards the study of social networks in the context of neurophenomenology. To determine the correlation of taxonometric units "social networks" and "neurophenomenology". To ascertain the proficient environment that constitutes the scientometric landscape of neurophenomenology with a special focus on the psycho-mental

impact of social networks. Based on the findings derived from the evaluation of professional viewpoints, to elaborate a factorial model of neurophenomenological factors of the future evolution of social networks. To elicit analytical conclusions regarding the system of ethical restrictions of the social networks evolution, taking into account the formed factorial model of neurophenomenological factors of the future evolution of social networks.

Literature Review

Currently, the global number of social network users comprises 4.88 billion people (60.6% of the total number of Internet users – 8.05 billion people) with an increase of 174.2% over the last decade (2013 – 1.78 billion people) (Kemp, 2023; Chaffey, 2023; Dixon, 2023a) and the potential growth of the focal populace up to 5.85 billion people by 2027 (by 19.9%) (Dixon, 2023b). Most frequently, individuals use social media platforms as a means of interpersonal communication and engagement (the most popular platforms in 2023 are chats and messengers (94.5%), social media platforms (94.1%)). According to a recent study by Kemp (2023), the average time users spend viewing social media is 2 hours 26 minutes (with a minimum value for Japan of 47 minutes per day and a maximum value for Brazil of 3 hours and 49 minutes) (Kemp, 2023). Likewise, the average social media engagement of the natural population is 60.6% (with a minimum value for Nigeria of 14.4% and a maximum value for the UAE of 94.5%), with 53% of active users using social media platforms as sources of information (with a minimum value for Japan of 23% and a maximum value for Nigeria of 78%) (Kemp, 2023).

The provided statistical data suggests a menacing impact of the social media proliferation:

– dissemination of disinformation, along with other studies documented in the research conducted by Agarwal et al. (2023);

– management of public opinion, e.g shown in the research of Wang et al. (2023);

– dependence on the opinion of public influencers, e.g. found in research of Conde and Casais (2023);

– the emergence of an information "bubble" from user preferences that distorts the perception of the real information panorama, e.g. revealed in the research of Bonifazi et al. (2023);

– low protection of personal information and privacy of the social networks use; especially vulnerable groups of users being younger children and teenagers, e.g. found in research by Chou and Chou (2023);

– a surge in polarization and the emergence of conflicts based on multifarious factors such as political beliefs, race, gender, ethnicity, and social class among its users, e.g. revealed in the research of Racz and Rigobon (2023);

– emergence of psycho-emotional issues among individuals who engage with social media platforms, manifested in reduced productivity, distracted attention, anxious and depressive states, confused perception of reality, low self-esteem, etc., which was in particular shown in the research of Garg (2023);

– decrease in the level of social interaction outside social networks, e.g. revealed in the recent studies of González-Bailón and Lelkes (2023);

− development of targeted informational "attacks", including such phenomena as "bullying", "cancelling", "shaming" and leading to suicide, etc., which was for instance revealed in the recent research of Hawkins (2023);

− physiological manifestations of uncontrolled social media usage, particularly among young users (such as insomnia, reduced physical activity, impaired sense of time, disruption of biorhythms, eating disorders, cognitive disorders, etc.), e.g. elaborated in the studies of Huang et al. (2023).

A critical take-away from these analyses is that a multitude of psycho-emotional and psycho-physiological complications have emerged amongst social media users. It is worth mentioning that the above issues not only affect the demographic, social, political and economic landscape of the world but also necessitate comprehensive research for the development of appropriate regulatory policies.

It is worth mentioning that one of the research vectors of mental well-being and cognitive integrity among users of social platforms is neurophenomenology.

Neurophenomenology is an interdisciplinary methodology for investigating consciousness that combines a phenomenological examination of subjective experience (first-person consciousness) with neuroscientific techniques of brain research (third-person consciousness). Taking a closer look at the concept of "neurophenomenology", it should be noted that the main idea is to combine subjective aspects of consciousness with objective data obtained using neurophysiological methods in order to get a profound and holistic comprehension of consciousness (Vörös, 2023).

It should be mentioned that neurophenomenology recognizes the importance of subjective experience and phenomenal consciousness, including feelings, experiences, and other aspects of consciousness that may be important for a comprehensive understanding of the human mental state. At the same time, according to Sopcak (2023), it utilizes scientific methods, such as functional magnetic resonance imaging (fMRI) and electroencephalography (EEG), to study the correlates of these phenomenal aspects of consciousness in the brain (Sopcak, 2023).

The main goal of neurophenomenology is to create a unifying approach that will allow a more detailed study of consciousness, including its physiological and philosophical aspects, and to understand how they interact with each other (Timmermann et al., 2023).

An important aspect of neurophenomenology is to understand how users perceive and interact with social media. Brain processes related to information processing on social networks are studied using functional magnetic resonance imaging (fMRI) and other neuroimaging methods (Marinovic, Glaría & Muñoz, 2016). This enables one to discern the specific regions of the brain that are stimulated while watching the feeds, providing feedback or engaging in exchanges with other users. Accordingly, phenomenal user experience is also explored in the context of social networks. Phenomenological methods make it possible to reveal the personal encounter of users, encompassing their individual experiences, affective responses and attitudes towards social media. This is specifically significant for understanding the impact of social networks on the psychological state and well-being of users (Cardeña et al., 2023).

