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RESEARCH

# Communicating Scientific Knowledge as News on Social Media: Analyses in Frames of Luhmann's System Theory

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## Abstract

Digital technology has posed a challenge to the conventional way in which scientific knowledge was disseminated and validated within the scientific system. Scientific knowledge has interfered into the mass media system through online platforms and social media networks. This tendency tremendously expanded after the Covid-19 pandemic, which challenged scientific community around the world to search for more effective ways of communicating scientific evidence. Meanwhile, recent studies show that trust towards science has globally increased since the pandemic. Moreover, it is a key driving force behind people's attitudes and has predictable impact on their pandemic-related behavior. Despite the widespread dissemination of scientific knowledge, it is often misrepresented, oversimplified, or distorted. People trust science globally, yet scientific knowledge is disseminated through the widely-used yet least trusted medium of social media.

This paper aims to analyze the interconnection between scientific and mass media systems and its effects on communicating scientific knowledge on social media. For this purpose, the logic of digital media platforms is explored, and Luhman's system theory is viewed as an essential theoretical background for the analyses of the spread and exposure of scientific knowledge across social media. Theoretical analyses, along with secondary data analysis of recent global studies on news consumption and trust towards the media and science, are used to analyze the structural coupling of the mass media and scientific systems. The author concludes that it is essential to interconnect scientific and mass media systems, taking into account trust towards the medium, message, and source.

**Keywords** Science · Communication · Social media · System theory · Trust · Luhmann

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## The Science System and Trust

Lumann describes science system as a functionally differentiated subsystem of modern society, which uses the communication medium truth for its own reproduction. The function of the scientific system is to construct and obtain new knowledge. However, scientific truth is not interpreted as something equivalent the real world, but rather as a symbolically generalized medium. This means that truth is not the reflection of reality, but a communicative construct, which shapes the reality of science as a social system. Theories and methods function as correctness conditions in the allocation of code values. They limit and determine what is accepted in scientific operations (Luhmann 1992). Each scientific communication produces something new, which can be adopted as a condition for further communication, or abandoned if it is later shown to be untrue or has no connectivity for research. In this sense, scientific truths can also be accepted or denied based on new knowledge.

The pandemic has highlighted the value of scientific knowledge, leading to an increased demand for such knowledge and its role in governmental decision-making. It is worth noting that trust in science is closely related to the concept of epistemic trust. Epistemic trust is a complex process that involves evaluating the reliability, relevance, and quality of information, as well as its source, to determine its trustworthiness (Tanzer et al. 2021). It concerns trust in the knowledge given by scientists, which reflects the trustors' inclination (because of their limited resources) to depend on and defer to the experts (trustees) (Mousoulidou et al. 2022). In this paper, we will view trust towards science from this epistemic perspective, defining it as trust towards scientific knowledge. We will also draw difference between information and knowledge, explaining the latter not merely as a type of information and data or combination of both. Following Dahlgren's approach, we will view knowledge as an "ongoing constructivist process, referring to integration of new information with people's existing frames of reference - including not least lived experience - to further extend or modify those frames, including even possibly identity aspects" (Dahlgren 2018). Given this approach, we can assert that trust in science is directly linked to the methods and channels used to disseminate scientific knowledge through media platforms. The epistemic essence of science means that the trustworthiness of science is largely dependent on how effectively scientific knowledge is communicated.

Recent global studies demonstrate that after the pandemic science still remains one of the most trusted institutions across the world. According to the Global Monitor survey, comparing people's responses in 2020 and 2018, there was a 10-percentage-point increase in those who stated they trust science in general 'a lot', while the percentage of those who said they trust scientists in their country 'a lot' has increased by 9% points (Global Monitor 2020). Data from Edelman Trust Barometer shows that although trust towards scientists decreased after the pandemic (-7 points in 2021 compared to 2020), they still remain the most trusted among societal leaders with + 3 points in 2023 (Edelman Trust Barometer 2022, 2023). Other global studies have revealed a strong interconnection between trust towards science and pandemic-related behavior. Trust in scientists is a key driver of the acceptance of restrictions or vaccinations rather than trust in others or in the government (Algan et al. 2021; Hromatko et al. 2021; Attwell et al. 2021; Dohle et al. 2020). Furthermore, trust in scientific research and the scientific community is the most crucial factor in determining people's behavior with regards to pharmaceutical (e.g., vaccination) and non-pharmaceutical measures, compared to trust in government, healthcare systems and

