Science disinformation as a security threat and the role of science communication in the disinformation society

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Summary

The danger of the spread of science disinformation was demonstrated by the coronavirus pandemic. This created a complex crisis, affecting economic, social, and public health security, so disinformation can be perceived as a security threat. Understanding characteristics, communication, and mechanisms of disinformation are particularly important. In this paper, I will elaborate on the concept of disinformation society based on the information society and the dangers of science disinformation, mainly using the example of the disinformation wave that accompanied the coronavirus epidemic. I present the main responses to the problem, highlighting the role of science communication. I will emphasize the need to change attitudes in science communication practices and show how understanding science disinformation can help to do this.

Keywords: science disinformation, pseudoscience, anti-science, disinformation society, disinformation network, science communication

Tudományos dezinformáció mint biztonsági fenyegetés és a tudománykommunikáció szerepe a dezinformációs társadalomban

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Összefoglalás

Az új kommunikációs és médiakörnyezet újítólag hat a dezinformáció megjelenésének és terjedésének módjára, formáira, a terjesztő aktorok számára, az alkalmazott új információmanipulációs technológiára és e tartalmak társadalmi hatásaira. Az információs társadalom koncepciójára reagálva, egyes szakértők már inkább dezinformációs társadalomról beszélnek. A dezinformáció, különösen a tudományos dezinformáció jelentőségét és terjedésének veszélyét a pandémia mutatta meg igazán, amely során a dezinformáció különböző formái, kiemelten az áltudományos és tudományellenes elméletek mennyisége, terjedésük sebessége és hálózatba szerveződése példátlan volt. A tudományos dezinformáció komoly veszélyt jelenthet akár az egyénre, a szélesebb közösségekre, vagy akár a társadalom egészére nézve is. Napjainkban a dezinformáció megjelenik a biztonságot, jelesül az információbiztonságot fenyegető veszélyek között is. A világjárvány komplex válsághelyzetet szült, amely a gazdasági, társadalmi és közegészségügyi biztonságot is meghatározza, ezért a dezinformáció felfogható nemzetbiztonsági fenyegetésként is. A tudományos dezinformáció működésének, kommunikációjának, hatásmechanizmusának megértése így különösen fontos, mivel közvetlenül biztonságot fenyegető tényezővé válhat. A tanulmányban bemutatom, hogyan épül az információs társadalom alapjaira a dezinformációs társadalom koncepciója, külön kiemelve a tudományos dezinformáció működését,

hálózatosodását és veszélyeit, elsősorban a koronavírus köré épülő infodémia példáján. Ezután a problémára adható főbb válaszreakciókat tárgyalom, kiemelve a tudománykommunikáció szerepét. Amellett érvelek, hogy olyan tudománykommunikációs fejlesztésre van szükség, amely elsősorban nem a közösségimédia-platformok használatát, hanem a tudománykommunikációs gyakorlatok során megmutatkozó szemlélet változását helyezi fókuszba. Végül bemutatom, hogy ehhez a szemléletváltáshoz milyen támpontokat nyújthat a tudományos dezinformáció jellemzőinek vizsgálata.

Kulcsszavak: tudományos dezinformáció, áltudomány, tudományellenesség, dezinformációs társadalom, dezinformációs hálózat, tudománykommunikáció

From information society to disinformation society

Although disinformation and some of its manifestations, such as fake news, pseudoscience content, anti-science, or conspiracy theories, are not new phenomena, investigating these has become particularly relevant in recent years. The importance of disinformation, and in particular science disinformation, and the dangers of its spread and mechanisms of action, have been highlighted by the pandemic. As topical as it is to reflect on the role of information and knowledge in life and society, and on the development of the technology for producing and acquiring them, it is also necessary to emphasize their negative aspects. The increase in the quantity of information is leading to an increase in the quantity of disinformation, and the development of the technology for producing, disseminating, and acquiring information is also leading to the development of technology for information manipulation and for producing, disseminating, and acquiring disinformation. Based on the concept of information society, some experts therefore write about disinformation society (see e.g. *Marshall et al. 2015; Marshall 2017*).

Information society is based on the increasing role of information and knowledge *(Z. Karvalics 2009; Webster 2014; Miller 2020)*. The concept of information society has also contributed to the growing importance and prestige of (modern) science as one of the knowledge-producing sources, with probably the greatest social support. Also, the results and developments of science are decisive for society, the economy, and everyday life *(Grundmann–Stehr 2012;* cf. also *Machlup 1962; Bell 1999)*.

The information, communication, and media environment created by the rise of information and communications technologies (further on ICTs) enable the flow of vast amounts of information, widespread access to information, participation in the production, dissemination, and use of information, interaction, and many forms of social action. This changes the nature of social publicity and shapes the reality, the quantity and behavior of communication actors, and the mode of producing and sharing information (cf. e.g. *Miller 2020*). Since information is no longer the result of release, it is possible to break away from the 'old' cultural patterns, bypass the gatekeepers, and thus to query the official (*Aczél 2015* based on *Jenkins 2008*). In this context, new media is characterized by a certain anti-authoritarianism *(Bokor 2015)*. Although the possession and use of information provide a position of power, the Internet platforms allow for participation, widespread access to information, and the possession and use of information. Power and authority are being challenged and power relations over knowledge and information are changing *(Castells 1996, 1997, 1998)*. The new information and communication ecosystem is therefore not only about new tools, technologies, and platforms, but also about a new cultural logic (*Aczél 2015* based on *Jenkins 2008*), a change in the way people relate to information, knowledge, and authority.

As a consequence, the boundary between opinions and facts is blurred (which leads to the concept of a post-truth worldview), and the structure of trust changes (i.e. which information source is considered credible and reliable). The information explosion creates a great amount of noise in information communication, and the algorithms behind online interfaces together with several psychological tendencies (cognitive bias) create and reinforce belief chambers and information bubbles. Meanwhile, not only ICTs, but information manipulation technologies (deep fake, artificial intelligence-generated content and social media profiles, search engine manipulation, etc.; see e.g. *Arnaudo et al. 2021*) are also evolving. These circumstances are also particularly conducive to the global spread of disinformation, and information society is increasingly turning into disinformation society.