Given the above, one of the key tasks of neurophenomenology in the framework of the present study of social networks is to reveal the relationship between brain processes, phenomenal experience and social interactions on these platforms. Consequently, it helps to

address the question of how the use of social media affects people's worldview and communication in the modern Internet environment.

The findings derived from neurophenomenological investigations of social networks will allow to identify the triggers, drivers and vectors of the prospective advancement of these network platforms and consequently will enable to minimize the negative impact on the mental, cognitive and psycho-emotional state of the global Internet community.
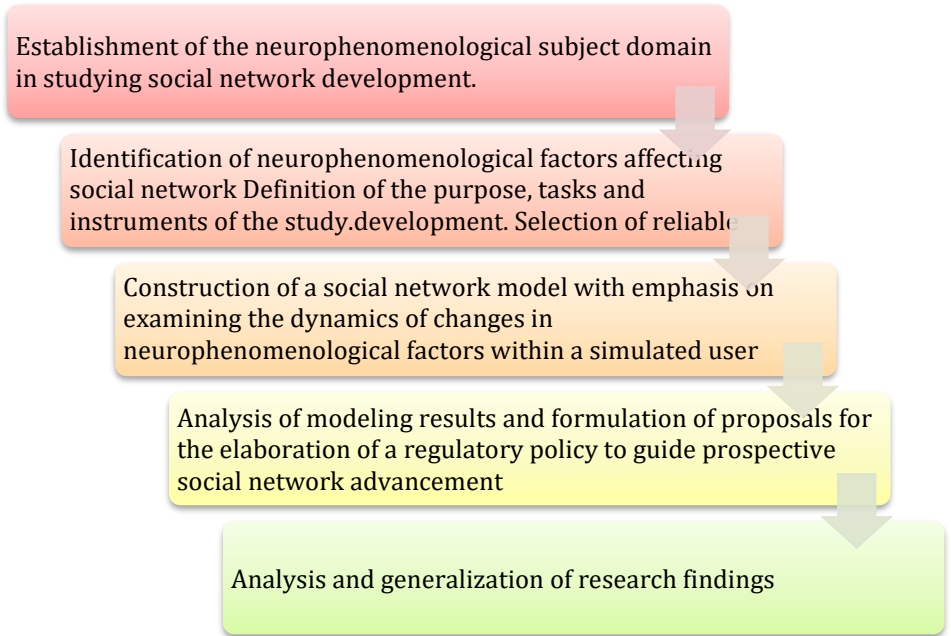
Research design and methods
Research procedure

To achieve the set aim, a multistage study procedure was developed. The present research was carried out according to the following procedure (Figure 1).

Figure 1.
Research procedure.

Establishment of the neurophenomenological subject domain in studying social network development.

Identification of neurophenomenological factors affecting social network Definition of the purpose, tasks and instruments of the study.development. Selection of reliable

Construction of a social network model with emphasis on examining the dynamics of changes in neurophenomenological factors within a simulated user

Analysis of modeling results and formulation of proposals for the elaboration of a regulatory policy to guide prospective social network advancement

Analysis and generalization of research findings

Formation of the sample

The research applied a social network model for 300 users, which allowed us to get closer to actual local clusters of social networks. Simulated users are divided into categories that have separate behavior patterns (neurophenomenological characteristics), which allowed to measure their population in chronometric dynamics. Such a number of volumes enables the prevention of excessive volume of data, which can complicate the analysis, as well as ensure adequate reproduction of the structure and behaviour of a social network Selection of such a

number of models corresponds to sample formation in ordinary sociological studies, which contributes to results comparison with available data.

The sample involved users with different characteristics such as age (from 16 to 55 years old), education (general secondary - 70 models, professional -110 models, higher - 120 models), social status, cultural profile, etc. This was made to ensure that the model maximally accurately reflects the actual variety of users of social networks. For example, the inclusion of different age groups enables analysis of age factors on interaction in the network, while differentiation by education enables understanding the influence of the educational level on activity and connections in the network. Consideration of these characteristics enables the development of a more comprehensive and accurate perception of the influence of neurophenomenological aspects on the development of social networks and the behaviour of their users.

For this particular model, we introduced a novel concept of a conditional information attack, i.e. false or harmful information, the perception of which entails among the participants of the simulated social network the development of psycho-emotional factors (anxiety, fear, panic, wrong decisions, etc.).

Furthermore, a neurophenomenological framework is implemented for every individual within the simulated social setting.

- susceptible – a user who is susceptible to information attacks (exhibits an average level of critical thinking);
- infected – a user who was subjected to an information attack (lacking critical thinking);
- resistant – a user who is not susceptible to information attacks (exhibits a high level of critical thinking).