health organizations (e.g., hand washing, mask use, social distancing, self-isolation), (Han 2022; Plohl and Musil 2021; Bicchieri et al. 2021). Meanwhile, some researchers assume that social media usage is positively related to trust towards science. Social media users interact with a larger quantity and wider range of science news and can engage with posts from people they trust, or directly from scientists, overcoming filters by owned media or journalists (Huber et al. 2019).

The positive trends regarding trust in science and its role in pandemic-related behavior are encouraging, indicating the importance of science and scientific knowledge in today's societies. Despite the remarkable and consistent trust in science, major challenges remain in communicating knowledge during global crises such as the recent pandemic, described by the World Health Organization (WHO) as an "infodemic". Experts, including health authorities, have equally emphasized the importance of combating misinformation in order to effectively cope with the virus. The diversity of sources and the variety of approaches used for disseminating information across different media channels have influenced how people have come to know and understand the virus. Examples of misinformation related to COVID-19 have included inaccurate information about the virus' origin (e.g., that it was intentionally created and released) as well as incorrect beliefs and conspiracy theories regarding the severity or mortality of the virus. This misinformation has caused confusion and panic among the public, with potentially serious consequences, such as people not taking the necessary precautions or adhering to quarantine and social distancing guidelines. According to research, three out of 10 in the US believed COVID-19 was created in a lab and a majority agreed that news coverage is exaggerating risks related to the virus (Dhanani and Franz 2020). Exposure to misinformation is also found to affect negatively on COVID-19 vaccination intention (Greene et al. 2021; Loomba et al. 2021). It is also associated with higher susceptibility to misinformation (Johnson NF et al. 2020). Meanwhile, the repetition of false claims makes it more difficult to refute this information as the evidence that threatens one's worldview (Dhanani and Franz 2020).

The abovementioned challenges and trends necessitate an examination of the media channels used for scientific communication. This requires a deeper exploration of the operation of contemporary digital media platforms based on the systematic approach proposed by Luhmann.

## The mass Media System, Digital Transformation and Trust

Luhmann analyzes the mass media system as an integrity of its three program strands - news/in-depth reporting, advertising and entertainment (2000). Operations in the mass media system are constantly and inevitably transforming information into non-information, using information-non information code for its reproduction. The mass media system operates with the assumption that its own communications will be continued during the next hour or on the next day (2000). The system presupposes itself as a self-produced irritation, without being accessible through its own operations and then sets about transforming irritation into information, which it produces for society. Topics organize communications memory and ensure structural coupling of the mass media system with other social domains. Through the news the system disseminates ignorance in the form of facts which must continually be renewed so that no one notices. A news item run twice might still have its meaning but

it loses its information value. Thus, in order to keep on operating and continuing communications, the system needs to generate new information. It is worth noting that Luhmann discusses truthfulness of information only in terms of its possible impact on the reputation of journalists, newspapers, editors, etc. The mass media are only interested in things that are true under severely limiting conditions that clearly differ from those of scientific research.

News as a phenomenon of mass communication has been widely discussed in the literature. Various definitions have been put forward, emphasizing its new, weird, dramatic, vivid and unexpected qualities. Some interpretations focus on news not just as a media phenomenon, but as a social construct, highlighting its role in shaping social reality and influencing public opinion (Palczewski 2018). Park defines news as a form of knowledge concerned with present (Park 1940). News comes in the form of small, independent communications that can be easily and rapidly comprehended. It is not concerned nor to the past, which is history, nor to the future, which deals with prediction. News is a substitute of knowledge and is characterized by possessing information value which is always relative and depends on the subjective assessment of potential audience. News is something new but it ages quickly (Palczewski 2018). Ostertag focuses on the emotional role news plays in society as a cultural object, analyzing it as a social and cultural construct (2019). News helps consumers to avoid uncertainty and alleviate the anxiety that comes with ontological insecurity and to generate pride and enhance their sense of self. Both the consumption and communication of news are motivated by shared emotional energy sets, themselves informed by ongoing problems and goal-seeking interests. In its capacity as a cultural object, news content helps satisfy these emotional urges. Another view on the news, that is worth to mention, is the ritualistic approach, suggested by Carrey. The author sees news as a ritual act, moral story, where consuming is like attending a mass, "a situation in which nothing new is learned but in which a particular view of the world is portrayed and confirmed" (Carey 2009).