Science disinformation: pseudoscience and anti-science

Disinformation is platform-independent and can take almost any form of communication, which makes the often dangerous science disinformation more visible. Science disinformation means misinformation that appears and spreads about scientific claims and issues *(ALLEA 2021):* pseudoscientific and anti-scientific beliefs, and the conspiracy theories that are often associated with them. A wide range of scientific or apparently scientific content is available on internet platforms, and the profile of actors communicating about science has become more varied. At the same time, not only genuine experts, but also other actors with misleading or manipulative intentions produce content presented as scientific, and, as

a result of the new cultural logic of participation, community and sharing, lay users want to shape scientific discourse, not just consume it, even though they do not necessarily have the conceptual apparatus to do so. The new media have thus shaped new forms of pseudoscientific and anti-scientific discourse *(Falyuna 2022a)*. There are many similarities in the communication and logic of pseudoscientific beliefs and anti-scientific beliefs *(Falyuna 2022a),* but whereas pseudoscience generally acknowledges the authority of science, and its proponents seek to prove that their theories or activities are scientific, anti-science questions scientific authority itself *(Hansson 2018; Hecht 2018),* especially when accompanied by conspiracy theories *(Peters 2020; Douglas et al. 2019; Pasek 2019; Krekó 2015; Goertzel 2010)*.

Science disinformation as a threat to security

Although the range of pseudoscientific and anti-scientific beliefs is too broad to be characterized and defined, and the distinction between pseudoscience and science raises several philosophical, theoretical, and practical issues, it is particularly relevant to address them here. The spread of these beliefs can have harmful consequences, for example for (public) health. 'Miracle diets', 'miracle cures' *(Falyuna 2022a)* or anti-vax movements *(Hussain et al. 2018)* are detrimental to people's health, but pseudoscientific and conspiracy theories also emerged during the coronavirus epidemic, encouraging people to reject health recommendations and vaccination (cf. e.g. *Islam et al. 2020; Bavel et al. 2020; Rzymski et al. 2021; Falyuna 2022b*). They can also erode democracy, as an ill-informed public is more easily manipulated and more easily persuaded to refuse medical treatment, to comply with harmful health advice, or even to support extreme political views (*Frankel 1998;* see also *Craft et al. 2017; Douglas et al. 2019; Krekó 2021; Falyuna et al. 2022*). Some beliefs may not appear harmful directly, but can become so indirectly. According to the literature, once an individual accepts a conspiracy or pseudoscientific theory, he or she may be inclined to turn to other, more dangerous theories (cf. *Uscinski 2018*). The interconnectedness of beliefs is also reinforced by similar logic, reasoning, and communication features, as well as the algorithms behind online platforms that link communities, groups, and sites based on similar beliefs *(Falyuna et al. 2022)*. Thus, in the current information ecosystem, not only information networks (cf. *Castells 1996*), but also the networking of disinformation is a feature of the disinformation society. For example, this is how even the seemingly trivial flat-earth belief can turn into extreme beliefs: discourse analyses of flat-earth believers show that many different pseudoscientific and conspiracy theories appear on the platform in their discourse, ranging from Holocaust denial to anti-vaccination *(Mohammed 2019; Falyuna 2019, 2022a; Olshansky et al. 2020)*.

Because of the interconnections, pseudoscientific and anti-scientific content can also be a conscious and deliberate means of conflict generation and manipulation, can become part of a disinformation strategy, an information weapon, and can serve to shape and maintain information noise and uncertainty. For example, *Strudwicke and Grant (2020),* examining the spread of Russian disinformation on Twitter, have shown that the spread of the flat-earth theory also became part of a disinformation strategy.

Conspiracy theories around AIDS, based on pseudoscientific arguments, claims of pseudo-scientists, and false 'scientific' sources were spread as part of a disinformation campaign in the past *(Kalichman 2009; Boghardt 2009)*. The Soviet Union's disinformation attack on the United States aimed to increase divisions in American society and undermine confidence in the government by spreading the idea that HIV was a racist biological weapon developed by the government to exterminate the African-American population *(Kalichman 2009; Boghardt 2009)*. But one can also think of the tobacco companies' past propaganda activities, using pseudoscientific and dismissive claims that trivialized official scientific findings to mislead people about the health harms of smoking (see e.g. *McKee–Diethelm 2010; Hansson 2018*).

Science disinformation can be a serious threat to individuals, communities, and society. As a significant part of today's security threats is related to information security, this includes any kind of disinformation. An excellent example to illustrate and concretize the problem is the wave of disinformation (infodemic) linked to the coronavirus pandemic, during which the spread and volume of various forms of disinformation, and in particular of pseudoscientific and anti-scientific theories, was unprecedented. The pandemic has given rise to a complex crisis situation, which also determines economic, social and public health security, and disinformation can be perceived as a threat to national security (see e.g. *Sługocki–Sowa 2021; Moral 2022; Falyuna 2022b*).

Pandemic infodemic

The amount of information on the coronavirus has increased enormously since the beginning of the pandemic. As this crisis does not only concern public health, a complex communication situation has emerged in which political communication, health communication, science communication, and crisis communication take place simultaneously and together *(Falyuna 2022b)*. There are many actors involved in communication and many inconsistencies between credible and not credible information since, in social media, not only experts and professional communicators, but anyone can disseminate and share anything. This information noise is particularly conducive to the spread of misleading content. Moreover, in a situation that touches people emotionally, arouses fear, it is much easier for misleading information

to have an impact *(Falyuna 2022b; Vraga–Jacobsen 2020),* especially if it fits people's beliefs and needs. Communication methods that can respond to people's patterns of behavior and thinking, including emotional reactions, in addition to conveying information, are successful. This mode of communication can also reinforce a post-truth worldview, which can emphasize beliefs, subjective feelings and opinions, making the dissemination of disinformation more productive. *(Falyuna 2022b)*.

The pandemic has amplified and developed the disinformation ecosystem, and the spread of pseudo-scientific, anti-scientific, and closely related conspiracy theories has become more organized and extensive. Actors and websites promoting different thematic beliefs have incorporated the coronavirus into their narratives *(Falyuna et al. 2022)*. The intertwined nature of these beliefs has brought together alternative medicine, pseudoscientific theories and products, spiritual-religious, obscure transcendence, anti-power politics, and anti-scientific ideas on the same platform. Connections, similar rhetoric, cross-referencing or copied content, the same content distributed on several different sites, groups, and sites linked by social media sites' algorithms, all these are organized into a common universe and a network is formed between them. Just as information networks *(Castells 1996),* disinformation networks can be capitalized on (*Falyuna et al. 2022;* see also *Szakács 2020* on the profiteering of fake news sites and clickbait sites in general).

In our recent study *(Falyuna et al. 2022),* we examined how Hungarian-language pseudo-scientific sites and actors spreading disinformation about COVID-19 turned the deliberate spread of disinformation into a business and profited from it. Internet platforms that use disinformation to gain people's attention can gain clicks, increase their followers and influence public opinion and even behavior with their content. In this way, they can profit from manipulation in many ways. They earn money from the clicks on the ads they place on their websites. The 93 Hungarian-language pseudo-scientific, covid-skeptical, alternative medicine, or anti-vaccine clickbait sites we have analyzed, based on our estimates with Google Ads, can generate a maximum annual advertising revenue of HUF 3.7 billion for the disinformation media group covered by the sites. Several actors who have been the main distributors of disinformation about the coronavirus also sell products and services. Prominent members of the Hungarian 'Doctors for Discernment' (Orvosok a Tisztánlátásért) group *(URL1)*[1] could be mentioned, many of whom also profit from product sales *(Fabók 2021; Falyuna et al. 2022)*. Another analysis, also related to the profiteering of disinformation actors linked to the coronavirus, focuses on the enrichment of the anti-vaccine 'industry' and how social media platforms that provide publicity to the 'industry' mutually benefit from content distribution *(CCDH 2020, 2021a, 2021b)*. According to the report, these communities could generate up to $1.1 billion in annual revenues for Big Tech and at least $35 million in annual revenues for the anti-vaccine industry *(CCDH 2021b)*.