The neurophenomenological factors of users in a simulated social network that is conditional are explicated by the following system of differential equations:

- description of users from the susceptible group:

$$\frac{dS}{dt} = -\beta \times \frac{S \times I}{N};$$

(1)

- description of users from the infected group3:

$$\frac{dI}{dt} = \beta \times \frac{S \times I}{N} - \gamma \times I;$$

(2)

- description of users from the resistant group4:

$$\frac{dR}{dt} = \gamma \times I,$$

(3)

where S – the number of susceptible group users; I – number of infected group users; R – number of resistant group users; N – total number of conditional modeled social network; t – a conditional period of modeling the dynamics of neurophenomenological factors of users of a conditional simulated social network; β – conditional constant of information attack

damage (level of susceptibility to informational influences at a low level of critical thinking); γ – conditional constant of resistance to damage by an information attack (level of development of critical thinking).

The study hypothesis can be formed as follows: in the absence of the regulatory policy, the risks of attacks on social networks and the development of neurophenomenological factors (phenomenal experience) among users of the studied social environments, manifest in increasing the favorability of negative informational campaigns, as well as a number of provocateurs who direct public opinion in their own interests.

Methods

1. Modeling of a social network with monitoring of the dynamics of neurophenomenological factors of users. The software environment of the NetLogo application (NetLogo, 2023) was used for modeling. NetLogo is a freely available programming language and modelling environment, specially designed for the development and analysis of agent models. Its main designation is to study complex systems such as social networks with the use of imitation modelling. It has an intuitive interface that makes it accessible to beginners, and it has a powerful set of functions for exploring various social and natural phenomena. Considering the functions, NetLogo provides means for agents creation and modelling, including their behaviour, interaction and evolution in time. Using NetLogo in this study, agent models of social networks were created, where each agent can represent a particular participant in the network. This model was selected due to its accessibility and numerous functions, which correspond to the purpose and tasks of this study (Ganguly et al., 2022).

2. Refinement and categorization of neurophenomenological variables that impact the formation of social networks. The first stage lies in the analysis of scientific culture for the identification of neurophenomenological aspects, which can influence the development of social networks, and include the factors and mechanisms of information perception, psychological aspects of interaction, decision-making mechanisms and other psychophysiological processes. The next step involves the creation of agent models of social networks, where each agent represents a particular participant in the network. At this, various neurophenomenological aspects, identified in the previous stage, are considered. Then the modelling of the influence of neurophenomenological factors on the behaviour and development of social networks is made. Finally, the modelling analysis takes place to outline key neurophenomenological factors, which have a significant influence on the development of social networks (Meleshko, Dreeva & Dreev, 2020).

3. The method of determination of functional dependencies in the dynamics of neurophenomenological factors of the users of the modelled social network is directed at the analysis and determination of interrelation between psychological and neuroscientific behaviour aspects in the network. This method enables the identification and evaluation of the influence of certain neurophenomenological factors on the dynamics of the development of social networks. Its use enables a better understating of the way psychological and neuroscientific factors define users; behaviour in virtual space (Safron, 2022).

Results

According to the proposed method, using the NetLogo digital environment (NetLogo, 2023), a conditional social network is modeled. The participant count is established at 300 individuals, whose interconnections are generated randomly. Accordingly, each participant within the simulated social network has a minimum of 10 connections with fellow participants (Figure 2).

Figure 2.
The conditional model of a social network for 300 participants.
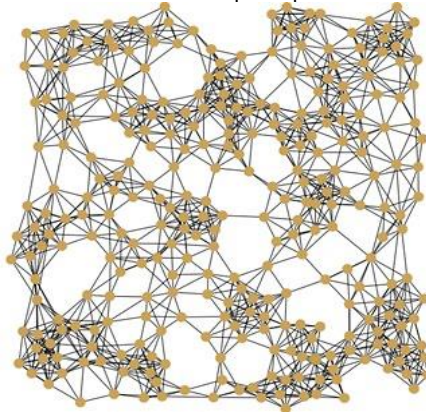
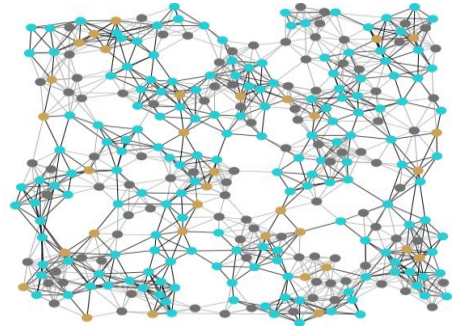Source: elaborated by the author in NetLogo PC (NetLogo, 2023)

Experiment No. 1. One instigator disseminated a campaign of disinformation ($I = 1$), while the risk of damage from a conditional negative information campaign for other participants of the simulated social environment comprised 5% ($\beta = 5\%$), and the chance of developing critical thinking and forming resistance to this type of attacks also comprised 5 % ($\gamma = 5\%$). Results of Experiment No. 1 are presented in Figure 3.