Combining various approaches discussed in this article, news can be defined as a piece of information about a current event that is processed and disseminated via a medium to a large number of people and has social, emotional, and informational value for both its creators and audiences.

Under a Luhmannian perspective, the analysis of news is closely related to the concept of communicative improbability. The author views communication as a selective occurrence, a processing of selection (1995). Communication grasps something out of the actual referential horizon that it itself constitutes and leaves other things aside. He distinguishes the following news selection criteria: surprise, conflicts, quantity, local relevance, norm violations (especially accompanied with moral judgements), topicality, expression of opinions, time and available space set by media companies. These criteria partly include those suggested by media researchers, following the news value approach. The latter was developed in the era of traditional media, when selective performances were carried out by media organizations and journalists acting as gatekeepers between news creators and audiences. Galtung and Ruge propose 12 news values: frequency (temporal structure of an event), meaningfulness (as indicated by the proximity and impact of a news event), unexpectedness, continuity (the relation of an event to established issues), power and influence, reference to (often prominent) persons, and negativity, as indicated by damage or conflict (1965). Schultz distinguishes six news values that dominate: timeliness, relevance, identification, conflict, sensation and exclusivity (2007). Approaches suggested later include other news value criteria, considering new forms of digital communication. Harcup and O'Neill suggest new criteria,

such as audio-visuals (stories that have arresting photographs, video, audio and/or which can be illustrated with infographics) and shareability (stories that are thought likely to generate sharing and comments) (2017).

Along with the emergence of digital technologies, social media became the main channel for getting news across the world. The latest digital news report by the Reuters Institute shows that more people worldwide access the news through social media, instead of websites (Newman et al. 2022). The social media arena is undergoing a radical shift, with new platforms like TikTok emerging and established networks like Instagram and Telegram becoming increasingly popular with the younger generation. Use of TikTok for news has globally increased fivefold among 18–24s over three years (3% in 2020 and 15% in 2022). Meanwhile, the majority of people access news first thing in the morning through the use of their smartphone.

Digital transformation of the media and news consumption was tremendously determined by the features of social networking platforms, describes by attention economy, hyper socialization and personalized mass persuasion (Aral 2020). Online spaces enhanced in a way that gave media agencies opportunity to spread news regularly and present it in innovative formats (Fenton 2009). These developments gave rise to a 'hybrid news system' (Chadwick 2013), where information and news sources circulate between traditional news media and digital media. The diversity of news channels has increased, transforming users into both newsmakers and prosumers; that is, individuals who produce and consume news simultaneously. In case of Luhmann's media system, observation of events throughout society occurs almost at the same time as the events themselves (Luhmann 2000). Social media expanded observation opportunities, allowing real-time exposure of events through live videos and instant messaging tools.

Abovementioned shifts within the mass media system inevitably affected trust towards it. It is worth highlighting that we will interpret trust towards the media in its epistemic sense, referring to social judgments about the reliability, relevance, and value of the information and knowledge spread by the media sources. Furthermore, we acknowledge that news, as one of the most common forms of content created and exposed within the mass media system, may contain data, information, or knowledge, or all three at the same time. Recent global studies demonstrate continuous decrease of trust towards the news and media. On average, around four in ten globally (42%) say they trust most news most of the time. Finland is the country with the highest levels of overall trust (69%), while news trust in the USA is the lowest, fallen by a further 3% points (26%). According to Edelman Trust Barometer, social media newsfeed has the lowest level of trust as an information source compared to owned and traditional media. It also has the biggest decrease (−8 points) from 2012 to 2022, with a slight improvement (+ 1 point) in 2023 (Edelman Trust Barometer 2022, 2023). A key factor contributing to the decrease of trust in the media is the rise of misinformation on digital platforms, particularly on social media. Across the world, just over half (54%) say they worry about identifying the difference between what is real and fake on the internet when it comes to news. Reasonably, people who say they mainly use social media as a source of news are more worried (61%) than people who don't use it at all (48%) (Newman et al. 2022). 62% think they see false or misleading information online every week. On the other hand, it becomes harder to distinguish truthful and misleading information. 39% say they have unintentionally shared false or misleading information. The reason for sharing misinformation for 55% is thinking the information was true. A third say they shared

