Central European Digital Media Observatory

Social networks, information disorders and health

Espresso

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Introduction

Social networks are nowadays an indispensable part of the life of the last two generations. Social networks can be divided into several categories, the most used of which are profile-based social networks (e.g. Facebook or LinkedIn), content-based social networks (YouTube, Instagram or Snapchat) or micro-blogging social networks (e.g. Twitter). More recently, social networks providing communication services (WhatsApp or Facebook Messenger) have been almost universally used. Another less well-known and used category is virtual social networks, such as Second Life, World of Warcraft and World of Tanks. Social networks provide the possibility of communicating and sharing personal data, thoughts, experiences and thus allow personal communication with virtually anyone who is also a participant in the network. All this can be considered a positive part of social life. At the same time, however, it brings with it the unpleasant fact that what is published on the Internet cannot, for the most part, be taken back. Thus, published data can become a source of cyberbullying, sexting, cyberbullying, which is essentially psychological manipulation, cyberstalking and disinformation, whether spontaneous or targeted. All of this has a negative impact on the psyche of the social network participant. In addition to the psychological effect, disinformation targeted at the health sector often has an effect on a person's physical health and can even negate the effect of conventional treatment of patients.

Social networks

The term social network refers to a group of people who communicate with each other by various means, currently dominated by Internet services that allow registered users to create personal profiles and share information in any form. The predecessor of today's Internet was created in 1969 under the name ARPANet (Advanced Research Project Agency Network), based on a project funded by the US Advanced Research Project Agency (ARPA), later renamed the Defense Advanced Research Project Agency (DARPA). The global network that would be called the Internet was officially launched in 1982 based on standardized protocols [1, 2]. The Internet provides a number of ways to share information, perhaps the most widely used being websites generally referred to as www. The first website appeared on the Internet on 6 August 1991, presenting a description of the World Wide Web project itself [3]. The Czech Republic first connected to the Internet on 13 February 1992 from a computer at the Czech Technical University in Prague (CTUT) [4].

Social networks allow communication in milliseconds and thus information is transmitted in essentially real time. In addition, the emergence of smart mobile devices such as smart phones and watches has enabled, on the one hand, virtually unlimited contact with the network, and on the other hand, the generation of data on people's movements, environmental data and monitoring of the social environment through the use of and access to information and knowledge on websites. Online social networks such as Facebook allow users to be in constant contact and communication with known and unknown persons. This creates weak and strong ties between network users. According to the theory of "The Strength of Weak Ties", published in 1973 by Mark Granovetter (* October 20, 1943), the speed and rate of spread of information in a network is proportional to the number of connections between elements in the network. Since weak ties in networks are dominated by the interconnections between different groups of people, the rate of information dissemination increases proportionally with the number of weak ties [5]. If a group of individuals on a network is not connected to other groups, i.e., it does not have enough weak ties, it will be deprived of information shared by other groups. However, finding a causal proof of the correctness of this paradoxical theory has proven difficult. The strength of

weak ties is not linear and has an inverted-U shape; moreover, weak ties measured by interaction strength and the number of mutual connections showed different values. Furthermore, the strength of weak bonds varied according to the industries tested [6]. When the network of scientific collaboration was tested, interesting results were obtained, namely that the strength of direct ties measured by the asymptotic proportion of joint publications shows that scientific success is significantly correlated with the structure of the network of collaborating scientists. It has been shown that among two scientists with similar achievements, the one with weaker ties tends to have a higher h-index(i.e. how many articles by a given author have a citation rate higher than the serial number of the article according to the number of citations) , and that teams connected by such ties produce more cited publications [7].