Figure 3. The results of Experiment No. 1 ($I = 1$, $\beta = 5\%$, $\gamma = 5\%$).
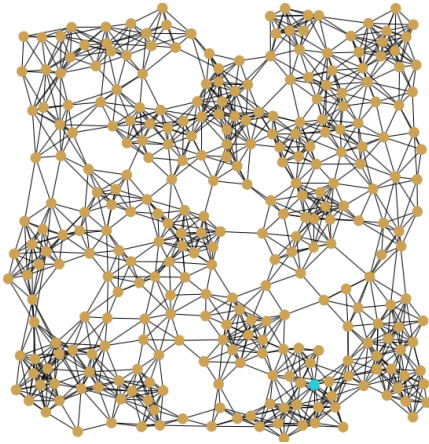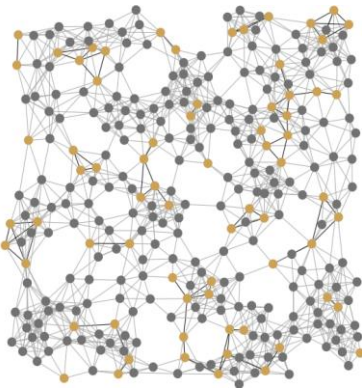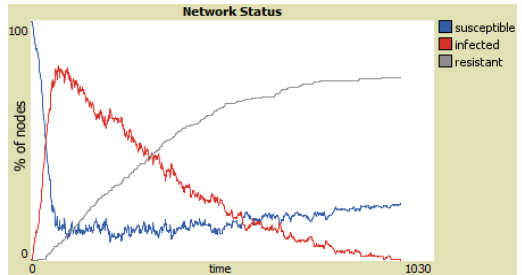
a. The initial state of the social network

b. The network subjected to impact of an information attack

c. The final state of the social network

d. The dynamics of neurophenomenological factors

Source: elaborated by the author in NetLogo PC (NetLogo, 2023)

Drawing upon the findings from Experiment No. 1 ($I = 1$, $\beta = 5\%$, $\gamma = 5\%$), the conditional time to overcome the crisis by the simulated social network was 1030 periods ($t = 1030$).

Experiment No. 2. Under the same conditions (Experiment No. 1), but with an increase in the susceptibility to infection ($\beta = 10\%$), the conditional time to overcome the crisis comprised $t = 1210$, i.e. it increased by 17.2 % (Figure 4).

Figure 4.

The results of Experiment No. 2 ($I = 1$, $\beta = 10\%$, $\gamma = 5\%$).
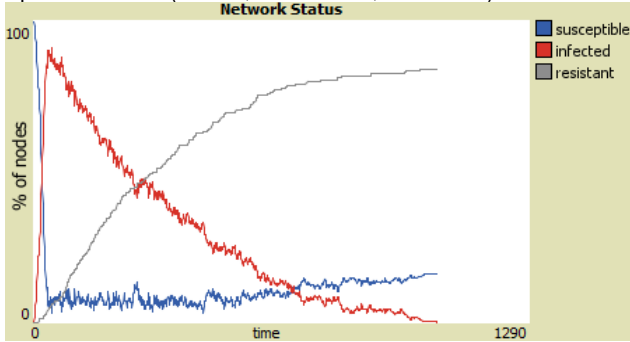
Source: elaborated by the author in NetLogo PC (NetLogo, 2023)

Experiment No. 3. Similarly, an increase in the number of instigators ($I = 10$) under the initial conditions of the simulation ($\beta = 5\%$, $\gamma = 5\%$) also leads to a greater time spent by the conditional network to overcome the crisis caused by the increase in the number and change of information attack vectors. In this case, the conventional overcoming time comprised $t = 1240$, that is, it increased by 20.4% (Figure 5).

Figure 5.

The results of Experiment No. 3 ($I = 10$, $\beta = 5\%$, $\gamma = 5\%$).
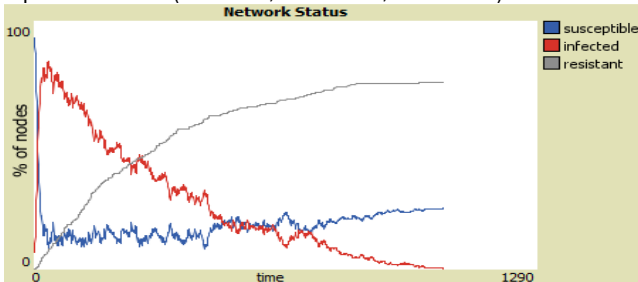
Source: elaborated by the author in NetLogo PC (NetLogo, 2023)

The findings of the experiments validate of the hypothesis. Considering the revealed interdependence, as supported by simulation results regarding the prospective progression of social networks, it is expedient to establish a regulatory framework aimed at guaranteeing a consistent and balanced phenomenal experience of users of the social environment under study:

1.   Enforce comprehensive protocols for ensuring the confidentiality of users' personal data: development and implementation of transparent and mandatory regulatory acts that supervise the storage and processing of users' personal data in social networks; requiring that social platforms obtain informed consent from users for the collection and utilization of their personal data, while also establishing mechanisms to facilitate user access to said data, as well as enabling its deletion or transfer.