impulsively (A Global Study on Information Literacy 2022). As a result of decrease of trust towards the news and media, interest in news has also fallen sharply around the world: from 63% to 2017 to 51% in 2022.

Decreasing trust towards the news and media has rather concerning consequences. First, it increases polarization on the social media platforms: the more users distrust news sources, the more they prefer following only those confirming their attitudes and beliefs (Pew Research Center 2022). Studies confirm that such polarization is affective and, in its turn, may decrease trust towards institutions and chances for change in opinions (Levy 2021). Large variety of news sources increases uncertainty and drives users to prefer sources confirming their views. This creates "echo chambers," in which individuals are largely exposed to conforming opinions. Additionally, search engines, news aggregators, and social networks are increasingly personalizing content through machine-learning models, potentially creating "filter bubbles", in which algorithms inadvertently amplify ideological segregation by automatically recommending content an individual is likely to agree with.

## Social Media Effects on Communicating Scientific Knowledge

In frames of Luhmann's theory, science as a system has structural couplings with other social systems, including the mass media. In the process of structural couplings with other social systems, mass media takes topics from them, and, as a result of selection, turns some of them into information. Other systems benefit from "mentions" in the media and are simultaneously irritated by them. The mass media system generates constantly renewed willingness to be prepared for surprises. In this respect, the mass media "fit" the accelerated auto-dynamic of other function systems, such as the economy, science and politics (Luhmann 2000). Meanwhile, the way mass media system functions, structures and limits what is possible as mass communication. Subsequently, we will further analyze scientific communication in the light of digital transformation of the mass media system and the logic of social media. We will explore social media as a part of the mass media system and define it as "Internet-based, disentrained, and persistent channels of mass personal communication facilitating perceptions of interactions among users, deriving value primarily from user-generated content" (Carr and Hayes 2015).

Another key point for our analyses, drawn by Luhmann, is the statement that communication only comes about when someone watches, listens, reads and understands to the extent that further communication could follow on (2000). Communicative operation becomes a part of a social system only with understanding, which brings to a new communication. Otherwise, there is always possibility of a communicative failure. In this respect, Luhman distinguishes three possible improbabilities regarding communication:

- First improbability concerns understanding of the meaning, given that bodies and minds of participants are separate and individual, as well as the necessity to have context and presuppositions, in order to prevent misunderstanding;
- The second improbability concerns reaching the addressee;
- The third improbability is success. Even if a communication is understood by the person it reaches, this does not guarantee that it is also accepted and followed.

The operation and conditioning of today's social media platforms for news consumption can be challenging for successful communication, due to several factors that we will discuss below.

**Algorithms** On social media platforms content selection is greatly determined by the algorithms. The news selection process is performed based on the user's interests and previous behavior (Tewksbury 2006). The algorithms tend to show posts by pages users are most likely to be interested in, thus creating filter bubbles of like-minded people. Recommendation algorithms are another determinant of the content users see within their networks. Content importance and popularity are conditioned by social recommendations, such as posts recommended by online connections and indications about users' engagement metrics (i.e., shares, comments, and reactions). These recommendations influence people's preferences on what content to consume, and facilitate information seeking behaviors (Buturoiu et al. 2022). Algorithms favor content that inspires more engagement, posts with more likes, comments and shares are more likely to be promoted in newsfeeds and reshared, driving attention inequality (Aral 2020). This does not ensure equality for everyone to raise a voice on digital spaces and to be heard, as commercialization of social media and attention economy create non equal opportunities for all news providers.