Furthermore, the Hungarian study *(Falyuna et al. 2022)* shows that several political movements started to operate based on disinformation related to the pandemic, so that the actors spreading science disinformation could also gain political capital. One such example is the 'Normal Life Party' (Normális Élet Pártja) of Doktor Gődény, whose campaign is based to a large extent on disinformation about the COVID-19 epidemic (e.g. 'The pandemic was artificially inflated along a long preparatory process', *URL2*). At present, the central claim of his rhetoric is that the Ukrainian–Russian war is just a pretext to divert attention so that power- and economic-interest-driven scientists and other holders of power do not have to admit that the pandemic was a lie. Two other members of 'Doctors for Discernment' have become the faces of an initiative called the 'Fateful National Assembly' (Sorsfordító Nemzetgyűlés). The initiative is a movement that denies the existence of the Hungarian state and seeks to build a parallel, alternative 'Hungary'. For example, one of the embodiments of the anti-state ideas is the 'Hungarian State Owners' Association' (Magyar Állam Tulajdonosainak Társulása), which issues its own identity cards. One can not only join the association (and thus become a co-owner instead of a citizen), but also deed businesses, cars, real estate, etc. The most extreme group of anti-state initiatives to date was the 'Responsible National Government of Hungarians' (Magyarok Felelős Nemzeti Kormánya), whose members were arrested on charges of 'attempting to violently change the constitutional order in preparation for manslaughter' *(HVG 2021),* as they also threatened to assassinate several public figures, including Viktor Orbán and Cecília Müller *(Falyuna et al. 2022)*.

On the still active blog of one of the arrested members *(URL3),* there is a dialogue about the activities of 'Doctors for Discernment', proving there is a link between the 'Responsible National Government of Hungarians' and the 'Doctors for Discernment'. Through them, pseudoscientific beliefs and products become not only a threat to security by endangering people's health and crisis management, but also by linking them to extremist political aspirations through the disinformation network and linkages that have been established. The editors of pseudoscientific sites are therefore not victims of deception, nor are they 'useful idiots' for spreading disinfor-

[1] A group of people with a medical degree but no scientific activity, who have been 'ostracised' by the medical community for their pseudoscientific views and conspiracy theories. Since the beginning of the pandemic, members of the group have been spreading their misleading content that the pandemic is a lie, vaccines are a tool of genocide, and promoting their 'alternative' cures and the 'truth' about the manipulation of scientists and politicians.

mation, but they use disinformation as an effective marketing tool for financial and political gain. Their actions can endanger the security of society.

Aspects of the fight against disinformation

There are several considerations to be taken into account when dealing with the spread and impact of disinformation, such as the regulation of social media and content moderation on social media platforms. The responsibility of internet users in the fight against disinformation is also a key issue, especially in the context of the pandemic crisis. The ability to manage a crisis and to defend against the effects of a pandemic depends to a large extent on the mood, attitudes, and behavior of citizens, which is highly dependent on the effectiveness of the fight against disinformation. Public information awareness is also of paramount importance because, although the success of disinformation depends on access to large networks, in social media those who fall victim to misleading content can also become distributors through content sharing and user-generated content. The aim is therefore to build public trust in reliable sources of information. Science disinformation is easier for scientists to identify and manage. On a given subject, it can be more difficult for laypeople – especially in the new media – to distinguish science from pseudoscience, the credible from the not plausible, the reliable from the unreliable, fact from opinion and belief, validated and effective remedies from 'miracle cures'. Furthermore, the factors such as an individual's attitudes, beliefs, emotions, and social environment influence the sources and experts that one trusts *(Petty et al. 2007; Schwarz 2012; NASEM 2017)*. The influence of these factors is even more amplified in the post-truth world.

In the information noise and the sea of opinions, the development of critical thinking, which is a key element of information and digital literacy and media literacy, is not based on the reception of more information.

The most effective way to develop people's 'cognitive immune response' is to 'vaccinate' people against disinformation, i.e. to involve people actively in processes whereby they learn about misinformation and even harmful disinformation (see inoculation in the literature; *Roozenbeek–van der Linden 2019; Basol et al. 2020; van der Linden et al. 2020; van der Linden–Roozenbeek 2021; Lewandowsky–Yesilada 2021; Lewandowsky–van der Linden 2021*). At the same time, it is not only the users' task and responsibility to identify, filter, and manage science disinformation: users need help to develop effective and modern science communication practices (including education) *(Falyuna 2022a, 2022c)*.

Role of science communication in the disinformation society

Just as users do not need more information for critical information management, science communication needs to move beyond the traditional deficit model. The deficit model has been widely criticized in the international literature on science communication research (cf. science studies), but the relationship and communication between science and society is still determined by the model's approach (see e.g. *Cortassa 2016; Meyer 2016; Simis et al. 2016*). This approach treats science and society in isolation, viewing science and scientific knowledge, practices, and institutions as an objective whole. The model is based on the assumption that public perception and understanding of science equals recognition, acceptance, and support of science, understanding of scientific knowledge, and application of science-based advice *(Miller 1992; Lewenstein 1995; Wynne 1995)*. Thus, the reason why the public opposes or rejects these, according to the model, is due to lay knowledge deficits and misunderstanding of the scientific knowledge. The practice of science communication should therefore be geared purely to the transfer of knowledge and to making science more 'attractive'. *(Miller 1983; Weigold 2001; Schäfer et al. 2019)*. The idea is that the elimination of the knowledge deficit, the mere dissemination of knowledge, will solve the problem of anti-science and pseudoscience *(Kutrovátz et al. 2008)*.

Further approaches to science communication that highlight the critical points of the deficit model (for a summary, see e.g. *Trench 2008; Akin–Scheufele 2017; Schmid-Petri–Bürger 2019)* guide effective science communication practices that address contemporary societal expectations in a more nuanced way *(Fischhoff–Scheufele 2013, 2014, 2019; Jennings 2014; Jensen–Gerber 2020)*. Approaches criticizing the deficit model point to the complexity of the communication context, the diversity of audiences (laypeople) and communicators, the additional sources from which audiences access information and which may also influence their attitudes towards scientific knowledge. Science communication must take into account both the functioning of these elements and their interaction with each other.