2.   Introduce detailed standards for ensuring transparency and accountability for social platforms: a requirement for social networks to disclose content moderation policies and recommendation algorithms; the obligation to respond to users' complaints within the established terms; imposition of sanctions on social media platforms in the event of non-compliance with transparency and accountability standards.

3.   Introduce centers for the verification of information circulating on social media platforms: establish autonomous entities or bodies responsible for examining the credibility of information disseminated through social networks; establishing fact-checking procedures to prevent the spread of misinformation and fakes; development of partnerships with independent fact-checking organizations and mandatory marking of dubious data.

4.   Establish protocols for identifying and thwarting malicious attempts to compromise data security, in particular with the utilization of ground-breaking technologies, such as neural networks and AI: development of systems for monitoring and analyzing content published in social networks in order to identify dangerous and harmful materials; using AI and neural networks to detect attacks and spam; establishing mechanisms to block accounts that disseminate false information or engage in deliberate acts of informational sabotage.

5.   Introduce centers for the development of information hygiene and resistance: providing users with access to educational resources that contribute to increasing the level of information hygiene and protection against information attacks; conducting training events and campaigns on media literacy, critical thinking and disinformation detection; ensure support for research and development of tools for protection against information threats.

The proposed concept is aimed at creating a safe and reliable Internet environment for social networks users as well as preventing the negative consequences of information attacks and disinformation.

It is anticipated that the implementation of the proposed idea will lead to the advancement of regulatory policy of ensuring a sustainable and balanced phenomenal experience of social networks users,. Consequently, the number of resistant participants will increase, which in the future will form the basis of the digital social environment.

Further, we shall evaluate the postulated hypothesis through Experiment No. 4.

Experiment No. 4. Under the initial settings of the conditional social network model ($I = 1$, $\beta = 10\%$), we increase the probability of developing critical thinking and resistance to information attacks among the users – $\gamma = 10\%$. The conditional time to overcome the crisis comprised – $t = 656$, that is it decreased by 1.57 times (Figure 6).

Figure 6.

The results of Experiment No. 4 (iteration #1) ($I = 1$, $\beta = 5\%$, $\gamma = 10\%$).
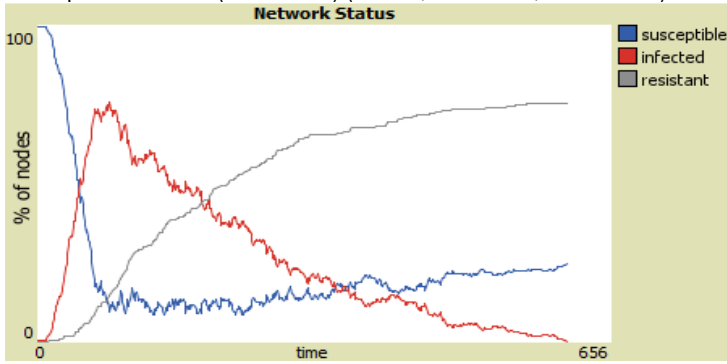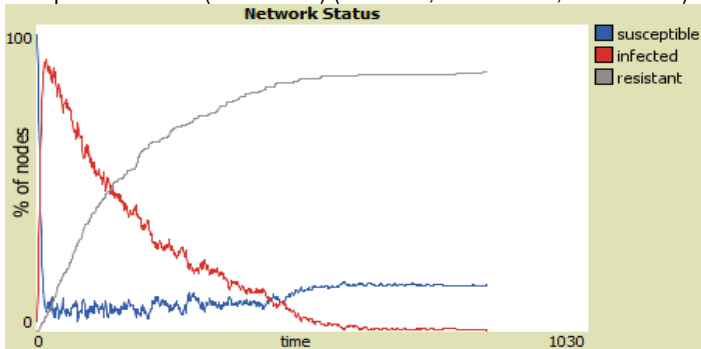

Source: elaborated by the author in NetLogo PC (NetLogo, 2023)

The tendency to a significant decrease in the time to overcome the crisis of the simulated network from a conditional information attack continues even for the combined conditions of experiment No. 2 and No. 2 – $I = 10$, $\beta = 10\%$. The value of the time to overcome the crisis comprised $t = 835$, which is 1.48 less than the corresponding value of the second and third experiments (Figure 7).

Figure 7.

The results of Experiment No. 4 (iteration #2) ($I = 10$, $\beta = 10\%$, $\gamma = 10\%$).

Source: elaborated by the author in NetLogo PC (NetLogo, 2023)

Thus, the results of conditional social network modeling indicate the possibility of obtaining practical results due to the application of the elaborated concept of the regulatory policy aimed at ensuring a stable and weighted phenomenal experience of the said network's users in the social environment under study. The above substantiation confirms the expediency of

researching the dynamics of neurophenomenological factors and taking them into account when formulating decisions regarding the advancement of social media platforms.