**Incidental News Consumption** One of the most discussed features of online news consumption is the phenomenon of incidental news consumption, described as getting exposed to news when not looking consciously for it. Studies refer to incidental news consumption as a particular type of consumption, described by examples of people reading the headlines of a publication while waiting to pay at the supermarket, or watching a short story being displayed at an electronics store while wondering across the streets. Technology (smartphones and mobile internet connection) has greatly contributed to the proliferation of incidental news consumption, making news content on social media easily accessible almost anywhere, and providing people with access to news with a small device in their hands, with minimal effort. Social media platforms also cultivate incidental news exposure, making news items more readily visible and bringing them to people's attention. Even if people do not actively seek out certain pieces of news, they can be exposed to them when other people from their network post, like, share, and comment (Buturoiu et al. 2022).

**Media Environment** People are multitasking while using social media by simultaneously performing other actions, for example, reading news articles and writing messages (Ahlers 2006). This affects their perception of information in cognitive level. Research by Nielsen-Norman has revealed that through 23 years people consume digital content in the same way: they rather scan it than read like on printed materials (Moran 2020). Recent studies have revealed that when using social media apps, users become deeply absorbed in their content consumption and mindlessly scroll on autopilot, while their minds are elsewhere. These instances of normative dissociation online are accompanied by a decreased sense of volition, which current designs can harness to maximize user time spent on the site (Baughan et al. 2022).

**Human Cognition** The phenomenon of selective exposure is another determinant of news consumption: people tend to search or believe information confirming their own beliefs

(Cinelli 2020). Flynn discusses this phenomenon through directionally motivated reasoning, when people tend to search for information that confirms their opinion; deny information that contradicts their opinion; consider information that confirms their opinion more persuasive than the one that contradicts it (Flynn et al. 2017). As a result of confirmation bias, diversity of opinions creates an isolated homogenous environment instead of stimulating discussions between opposite poles. Such homogenous environments, called echo chambers, make fake diversity of opinions and surround a user with similar views (Sunstein 2001).

The above discussion of challenges related to digital news consumption necessitates an analysis of their effects on scientific communication more precisely, in the light of the structural coupling of scientific and mass media systems.

**Fragmented Background Knowledge** According to Luhmann, the primary role of the mass media system is to generate memory. Mass media make available background knowledge and carry on writing it as a starting point of communication and expressing opinion. Memory contributes to the ongoing checks on consistency by keeping one eye on the known world and excluding any information that is too risky. Everyone can, as an observer, expose himself or herself to observation by others without getting the feeling of living in different, incommensurable worlds (Luhmann 2000). As illustrated in this paper, social media is a part of mass media system highly polarized and fragmented, due to the algorithms, selective exposure and incidental news consumption. Such environment generates a fragmented background knowledge and memory, which sets news consumers into incommensurable realities and distorts consistency of background knowledge. As already mentioned in this paper, Luhmann's constructivist approach views scientific truth as a communicative construct that shapes the reality of the scientific system. In this respect, while scientific reality interacts with social media platforms, it may remain fragmented and reach only those audiences that share a specific background knowledge, missing out on those outside this circle.

**New Information Selection Factors** On social media, scientific news must compete with other pieces of information to gain attention. People's brains are constantly bombarded with real-time updates on current news and events. Meanwhile, human attention span has decreased due to emerging information overload (McSpadden 2015). Most part of information remains uncoded and becomes a noise. In this regard, audience's attention becomes a key selection factor. As a result of information overload, the referential horizon has dramatically expanded, and probability of reaching the addressee has decreased. Algorithms, echo chambers and filter bubbles, on their turn, are also news selectors, boosting improbability of reaching the audiences.

**Distorted Attention and Meanings** Absorbed users and biased news consumption increase the improbability of success in terms of understanding communication and following it. Even if a scientific news gets the audience's attention, communication may not come into being, as an audience, often incidentally consuming it, may not pay enough attention for understanding. On the other hand, their brains may reject a specific piece of information or opinions contradicting his or her existing views. Social media is a space of expressing opinions. Unlike traditional media, where the right to express opinion is limited to a few

people based on their reputation, on social media, each user can become a media platform by gaining a significant number of followers and thus becoming subject to a complex selection process. On these spaces, remarkable reputation based on standing or personality, mentioned by Luhmann, is no longer a prerequisite for expressing opinion. Meanwhile, media organizations actively communicate opinions of users and influencers, thus, increasing their audience reach. As a result, opinions tend to be a dominant type of content people see in their newsfeed. This may greatly distort meanings of scientific messages due to the social influence bias, thus hindering communicative success. This is a rather dangerous tendency especially for scientific news based on true/false coding.