Human society is organized hierarchically and forms social groups according to a given criterion. Ethnicity, religion, and perceived social class play a large role in structuring community social networks [8, 9]. The actions of an individual are then conditioned by the basic thesis that states that each individual tries to maintain the resources already existing and seeks to acquire new resources [10]. Following the theory of "The Strength of Weak Ties", better resources can be achieved through weak ties. However, these ties are only a means of reaching people who are higher in the social hierarchy than us and have no family or friendship ties with us [10]. An individual's use of social networks can then be characterized by Parsons' action theory (Talcott Parsons (1902-1979)), which incorporates a systems-theoretical approach that integrates metastructural analysis with voluntarism and sees motives for action such as goals, purposes, and ideals as part of a person's actions [11, 12].

All of the above sociological theories, supplemented by contemporary analyses, are valid in their entirety for the use of social networking sites and also suggest the nature of the emergence of information disorders.

Information disorders

Information disorders can be divided into three basic types. These include misinformation, which arises from the incorrect combination of several pieces of information to produce misleading content that the author believes to be factually correct and true. While misinformation refers to the accidental dissemination of inaccurate information, disinformation is not only inaccurate but is intended to mislead and is disseminated with the aim of causing serious harm. This distinguishes misinformation from disinformation. Disinformation then has a false context and fictitious, manipulated or fraudulent content. The third basic type of information failure is misinformation [13]. Malinformation is the truth used to harm a person, organization or country with the intent to harm (the term malinformation was coined by media researcher Hossein Derakhshan in a Council of Europe report entitled "Information Disorder"). Malinformation concerns, among other things, religion or sexual orientation and takes many forms, such as phishing, catfishing, doxing, swatting or revenge porn. It can also be information based on the truth but exaggerating certain information to the extent that it becomes misleading and damaging [14, 15]. Given the context of this article, which focuses on the impact of information disorders on human health, we will only discuss misinformation and misinformation in detail. Targeted misinformation can also harm the mental health of the person concerned and induce psychosomatic problems or damage his/her social reputation, but if one enters the search engine PubMed (National Institute of Health, Bethesda, USA) with the keyword "malinformation AND health" or just "malinformation", the search engine will not provide any information response.

Misinformation is part of propaganda and is generally understood as false information that is deliberately disseminated to deceive people [16, 17]. According to the United Nations, there is no universally accepted definition of disinformation, as each may be imprecise due to the wide range of contexts where disinformation can occur, such as current climate change, armed conflict, public health, or electoral processes. Misinformation can be disseminated by state and non-state actors and can affect a wide range of human rights, reactions to

policy decisions or decisions by politicians themselves, or amplify tensions in times of emergency or armed conflict [18]. It is reported that the word itself comes from the Russian word "дезинформация", which is derived from the French word "désinformation". It is very likely that the origin of the word disinformation is also disinformation. The word disinformation has historically been tied to political aspects of life, and so the claim that the term disinformation entered English via Russian is deceptively designed to make it sound like a word derived from a Western European language and to mask its Soviet origin. In fact, however, the word was already in the English language in the nineteenth century. This is documented, for example, by extracts from the American press in the 1880s, when the press accused its opponents of disinformation. Another example is from the British Parliament, where a British MP in 1901 accused local authorities of using disinformation to justify the incorrect implementation of a parliamentary law [19]. Thus, it can be assumed that the term disinformation came to be used to distinguish the self as the bearer of the only truth from the other or others who were promoters of deception.

Just as the means of communication changed over time, so did the content of disinformation. Nowadays, disinformation can be divided according to its intensity and the way it is expressed. Passive disinformation affects existing information by trying to delay, conceal or destroy it. Active disinformation is either entirely newly created or information that has been purposefully altered. Both of these categories can be further subdivided according to the purpose for which they were created (political, military, disinformation aimed at the health sector, etc.) or according to the time sequence into disinformation planned, prepared in advance, and disinformation subsequent in response to already published information. Finally, according to the objectives and means, disinformation can be divided into strategic, global disinformation aimed at maintaining or changing the consensus and tactical disinformation used as a tool to achieve a strategic objective. An example of targeted disinformation can be disinformation focused on the issue of climate change. It has been shown to be disseminated in an organized manner through well-funded networks, in the United States mostly from conservative think tanks publishing publications without peer review [20, 21]. The content is aimed at challenging scientific consensus, the quality of the peer-review process for publishing scientific papers, or undermining trust in responsible institutions [22]. Other dominant targets of disinformation are health issues or, for example, nutrition. Disinformation targeting health problems concerns both infectious diseases, most commonly caused by Zika, Ebola, human papillomavirus, measles or influenza viruses, and health problems related to cancer. Vaccines and antibiotics are very attractive targets for disinformation [23, 24].