The study's findings suggest that fostering critical thinking, instilling healthy information consumption habits, and cultivating a profound sensory experience (in relation to achieving positive neurophenomenological outcomes) promotes the enduring growth of a mentally sound society. This has far-reaching implications for all facets of its being (economy, science, creativity, industry, etc.).

Discussion

The following findings are presented for discussion:

– the phenomenal experience of social networks users is an important trigger that determines the general dynamics and vectors as regards the future development of social media platforms;

– the examination of neurophenomenological factors of social network users makes it possible to determine critical aspects as regards the future development of social media platforms;

– the development of critical thinking, in particular information resistance and hygiene of individual users allows to ensure the stability of the entire volume of social networks. In such a way it contributes to the sustainable development of a mentally healthy community, which has a corresponding impact on the overall progression of human society.

The study by Yang, Bao and Qiu (2023) offers MGCNSI (Motif-based Graph Convolutional Networks for Source Identification) – a framework approach to source identification in social networks, that is based on GCN. The results of the study confirm the advantage of MGCNSI method in the identification in social networks, especially networks with a dense structure, and enabling using of a neural network modelling in further studies of social network evolution. Such conclusions enabled the implementation of similar modelling in this study.

Şimşek (2022) in study offered a new method called Lexical Sorting Centrality (LSC), which combines several centralised metrics to determine the capability of nodes in identification and spreading information attacks in the networks. LSC uses a sorting mechanism, which is analogous to lexical sorting, for combining centralised metrics and node ranking. Experiments conducted by the author confirm the data received in this study. Thus, it enables focus on the study of the elements of social media platforms.

The method for identifying influencers in social networks, proposed in the work by Ganguly et al. (2022) enabled the use of neural network modelling in this study. The model Susceptible-Infectious-Recovered (SIR) was used to simulate the spread of information attacks. This study is more general, as demonstrates mechanisms of informational attach transfer from a provocateur to the whole volume of a conditional model network. However, the received results supplement this study in relation to detailing the mechanisms of the conception of the regulatory policy of ensuring the stable and weighted phenomenal experience of the users of the studied social environment.

Studies by Sun et al. (2019) and Bioglio and Pensa (2017) expand the classic epidemic model Susceptible-Infectious-Recovered (SIR) to consider users' treatment of privacy in social networks. It was conducted experimentally with the use of stochastic simulations in four synthetic networks, generated with the use of classic algorithms. The received results are close to the problem of neurophenomenological analysis of the development of social networks, but focus on

only one aspect, while this study covers a larger mechanism of interaction of agents of social network platforms during informational attacks conducted by provocateurs.

Thus, the considered relevant publications in the current search horizon demonstrate the possibility of neurophenomenological analysis of the future development of social networks, but they focus on certain aspects of the research vector. The current inquiry is broader as regards studying the dynamics of neurophenomenological factors and can integrate individual results in subsequent research. Accordingly, it will become the basis for the development of a balanced regulatory policy for the development of social media platforms in the future.

The pertinent publications examined in the present inquiry indicate that neurophenomenological analysis of social network development is feasible. However, these studies concentrate on specific aspects of the research vector. Conversely, this study takes a broader approach to investigating the dynamics of neurophenomenological factors and can encompass individual findings in subsequent research iterations. Given the above, this will establish a foundation for creating a detailed and balanced regulatory policy for future advancements in social media platforms.

Practical results of the study include the development of more effective methods of informational influence and protection from the negative influence of social networks, Consideration of neurophenomenological factors allows improving algorithms of identification of the sources of information attacks, increasing resistance to them and preserving stability in the social environment. The study results may be used for the development of recommendations concerning the formation of the policy of social network regulation, aimed at ensuring the mental health of the users and enhancing their information literacy.

The theoretical results of the study include expanding our understanding of the interaction between psychological and neuroscientific aspects within the context of social networks, The study of neurophenomenological factors contributes to deepening knowledge about the mechanisms, which influence behaviour and development of social networks. The study may be the basis for further theoretical investigations in the field of Internet psychology and social cybernetics, as well as contribute to the development of deeper and more complex models of interaction in social networks.

Methodological limitations of the study include limited representativeness of the sample and difficulty in considering all possible neurophenomenological factors. First, the limited participants number in the model social network can fail to represent the whole variety of real situations and interactions in social networks. Second, difficulty in considering all possible neurophenomenological factors in the behaviour of users can lead to simplification of the model or omission of some key aspects. The possibility of the presence of other unknown factors, which can influence the development of social networks and user behaviours, and which were not involved in the study, should be considered.

Conclusions

The ubiquitous nature of social networks on a global scale is undeniable. However, concerning patterns have emerged regarding the dynamic and uncontrolled growth of these platforms. Such developments are currently causing detrimental effects on users' psychological and emotional well-being, resulting in societal stagnation due to behavior deviations. Given these

alarming circumstances, it is imperative to conduct an in-depth analysis of the interactions between social network agents and establish a cohesive regulatory framework for the development of said platforms in the future.