The reason for beliefs that do not necessarily agree with or reject scientific knowledge is not simply a lack of scientific literacy and knowledge *(Blanco–Matute 2018)*. Understanding does not necessarily mean acceptance and support *(Wynne 1995; Gregory–Miller 1998; Burns et al. 2003; NASEM 2017)*. It depends on several factors: experiences, interests, goals, beliefs, emotions, concerns, socio-cultural context, the individual's groups and communities, etc. Individuals may deliberately choose to reject, as they do not make decisions in their lives only

based on scientific information, or on what they consider credible and trustworthy (*Petty et al. 2007; Schwarz 2012; NASEM 2017; Blanco–Matute 2018; Lobato–Zimmerman 2018;* see also *Allchin–Zemplén 2020*). Moreover, not all scientific facts and theories are important, useful, or interesting to a layperson, which further highlights the relevance of information (*Wynne 1995; Lewenstein 2003;* see also *Kutrovátz et al. 2008*). Individuals do not react passively to information *(Lewenstein 2003)*, they receive it in different contexts and their processing is influenced by their experiences, environment, emotions, beliefs, and attitudes. People will do better not if they have more scientific knowledge, but if they have more *relevant* knowledge *(Lewenstein 2003)*. Science communication practices based on the deficit model do not take into account the perspective of the individual, and the individual can turn to a communicator who is less scientifically credible but who presents himself/herself as an expert. Furthermore, science communication overemphasizing the knowledge deficits of laypeople may inadvertently contribute to the emergence of anti-science, alienation from science, distrust of science, and the spread of pseudoscientific content (cf. e.g. *Wynne 1987; Ezrahi 1990; Michael 1992; Wynne 1995; Shapin 2001*). Moreover, simply providing more information and more communication will not solve the problem. Studies about whether correcting misinformation changes an individual's beliefs claim that there is little chance of this happening because of the effect of the echo chamber. *(Ding et al. 2011; Lewandowsky et al. 2012; Bolsen–Druckman 2015; Thorson 2016; Vraga–Bode 2018; Garrett 2017; Vraga–Bode 2020)*. In the case of anti-scientific beliefs, only more communication can lead to further polarization *(Kahan 2012)*. Further research also shows that mere trust in science, without actual understanding of science, can also contribute to the acceptance of pseudoscientific beliefs *(O'Brien et al. 2021)*, as pseudoscience gives the appearance of science by counterfeiting scientific communication *(Falyuna 2002a)*. In the curricular literature on science communication, the emphasis is on participation and dialogue rather than the dissemination of scientific knowledge (public participant or public engagement model; *Ziman 2000a, 2000b; Lewenstein 2003; Bucchi 2009; Einsiedel 2014; Schäfer et al. 2019*). According to this model, the 'science *and* society' approach, which sees the two as essentially separate and the connection between them as bridges to be built, must be replaced by a 'science *in* society' approach (*Bucchi–Trench 2014;* cf. also *Zemplén 2019; Allchin–Zemplén 2020*). Participation is an opportunity to increase transparency and facilitate stakeholder input, sharing experiences, information, and perspectives *(Renn–Levine 1991)*. This is also important because the way to scientific knowledge is not as clear and conflict-free as the deficit model presents. Understanding this, and a more realistic representation of science, can build and maintain social trust *(Renn–Levine 1991; Wynne 2006; NASEM 2017)*. The public encounters these contradictions in different contexts and can access different scientific information on a certain topic at different platforms. People not only have problems in deciding which experts and information are credible, but also in dealing with conflicting (often also credible) information (see e.g. *NASEM 2017*; on trust as a key concept in science communication, especially in the post-truth world, see *Leßmöllmann 2019*). If there is a lack of transparency in the way science works and the process of producing scientific knowledge, and there is a lack of understanding of the uncertainties and contradictions that arise in scientific work, people may decide on the credibility and reliability of information and sources based solely on their own beliefs if they are not experts in a given field. For the same reason, it is also harder for them to verify the credibility of contradictory information. In the information noise, pseudo-scientists and pseudo-experts can have a greater impact. A successful communication strategy is one that not only provides information but also responds to people's feelings and needs.

In the information society, it is particularly important not only to provide and share information and knowledge, but also to help people understand the process of producing and interpreting information and knowledge. It is equally important to teach them how to use knowledge effectively and how to reflect on deception. This involvement and participation are in accord with participation in learning about disinformation ('inoculation'). In science communication practices, including in pedagogy, the traditional deficit model approach, which emphasizes the transmission of facts, needs to be replaced by a more effective, interaction- and participation-based model that is more in accordance with today's expectations. This requires scientists who can engage in dialogue with the public, not scientists working in isolation from society, and just informing and educating the public. Online platforms have also become more relevant for science communication. At the same time, in a disinformation society, the development of science communication does not primarily imply the use of new communication tools and channels, but rather a change in the *attitude* of the science communication practices *(Falyuna 2022a, 2022c)*.

For science communication to be successful and effective, science communicators need to know the society with and in which they communicate; to reflect on what the public (the lay public) means, how it has changed, who is included in it, and their own reactions when the public expresses concerns or doubts. They also need to reflect on the growth in the number of communicators, the changing relationship of the public to information and knowledge, to authority and the official, and the changing weight of opinions and beliefs *(Falyuna 2022a, 2022c)*.

The study of the communication characteristics, dissemination, and mechanism of action of science disinfor-

mation can help to develop this approach to science communication. The public understanding of pseudo- and anti-science also facilitates people's cognitive 'vaccination' (cf. inoculation), involving public participation and social engagement of scientific actors (based on *Falyuna 2022a, 2022c*).

On the one hand, pseudoscientific and anti-scientific beliefs (as well as conspiracy theories, *Cairns 2014*) can reveal a lot about social reality, hierarchies, lay people's questions, and concerns about certain social and political events, scientific discoveries, and technological innovations. It is important to understand why and how pseudoscientific, anti-scientific, or conspiracy theories become convincing, how they respond to people's needs and questions, and how they become relevant sources of information. Exploring these can help science communication actors to contextualize their communication practices: what information is really relevant and useful for a given audience on a given topic *(Falyuna 2022a, 2022c)*. Furthermore, the analysis of pseudoscientific or anti-scientific theories can provide new perspectives and questions for the study of the public's attitude towards science and the public understanding of science *(Falyuna 2022a, 2022c)*.