**Increased Speed of news Updates** On social media, information loses its value quickly, forcing news creators and prosumers to update information rapidly, risking the degradation of content quality and encouraging the proliferation of unverified false facts. Regular updates and the necessity to get attention also make newsmakers frame the content appropriately in order to increase the reach, clicks and views, necessary for monetization. In this regard, in-depth research and journalists' reputation become secondary. Meanwhile, real-time updates on news and speed of content creation and circulation through online networks become essential. Due to the fast speed of information flow, irritations are more intensive not only within the mass media system, but also between the system and other social systems. Other systems, on their turn, also have to react and operate in a higher speed in order to respond to irritations caused by the mass media system. Again, truthfulness of scientific news or their unbiased exposure suffer by the logic of social media.

Summing up the discussion above, it becomes clear that social media is a rather hostile environment not only for scientific knowledge with its generalized medium "truth", but also in terms of functioning of the mass media system. The operation logic of social media illustrates key obstacles scientific knowledge may face in such polarized and misinformation-friendly environment. Scientific truths verified within the academic community appear in an environment where journalistic in-depth research has become secondary, news loses its value quickly, trends and algorithms determine success of communication. Social media platforms are not always successful in generating background memory necessary for further communication and structural couplings between the mass media and scientific systems. In this regard, we can state that trust towards science cannot merely be a sufficient prerequisite for successful scientific communication, as trust towards the media is also epistemic and is linked to its logic of operation. On the one hand, trust towards science reduces uncertainty, on the other hand, distrust towards the mass media increases it and fosters ontological insecurity. Epistemic trust towards science and media is primarily related to communicative factors determining spread and exposure of scientific knowledge on social media platforms. Moreover, challenges regarding communicative success on social media decrease communicative success within trust building processes. The factors affecting news consumption, discussed above, combined with the low level of trust towards social media, affect negatively on epistemic trust. On the one hand, the minimal trust people should allocate to the sources of scientific knowledge is under threat because of decreasing trust towards channels and sources on social media. On the other hand, cognitive and emotional factors determining trust towards news content and its filtration as trustworthy information, decrease vigilant trust (the complex of cognitive mechanisms, emotional dispositions, inherited norms, repu-

tational cues we put at work while filtering the information we receive). Hence, we conclude that trust towards science should be analyzed through splitting it into three components (trust towards the message (scientific knowledge), trust towards the medium/channel (social media) and trust towards the source (scientists, media organizations, users, bloggers, influencers, etc.), and taking under consideration the interconnection between them.

## Conclusion

Communicating scientific knowledge on social media is a process of structural coupling between the science and mass media systems, with high and low levels of trust, respectively, on a global scale. This paper illustrates that trust and communication are interconnected for both the science and mass media systems. Although trust in science generally remains high and is a predictor of people's behavior, it is still necessary to explore the effects of social media platforms on scientific communication. As a communicative medium, social media can often fail to generate consistent background knowledge due to its fragmented and polarized environment. This creates obstacles for successful communication, as information circulates much faster, distorting meanings and introducing additional selection criteria. Additionally, algorithms, incidental news consumption, and selective exposure can set people in different realities, reducing the possibility of successful communication based on shared knowledge. Thus, in order to explore scientific communication, it is essential to consider trust towards science and media, as well as their interconnection, including trust towards the medium, message, and source.

Contemporary social media platforms generally follow the logic of the mass media system described by Luhmann. However, the issues discussed in this article demonstrate that new developments in the mass media system cause this logic to manifest in new ways and on different scales. This presents new opportunities for further developing Luhmann's theory and applying it to media studies, while taking into account the structural and technological attributes of social media, as well as its role in influencing communicative processes and determining their success.

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