According to the study findings, it was established that the neurophenomenological examination of social media user interactions constitutes a complex network of psycho-emotional variables, the adverse dynamics thereof contribute to societal stagnation, thereby resulting in corresponding civilizational consequences. At the same time, it is mathematically proven that with minimal development of resistance to information attacks among users of social media platforms, conditions for stabilization and sustainable development of social networks and, accordingly, natural society are formed. Thus, the proposition to execute the devised framework of regulatory measures aimed at ensuring a consistent and equitable user experience within the studied social environment, is sound. It will allow keeping the appropriate vector of the social development of civilization.

The obtained research results can be applied in the study of social networks in the context of examining social, technological, psycho-emotional, neurophysiological and neurophenomenological aspects of social media platforms, as well as for the establishment of a well-crafted regulatory framework, aimed at mitigating the adverse effects stemming from unbridled and dynamic growth in social networks.

In the future, we aim to explain the preliminary concept of regulatory policy concerning the prospective progress of social networks, which was formulated in the present study. Furthermore, our intention is to incorporate the results from other relevant scholarly works into our research findings, thereby engendering a more comprehensive and holistic neurophenomenological analysis of the social platforms evolution in times ahead.

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The authors do not have any interest conflict.

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References
Agarwal, B., Agarwal, A., Harjule, P., & Rahman, A. (2023). Understanding the intent behind sharing misinformation on social media. *Journal of Experimental & Theoretical Artificial Intelligence, 35*(4), 573-587. https://doi.org/10.1080/0952813X.2021.1960637

Benrouba, F., & Boudour, R. (2023). Emotional sentiment analysis of social media content for mental health safety. *Social Network Analysis and Mining, 13*(1), 17. https://doi.org/10.1007/s13278-022-01000-9

Bioglio, L., & Pensa, R. G. (2017). Modeling the impact of privacy on information diffusion in social networks. In: *Complex Networks VIII: Proceedings of the 8th Conference on*

Complex Networks, CompleNet 2017, vol. 8 (pp. 95-107). Springer International Publishing. https://doi.org/10.1007/978-3-319-54241-6_8

Bonifazi, G., Corradini, E., Ursino, D., & Virgili, L. (2023). A social network analysis–based approach to investigate user behaviour during a cryptocurrency speculative bubble. *Journal of Information Science, 49*(4), 1060-1085. https://doi.org/10.1177/0165551521104742

Bouyer, A., Beni, H. A., Arasteh, B., Aghaee, Z., & Ghanbarzadeh, R. (2023). FIP: A fast overlapping community-based Influence Maximization Algorithm using probability coefficient of global diffusion in social networks. *Expert Systems with Applications, 213*, 118869. https://doi.org/10.1016/j.eswa.2022.118869

Cardeña, E., Lindström, L., Goldin, P., van Westen, D., & Mårtensson, J. (2023). A neurophenomenological fMRI study of a spontaneous automatic writer and a hypnotic cohort. *Brain and Cognition, 170*, 106060. https://doi.org/10.1016/j.bandc.2023.106060

Chaffey, D. (2023, June 07). Global social media statistics research summary 2023. Smart Insights (Marketing Intelligence) Ltd. https://www.smartinsights.com/social-media-marketing/social-media-strategy/new-global-social-media-research/

Chou, H. L., & Chou, C. (2023). How teens negotiate privacy on social media proactively and reactively. *New Media & Society, 25*(6), 1290-1312. https://doi.org/10.1177/14614448211018797

Conde, R., & Casais, B. (2023). Micro, macro and mega-influencers on instagram: The power of persuasion via the parasocial relationship. *Journal of Business Research, 158*, 113708. https://doi.org/10.1016/j.jbusres.2023.113708

Dhiman, D. B. (2023). Ethical Issues and Challenges in Social Media: A Current Scenario. http://dx.doi.org/10.2139/ssrn.4406610

Dixon, S. J. (2023a, August 29). Most popular social networks worldwide as of January 2023, ranked by number of monthly active users (in millions). Statista. https://www.statista.com/statistics/272014/global-social-networks-ranked-by-number-of-users/

Dixon, S. J. (2023b, August 29). Number of social media users worldwide from 2017 to 2027 (in billions). Statista. https://www.statista.com/statistics/278414/number-of-worldwide-social-network-users/

Ganguly, M., Dey, P., Chatterjee, S., & Roy, S. (2022, June). Influential Node Detection in Online Social Network for Influence Minimization of Rumor. In: *Proceedings of International Conference on Frontiers in Computing and Systems: COMSYS 2021* (pp. 589-596). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-19-0105-8_58

Garg, M. (2023). Mental health analysis in social media posts: a survey. *Archives of Computational Methods in Engineering, 30*(3), 1819-1842. https://doi.org/10.1007/s11831-022-09863-z

González-Bailón, S., & Lelkes, Y. (2023). Do social media undermine social cohesion? A critical review. *Social Issues and Policy Review, 17*(1), 155-180. https://doi.org/10.1111/sipr.12091

Hawkins, Y. (2023). Traditional Bullying and Cyberbullying in Adolescence: A Review of Mental Implications & Policy. Doctoral dissertation, California State University, Northridge. https://scholarworks.calstate.edu/downloads/4x51hr721