In particular, how the public perceives and understands both the messages about risk and danger, and the scientific knowledge and information about the management of an epidemic, is a crucial issue *(Falyuna 2022b)*. Thus, public communication of science and crisis communication *(Malecki et al. 2021)* can converge. However, actual health threats and scientific information that prove these are only one aspect of risk perception. Individual beliefs, emotions, and attitudes also shape the response to the threat. It is important to understand what factors actually shape people's attitudes to science in general and their perception of risk in a pandemic *(Malecki et al. 2021)*. Planning effective communication also requires examining and taking into account the needs, feelings, fears, and attitudes of the audience. These influence the choices people make, their attitudes to scientific recommendations, government decisions and health regulations, and the communication actors and information sources they trust. These attitudes and feelings are influenced by the discourse that emerges in the information ecosystem. Science disinformation expresses the concerns and issues that make people distrustful. By understanding and responding to these concerns, a dialogue between science and society can be established *(Falyuna 2022a)*.

Analysis of science disinformation content can also show how laypeople react to contradictory scientific information. Exploring these can provide a basis for how to present science more realistically *(Falyuna 2022a, 2022c)*. In particular, uncertainty about a disease or epidemic may arise if the information is contradictory, incomplete, or inadequate; if the information is difficult to understand; and if the future outcome, likelihood, or risk of the disease is unclear *(Finset et al. 2020)*. Therefore, it is particularly important to communicate the process of scientific knowledge production in order to avoid uncertainties arising from contradictions. If people not only receive scientific knowledge, but also understand how science works, are aware of the process of producing and interpreting information and knowledge, and can use this knowledge effectively, it will be possible to remedy trust relationships, and also to reflect on when someone tries to deceive or manipulate, for example, through scientific authority or scientific communication (*Falyuna, 2022a, 2022b, 2022c;* cf. also *Rzymski et al. 2021*).

The comprehensibility of the content is also important. On the one hand, it is important to highlight the misleading and manipulative effects of the use of terminology. It is worth including terminology in the development of competence in identifying and dealing with disinformation, and to include the study of 'pseudo-terminologies' in the scope of terminology management *(Falyuna 2022a, 2022b, 2022c)*.

Furthermore, setting the boundaries of science is more difficult for the public than for the scientific community. While it is difficult to provide a list of uniform characteristics of pseudo-scientific and anti-scientific beliefs, it is also difficult to know what can and should be communicated to the public about them. However, by analyzing different cases, the characteristics can be identified and described, and this can provide a basis for practices to develop public engagement and inoculation against disinformation *(Falyuna 2022a, 2022c)*.

References

Aczél P. (2015) Médiaműveltség. In: Aczél, P., Andok, M., & Bokor, T. (eds) Műveljük a médiát! Budapest, Wolters Kluwer. pp. 133–177.

Akin, H., & Scheufele, D. A. (2017) Overview of the science of science communication. In: Jamieson, K. H., Kahan, D. M., & Scheufele, D. (eds) The Oxford handbook on the science of science communication. Oxford, Oxford University Press. pp. 25–33. https://doi.org/10.1093/oxfordhb/9780190497620.013.3

Allchin, D., & Zemplén G. Á. (2020) Finding the place of argumentation in science education: Epistemics and whole science. Science Education, Vol. 104. No. 5. pp. 907–933. https://doi.org/10.1002/sce.21589

ALLEA (2021) Fact or fake? Tackling science disinformation. ALLEA Discussion Paper, 5. Berlin. https://doi.org/10.26356/fact-or-fake

Arnaudo, D., Bradshaw, S., Ooi, H. H., Schwalbe, K., Zakem, V., & Zink, A. (2021) Combating information manipulation: A playbook for elections and beyond. The International Republican Institute & The National Democratic Institute & The Stanford Internet Observatory.

Basol, M., Roozenbeek, J., & van der Linden, S. (2020) Good news about bad news: Gamified inoculation boosts confidence and cognitive immunity against fake news. Journal of Cognition, Vol. 3. No. 1. https://doi.org/10.5334/joc.91

Bavel, J. J. V., Baicker, K., Boggio, P. S., Capraro, V., Cichocka, A., Cikara, M., … Willer, R. (2020) Using social and behavioural science to support COVID-19 pandemic response. Nature Human

Behaviour, Vol. 4. No. 5. pp. 460–471. https://doi.org/10.1038/s41562-020-0884-z.

Bell, D. (1999) The coming of post-industrial society. A venture in social forecasting. New York, Basic Books.

Blanco, F., & Matute, H. (2018) The illusion of causality: A cognitive bias underlying pseudoscience. In: Kaufman, A. B., & Kaufman, J. C. (eds) Pseudoscience: The conspiracy against science. MIT Press Scholarship Online. pp. 45–75. https://doi.org/10.7551/mitpress/9780262037426.003.0003

Boghardt, T. (2009) Operation INFEKTION: Soviet Bloc intelligence and its AIDS disinformation campaign. Studies in Intelligence, Vol. 53. No. 4. pp. 1–24.

Bokor T. (2015) Médiaértés. In: Aczél P., Andok M., & Bokor T. (eds) Műveljük a médiát! Budapest, Wolters Kluwer. pp. 179–239.

Bolsen, T., & Druckman, J. N. (2015) Counteracting the politicization of science. Journal of Communication, Vol. 65. No. 5. pp. 745–769. https://doi.org/10.1111/jcom.12171

Bucchi, M. (2009) Beyond technocracy. Science, politics and citizens. New York, Springer.

Bucchi, M., & Trench, B. (2014) Science communication research. Themes and challenges. In: Bucchi, M., & Trench, B. (eds) Routledge handbook of public communication of science and technology. Second Edition. London & New York, Routledge. pp. 1–15.

Burns, T. W., O'Connor, D. J., & Stocklmayer, S. M. (2003) Science communication. A contemporary definition. Public Understanding of Science, Vol. 12. No. 2. pp. 183–202. https://doi.org/10.1177/09636625030122004

Cairns, R. (2014) Climates of suspicion. 'Chemtrail' conspiracy narratives and the international politics of geoengineering. The Geographical Journal, Vol. 182. No. 1. pp. 70–84. https://doi.org/10.1111/geoj.12116

Castells, M. (1996) The rise of the network society. The information age: Economy, society and culture Vol. I. Cambridge, Massachusetts & Oxford, UK, Blackwell.

Castells, M. (1997) The power of identity. The information age: Economy, society and culture Vol. II. Cambridge, Massachusetts & Oxford, UK, Blackwell.

Castells, M. (1998) End of millennium. The information age: Economy, society and culture Vol. III. Cambridge, Massachusetts & Oxford, UK, Blackwell.

CCDH (2020) The anti-vaxx industry. How big tech powers and profits from vaccine misinformation. Center for Countering Digital Hate.

CCDH (2021a) The disinformation dozen. Center for Countering Digital Hate.

CCDH (2021b) The pandemic profiteers. The business of anti-vaxx. Countering Digital Hate.