Heidari, E., Salimi, G., & Mehrvarz, M. (2023). The influence of online social networks and online social capital on constructing a new graduate students' professional identity. *Interactive Learning Environments, 31*(1), 214-231. https://doi.org/10.1080/10494820.2020.1769682

Huang, P. C., Latner, J. D., O'Brien, K. S., Chang, Y. L., Hung, C. H., Chen, J. S., ... & Lin, C. Y. (2023). Associations between social media addiction, psychological distress, and food addiction among Taiwanese university students. *Journal of Eating Disorders, 11*(1), 1-9. https://doi.org/10.1186/s40337-023-00769-0

Kemp, S. (2023, July 20). Digital 2023 july global statshot report — datareportal – global digital insights. DataReportal – Global Digital Insights. https://datareportal.com/reports/digital-2023-july-global-statshot

Laughlin, C. D. (2023). Intersubjectivity, Empathy, Life-World, and the Social Brain: The Relevance of Husserlian Neurophenomenology for the Anthropology of Consciousness. *Anthropology of Consciousness, 34*(1), 229-260. https://doi.org/10.1111/anoc.12171

Marinovic, M. M., Glaría, A., & Muñoz, J. M. (2016). Neurophenomenology of Social Tension: A theoretical framework for modelling prospective scenarios. In: SAI Intelligent Systems Conference, vol. 15, 232-250. https://cutt.ly/QwxChuF9

Meleshko, E.V., Dreeva, H. M., & Dreev, O. M. (2020). A method of clustering social network users based on neural networks. In: *Proceedings of the XXII International Scientific and Practical Seminar named after A.Y. Petreniuk "Combinatory Configurations and Their Applications"* pp. 86-89. Zaporizhzhia. https://dspace.sfa.org.ua/bitstream/123456789/488/1/Materiali_22_seminaru.pdf#page=86

NetLogo. (2023). Home Page. The CCL. Available at: https://ccl.northwestern.edu/netlogo/

Popat, A., & Tarrant, C. (2023). Exploring adolescents' perspectives on social media and mental health and well-being – A qualitative literature review. *Clinical Child Psychology and Psychiatry, 28*(1), 323-337. https://doi.org/10.1177/1359104522109288

Racz, M. Z., & Rigobon, D. E. (2023). Towards consensus: Reducing polarization by perturbing social networks. *IEEE Transactions on Network Science and Engineering*. https://doi.org/10.1109/TNSE.2023.3262970

Safron, A. (2022). Integrated world modeling theory expanded: Implications for the future of consciousness. *Frontiers in Computational Neuroscience*, *16*, 642397. https://doi.org/10.3389/fncom.2022.642397

Şimşek, A. (2022). Lexical sorting centrality to distinguish spreading abilities of nodes in complex networks under the Susceptible-Infectious-Recovered (SIR) model. *Journal of King Saud University-Computer and Information Sciences, 34*(8), 4810-4820. https://doi.org/10.1016/j.jksuci.2021.06.010

Smolla, M., & Akcay, E. (2023). Pathways to cultural adaptation: the coevolution of cumulative culture and social networks. *bioRxiv*, 2023-02. https://doi.org/10.1101/2023.02.21.529416

Sopcak, P. (2023). Understanding mixed and ambiguous emotions–integrating neurophenomenology and literary studies. *Cognitive Neuroscience, 14*(2), 73-74. https://doi.org/10.1080/17588928.2023.2181323

Sun, Q., Li, Y., Hu, H., & Cheng, S. (2019). A model for competing information diffusion in social networks. *IEEE Access, 7,* 67916-67922. https://doi.org/10.1109/ACCESS.2019.2918812

Timmermann, C., Bauer, P. R., Gosseries, O., Vanhaudenhuyse, A., Vollenweider, F., Laureys, S., ... & Lutz, A. (2023). A neurophenomenological approach to non-ordinary states of consciousness: hypnosis, meditation, and psychedelics. *Trends in Cognitive Sciences*. https://doi.org/10.1016/j.tics.2022.11.006

Vörös, S. (2023). Neurophenomenology Revisited: From Naturalism to Dialectics. HUMANA. *MENTE Journal of Philosophical Studies, 16*(43), 59-87. https://www.humanamente.eu/index.php/HM/article/view/440

Wang, Z., Zhang, S., Zhao, Y., Chen, C., & Dong, X. (2023). Risk prediction and credibility detection of network public opinion using blockchain technology. *Technological Forecasting and Social Change, 187,* 122177. https://doi.org/10.1016/j.techfore.2022.122177

Wood, A., Kleinbaum, A. M., & Wheatley, T. (2023). Cultural diversity broadens social networks. *Journal of Personality and Social Psychology, 124*(1), 109. https://doi.org/10.1037/pspi0000395

Yang, K., Bao, Q., & Qiu, H. (2023). Identifying Multiple Propagation Sources with Motif-based Graph Convolutional Networks for Social Networks. *IEEE Access*. https://doi.org/10.1109/ACCESS.2023.3287214