Cortassa, C. (2016) In science communication, why does the idea of a public deficit always return? The eternal recurrence of the public deficit. Public Understanding of Science, Vol. 25. No. 4. pp. 447–459. https://doi.org/10.1177%2F0963662516629745

Craft, S., Ashley, S., & Maksl, A. (2017) New media literacy and conspiracy theory endorsement. Communication and the Public, Vol. 2. No. 4. pp. 388–401. https://doi.org/10.1177%2F2057047317725539

Ding, D., Maibach, E. W., Zhao, X., Roser-Renouf, C., & Leiserowitz, A. (2011) Support for climate policy and societal action are linked to perceptions about scientific agreement. Nature Climate Change, Vol. 1. No. 9. pp. 462–466. https://doi.org/10.1038/nclimate1295

Douglas, K. M., Uscinski, J. E., Sutton, R. M., Cichocka, A., Nefes, T., Ang, Ch. S., & Deravi, F. (2019) Understanding conspiracy theories. Political Psychology, Vol. 40. No. S1. pp. 3–35. https://doi.org/10.1111/pops.12568

Einsiedel, E. F. (2014) Publics and their participation in science and technology: Changing roles, blurring boundaries. In: Bucchi, M., & Trench, B. (eds) Routledge handbook of public communication of science and technology. Second Edition. London & New York, Routledge. pp. 125–140.

Ezrahi, Y. (1990) The descent of Icarus. Science and the transformation of contemporary democracy. Harvard, Harvard University Press.

Fabók B. (2021) Százmilliókkal gazdagította a járvány a vírusszkeptikus Dr. Lenkeit, nagyot szakítottak Dr. Gődénnyel is. G7.hu, 2 June 2021. https://g7.hu/kozelet/20210602/szazmilliokkal-gazdagitotta-a-jarvany-a-virusszkeptikus-dr-lenkeit-nagyot-szakitott-dr-godeny-is/ [Downloaded: 16 April 2022].

Falyuna N. (2019) Esettanulmány a magyar laposföld-hívők online közösségének diskurzusáról. Médiakutató, Vol. 20. No. 4. pp. 65–82.

Falyuna N. (2022a) Az áltudományos diskurzus jellemzői. Az újmédiában megjelenő áltudományos tartalmak nyelvészeti-kommunikációs elemzése. PhD thesis. Manuscript. Budapest, ELTE BTK Nyelvtudományi Doktori Iskola. https://doi.org/10.15476/ELTE.2022.014

Falyuna N. (2022b) A pandémia nyelve, retorikája és kommunikációja. Magyar Tudomány, Vol. 183. No. 5. pp. 610–620.

Falyuna N. (2022c, forthcoming) "A tudósok fehér galléros bűnözők" – Tudományellenesség és tudománykommunikáció a (dez)információs társadalomban. Filológia.hu.

Falyuna N., Krekó P., & Berkes R. (2022) Álszent antikapitalisták. Nyereségvágyból terjesztett áltudományos dezinformáció az interneten. Political Capital.

Finset, A., Bosworth, H., Butow, P., Gulbrandsen, P., Hulsman, R. L., Pieterse, A. H., … van Weert, J. (2020) Effective health communication - a key factor in fighting the COVID-19 pandemic. Patient Education and Counseling, Vol. 10. No. 5. pp. 873–876. https://doi.org/10.1016/j.pec.2020.03.027

Fischhoff, B., & Scheufele, D. A. (2013) The science of science communication. Proceedings of the National Academy of Sciences, Vol. 110. No. Supplement 3. pp. 14031–14032. https://doi.org/10.1073/pnas.1312080110

Fischhoff, B., & Scheufele, D. A. (2014) The science of science communication II. Proceedings of the National Academy of Sciences, Vol. 111. No. Supplement 4. pp. 13583–13584. https://doi.org/10.1073/pnas.1414635111

Fischhoff, B., & Scheufele, D. A. (2019) The science of science communication III. Proceedings of the National Academy of Sciences, Vol. 116. No. Supplement 16. pp. 7632–7633. https://doi.org/10.1073/pnas.1902256116

Frankel, M. S. (1998) The role of science in making good decisions. https://www.aaas.org/resources/role-science-ma-king-good-decisions [Downloaded: 21 February 2021].

Garrett, R. K. (2017) The "echo chamber" distraction. Disinformation campaigns are the problem, not audience fragmentation. Journal of Applied Research in Memory and Cognition, Vol. 6. No. 4. pp. 370–376. http://dx.doi.org/10.1016/j.jarmac.2017.09.011

Goertzel, T. (2010) Conspiracy theories in science. EMBO Reports, Vol. 11. No. 7. pp. 493–499. https://doi.org/10.1038/embor.2010.84

Gregory, J., & Miller, S. (1998) Science in public. Communication, culture, and credibility. New York, Plenumtrade.

Grundmann, R., & Stehr, N. (2012) The power of scientific knowledge. Cambridge, Cambridge University Press. https://doi.org/10.1017/CBO9781139137003

Hansson, S. O. (2018) Dealing with climate science denialism: Experiences from confrontations with other forms of pseudoscience. Climate Policy, Vol. 18. No. 9. pp. 1094–1102. https://doi.org/10.1080/14693062.2017.1415197

Hecht, D. K. (2018) Pseudoscience and the pursuit of truth. In: Kaufman, A. B., & Kaufman, J. C. (eds) Pseudoscience. The conspiracy against science. Cambridge, MA, MIT Press. pp. 3–20.

Hussain, A., Ali, S., Ahmed, M., & Hussain, S. (2018) The anti-vaccination movement: A regression in modern medicine. Cureus, Vol. 10. No. 7. e2919. https://doi.org/10.7759/cureus.2919

HVG (2021) Posta Imre és két társa biztosan börtönben tölti az ünnepeket. HVG, 29 October 2021. https://hvg.hu/itthon/20211029_posta_imre_letartoztatas_magyarok_felelos_nemzeti_kormanya [Downloaded: 24 January 2022].

Islam, M. S., Sarkar, T., Khan, S. H., Mostofa Kamal, A.-H., Hasan, S. M. M., Kabir, A., … Seale, H. (2020) COVID-19-related infodemic and its impact on public health: A global social media analysis. The American Journal of Tropical Medicine and Hygiene, Vol. 103. No. 4. pp. 1621–1629. https://doi.org/10.4269/ajtmh.20-0812.

Jenkins, H. (2008) Convergence culture: Where old and new media collide. New York, New York University Press.

Jennings, R. C. (2014) Theory and practice in science communication. Studies in Science Education, Vol. 50. No. 2. pp. 249–56. https://doi.org/10.1080/03057267.2013.831972

Jensen, E. A., & Gerber, A. (2020) Evidence-based science communication. Frontiers in Communication, Vol. 4. https://doi.org/10.3389/fcomm.2019.00078

Kahan, D. M. (2012) Cultural cognition as a conception of the cultural theory of risk. In: Roeser, S., Hillerbrand, R., Sandin, P., & Peterson, M. (eds) Handbook of risk theory. epistemology, decision theory, ethics, and social implications of risk. Amsterdam, Springer. pp. 725–759. https://doi.org/10.1007/978-94-007-1433-5_28

Kalichman, S. C. (2009) Denying AIDS. Conspiracy theories, pseudoscience, and human tragedy. New York, Springer.

Krekó P. (2015) Conspiracy theory as collective motivated cognition. In: Bilewicz, M., Cichocka, A., & W. Soral (eds) The psychology of conspiracy. Routledge, Taylor & Francis Group. pp. 62–75.

Krekó P. (2021) Tömegparanoia 2.0. Összeesküvés-elméletek, álhírek és dezinformáció. Budapest, Athenaeum.

Kutrovátz G., Láng B., & Zemplén G. (2008) A tudomány határai. Budapest, Typotex.

Leßmöllmann, A. (2019) Current trends and future visions of (research on) science communication. In: Leßmöllmann, A., Dascal, M., & Gloning, T. (eds) Science communication. Walter de Gruyter. pp. 657–688. https://doi.org/10.1515/9783110255522

Lewandowsky, S., Ecker, U. K. H., Seifert, C. M., Schwarz, N., & Cook, J. (2012) Misinformation and its correction continued influence and successful debiasing. Psychological Science in the Public Interest, Vol. 13. No. 3. pp. 106–131. https://doi.org/10.1177/1529100612451018

Lewandowsky, S., & van der Linden, S. (2021) Countering misinformation and fake news through inoculation and prebunking. European Review of Social Psychology, Vol. 32. No. 2. pp. 348–384. https://doi.org/10.1080/10463283.2021.1876983

Lewandowsky, S., & Yesilada, M. (2021) Inoculating against the spread of Islamophobic and radical-Islamist disinformation. Cognitive Research: Principles and Implications, Vol. 6. No. 57. https://doi.org/10.1186/s41235-021-00323-z

Lewenstein, B. V. (1995) Science and the media. In: Jasanoff, S., Markle, G. E., Peterson, J. C., & Pinch, T. (eds) Handbook of science and technology studies. Sage Publications. pp. 344–361.

Lewenstein, B. V. (2003) Models of public communication of science and technology. Cornell University, Departments of Communication and of Science & Technology Studies.

Lobato, E. J. C., & Zimmerman, C. (2018) The psychology of (pseudo)science: Cognitive, social, and cultural factors. In: Kaufman, A. B., & Kaufman, J. C. (Eds) Pseudoscience: The conspiracy against science. Cambridge, MA, MIT Press. pp. 21–43. https://doi.org/10.7551/mitpress/9780262037426.003.0002

Machlup, F. (1962) The production and distribution of knowledge in the United States. Princeton, NJ, Princeton University Press.

Malecki, K. M. C., Keating, J. A., & Safdar, N. (2021) Crisis communication and public perception of COVID-19 risk in the era of social media. Clinical Infectious Diseases, Vol. 72. No. 4. pp. 697–702. https://doi.org/10.1093/cid/ciaa758

Marshall, J. P. (2017) Disinformation society, communication and cosmopolitan democracy. Cosmopolitan Civil Societies: An Interdisciplinary Journal, Vol. 9. No. 2. pp. 1–24. http://orcid.org/0000-0002-3914-7697

Marshall, J. P., Goodman, J., Zowghi, D., & da Ramini, F. (2015) Disorder and the disinformation society. The social dynamics of information, networks and software. New York, Routledge. https://doi.org/10.4324/9781315693460

McKee, M., & Diethelm, P. (2010) How the growth of denialism undermines public health. BMJ, 2010 Dec 14;341:c6950. https://doi.org/10.1136/bmj.c6950. PMID: 21156741

Meyer, G. (2016) In science communication, why does the idea of a public deficit always return? Public Understanding of Science, Vol. 25. No. 4. pp. 433–446. https://doi.org/10.1177/0963662516629747

Michael, M. (1992) Lay discourses of science: Science-in-general, science-in-particular, and self. Science, Technology, & Human Values, Vol. 17. No. 3. pp. 313–333. https://doi.org/10.1177/016224399201700303

Miller, J. D. (1983) Scientific literacy. A conceptual and empirical review. Daedalus, Vol. 112. No. 2. pp. 29–48.

Miller, J. D. (1992) Toward a scientific understanding of the public understanding of science and technology. Public Understanding of Science, Vol. 1. No. 1. pp. 23–26. https://doi.org/10.1088/0963-6625/1/1/005

Miller, V. (2020). Understanding digital culture. Second edition. London, Sage Publications.

Mohammed, S. N. (2019) Conspiracy theories and flat-earth videos on YouTube. The Journal of Social Media in Society, Vol. 8. No. 2. pp. 84–102.

Moral, P. (2022) The challenge of disinformation for national security. In: Cayón Peña, J. (ed.) Security and defence: Ethical and legal challenges in the face of current conflicts. Advanced Sciences and Technologies for Security Applications. Springer, Cham. pp. 103–119. https://doi.org/10.1007/978-3-030-95939-5_8

NASEM = National Academies of Sciences, Engineering, and Medicine (2017) Communicating science effectively. A research agenda. Washington, DC, The National Academies Press. https://doi.org/10.17226/23674

O'Brien, T. C., Palmer, R., & Albarracin, D. (2021) Misplaced trust: When trust in science fosters belief in pseudoscience and the benefits of critical evaluation. Journal of Experimental Social Psychology, Vol. 96(6099). 104184. https://doi.org/10.1016/j.jesp.2021.104184

Olshansky, A., Peaslee, R. M., & Landrum, A. R. (2020) Flat-smacked! Converting to flat eartherism. Media and Religion, Vol. 19. No. 2. pp. 46–59. https://doi.org/10.1080/15348423.2020.1774257

Pasek, J. (2019) Don't trust the scientists! Rejecting the scientific consensus "conspiracy". In: Uscinski, J. (ed.) Conspiracy theories and the people who believe them. Oxford, Oxford University Press. pp. 201–213. https://doi.org/10.1093/oso/9780190844073.001.0001

Peters, M. A. (2020) On the epistemology of conspiracy. Educational Philosophy and Theory, Vol. 53. No. 14. pp. 1413–1417. https://doi.org/10.1080/00131857.2020.1741331

Petty, R. E., Briñol, P., Tormala, Z. L., & Wegener, D. T. (2007) The role of metacognition in social judgment. In: Kruglanski, A. W., & Higgins, E. T. (eds) Social psychology: Handbook of basic principles. New York, Guilford Press. pp. 254–284.

Renn, O., & Levine, D. (1991) Credibility and trust in risk communication. In Kasperson, R. E., & Stallen, P. J. M. (eds) Communicating risks to the public. Dordrecht, Springer. pp. 175–217.

Roozenbeek, J., & van der Linden, S. (2019) The fake news game: Actively inoculating against the risk of misinformation. Journal of Risk Research, Vol. 22. No. 5. pp. 570–580. https://doi.org/10.1080/13669877.2018.1443491

Rzymski, P., Borkowski, L., Drąg, M., Flisiak, R., Jemielity, J., Krajewski, J., … Fal, A. (2021) The strategies to support the COVID-19 vaccination with evidence-based communication and tackling mis-

information. Vaccines, Vol. 9. No. 109. https://doi.org/10.3390/vaccines9020109.

Schäfer, M. S., Kessler, S. H., & Fähnrich, B. (2019) Analyzing science communication through the lens of communication science. Reviewing the empirical evidence. In: Leßmöllmann, A., Dascal, M., & Gloning, T. (eds): Science communication. Berlin, Boston, De Gruyter Mouton. pp. 77–104.

Schmid-Petri, H., & Bürger, M. (2019) Modeling science communication: From linear to more complex models. In: Leßmöllmann, A., Dascal, M., & Gloning, T. (eds) Science communication. Berlin, Boston, De Gruyter Mouton. pp. 105–122.

Schwarz, N. (2012) Feelings-as-information theory. In: Van Lange, P., Kruglanski, A. W., & Higgins, E. T. (eds) Handbook of theories in social psychology. Thousand Oaks (CA), Sage Publications. pp. 289–308. https://dx.doi.org/10.4135/9781446249215

Shapin, S. (2001) How to be antiscientific. In: Labinger, J. A., & Collins, H. (eds) The one culture?: A conversation about science. Chicago, University of Chicago Press. pp. 99–115. https://doi.org/10.7208/9780226467245-009

Simis, M. J., Madden, H., Cacciatore, M. A., & Yeo, S. K. (2016) The lure of rationality. Why does the deficit model persist in science communication? Public Understanding of Science, Vol. 25. No. 4. pp. 400–414. https://doi.org/10.1177/0963662516629749

Sługocki, W. Ł., & Sowa, B. (2021) Disinformation as a threat to national security on the example of the COVID-19 pandemic. Security and Defence Quarterly, Vol. 35. No. 3. pp. 63–74. https://doi.org/10.35467/sdq/138876

Strudwicke, I. J., & Grant, W. J. (2020) #JunkScience: Investigating pseudoscience disinformation in the Russian Internet Research Agency tweets. Public Understanding of Science, Vol. 29. No. 5. pp. 1–14. https://doi.org/10.1177/0963662520935071

Szakács J. (2020) The business of misinformation. CMDS. https://cmds.ceu.edu/business-misinformation [Downloaded: 16 April 2022].

Thorson, E. (2016) Belief echoes. The persistent effects of corrected misinformation. Political Communication, Vol. 33. No. 3. pp. 460–480. https://doi.org/10.1080/10584609.2015.1102187

Trench, B. (2008) Towards an analytical framework of science communication models. In: Cheng, D., Claessens, M., Gascoigne, T., Metcalfe, J., Schiele, B., & Shi, S. (eds) Communicating science in social contexts: New models, new practices. Dordrecht, Springer. pp. 119–135. http://dx.doi.org/10.1007/978-1-4020-8598-7

Uscinski, J. (2018) Down the rabbit hole we go! In: Uscinski, J. (ed.) Conspiracy theories and the people who believe them. Oxford, Oxford University Press. pp. 1–32. https://doi.org/10.1093/oso/9780190844073.001.0001

van der Linden, S., & Roozenbeek, K. (2021) Psychological inolucation against fake news. In: Greifeneder, R., Jaffé, M. E., Newman, W. J., & Schwarz, N. (eds) The psychology of fake news. Accepting, sharing, and correcting misinformation. Routledge. pp. 147–169.

van der Linden, S., Roozenbeek, J., & Compton, J. (2020) Inoculating against fake news about COVID-19. Frontiers in Psychology, Vol. 2020. No. 11. https://doi.org/10.3389/fpsyg.2020.566790

Vraga, E. K., & Bode, L. (2018) I do not believe you: How providing a source corrects health misperceptions across social media platforms. Information, Communication & Society, Vol. 21. No. 10. pp. 1337–1353. https://doi.org/10.1080/1369118X.2017.1313883

Vraga, E. K., & Bode, L. (2020) Correction as a solution for health misinformation on social media. American Journal of Public Health, Vol. 110. No. 3. S78–S80. https://doi.org/10.2105/ajph.2020.305916

Vraga, E. K., & Jacobsen, K. H. (2020) Strategies for effective health communication during the coronavirus pandemic and future emerging infectious disease events. World Medical & Health Policy, Vol. 12. No. 3. pp. 233–241. https://doi.org/10.1002/wmh3.359

Webster, F. (2014) Theories of the information society. Fourth edition. London & New York, Routledge.

Weigold, M. F. (2001). Communicating science. A review of the literature science communication. Science Communication, Vol. 23. No. 2. pp. 164–193. http://dx.doi.org/10.1177/1075547001023002005

Wynne, B. (1987) Risk management and hazardous wastes. Implementation and the dialectics of credibility. Berlin: Springer-Verlag.

Wynne, B. (1995) Public understanding of science. In: Jasanoff, S., Markle, G. E., Peterson, J. C., & Pinch, T. (eds) Handbook of science and technology studies. Sage Publications. pp. 361–388.

Wynne, B. (2006) Public engagement as a means of restoring public trust in science. Hitting the notes, but missing the music? Community Genetics, Vol. 9. No. 3. pp. 211–220.

Z. Karvalics L. (2009) Information society dimensions. Szeged.

Zemplén G. (2019) The contribution of laboratory studies, science studies and Science and Technology Studies (STS) to the understanding of scientific communication, In: Leßmöllmann, A., Dascal, M., & Gloning, T. (eds) Science communication. Walter de Gruyter. pp. 123–142. https://doi.org/10.1515/9783110255522

Ziman, J. M. (2000a) Postacademic science. Constructing knowledge with networks and norms. In: Segerstrale, U. (ed.) Beyond the science wars. The missing discourse about science and society. New York, State University of New York Press. pp. 135–154.

Ziman, J. M. (2000b). Real science. What it is and what it means. Cambridge, Cambridge University Press.

URL1 = Website of the 'Doctors for Discernment' group, https://orvosokatisztanlatasert.hu/ [Downloaded: 27 April 2022].

URL2 = Campaign material of the 'Normal Life Party', https://normaliselet.hu/download/covid_allaspont.pdf [Downloaded: 27 April 2022].

URL3 = Blog of the 'Responsible National Government of Hungarians' group leader, https://postaimre.euroweb4you.com/ [Downloaded: 27 April 2022].