The rapid spread of misinformation has been facilitated not only by social networks, but also by the advertising models of large online platforms that use personal data with malicious intent. The UN Special Rapporteur Irene Khan once stated that disinformation is a modern way of making money in the digital era by spreading lies on purpose [25]. Clickbait is also used for this purpose, whereby clicking on an eye-catching controversial headline will spark curiosity and drive traffic to a website [26]. The content presented usually has little to do with the headline. The success of clickbait relies on human curiosity and is classified as misinformation with an economic motivation.

Thus, it is wrong to conclude that misinformation is now a common part of information flows on social networks, not only on the dominant ones such as Facebook and Twitter, but also on sites designed specifically to spread misinformation. In the Czech Republic there were several dozens of such websites [27]. The issue of misinformation is now so broad and dangerous to human health that applications that analyze information on social networks and databases to identify misinformation and fake-news are beginning to be created with the help of machine learning and artificial intelligence [28, 29].

Misinformation, especially misinformation related to health and medical issues in general, dominates social media. This is reflected in the number of studies and publications focused on misinformation analysis. On the PubMed search engine, 2,872 publication references can be found for 1982, while in 1992 the number was already 5,801, and then, at ten-year intervals, 11,124, 28,107, and for 2022, 51,848 literature references. Thus, a number of summaries of misinformation and even summaries of summaries are published [30]. The breeding

ground of misinformation is then social media platforms, which can be a potential source for the promotion of anecdotal evidence, rumours, fake news and general misinformation. This is then promoted by so-called "digital influencers" who do this activity as a hobby or are paid for it by well-placed social interest groups.

In addition to rumours, false or altered information, misinformation is also a source of misinformation based on a serious interpretation of a certain phenomenon, which differs from one another over time [31]. A very instructive example of a source of misinformation and misinformation based on scientific papers is the question of the origin of the SARS-CoV-2 virus, which is responsible for the Covid-19 pandemic and, in fact, the infodemia resulting in syndemia, which is the confluence of several diagnoses. Some publications suggest that the virus may have been genetically engineered in the laboratory and inadvertently or deliberately leaked into the public domain, causing the pandemic. The authors of these studies point to the presence of a furin cleavage site in the 'spike' protein responsible for binding to the host cell, a site that they suggest is not present in other coronaviruses and may have been artificially inserted [32]. However, other studies have challenged this claim and suggested that the furin cleavage site may have arisen naturally as a result of recombination [33]. In addition, some researchers have pointed out the high genetic similarity between SARS-CoV-2 and other coronaviruses found in bats and pangolins, suggesting a natural origin of the virus [34]. The debate on the origin of SARS-CoV-2 is still ongoing [35-38]. A full understanding of the genetic makeup of SARS-CoV-2 virus, its possible origin and the possibility of its transfer from animal to human will require further detailed study. However, Cocid-19 disease itself has generated such a wave of information, misinformation and misconceptions that it has become the subject of entire books [13, 39].

The Covid-19 pandemic essentially repeated the situation created by the AIDS pandemic. Even in the case of HIV-1 and HIV-2, the origins of the viruses became the subject of manipulation of relevant information, but misinformation was dominant. Not only that, according to a 2005 study by the American research institution RAND, a quarter of African Americans believed, or perhaps still believe, that HIV, the causative agent of AIDS, originated in American state laboratories, and not only that 15% of all respondents said that it was a form of genocide against people with black skin [40], but also state-driven disinformation campaigns emerged. One of these originated in India on July 17, 1983, when the obscure newspaper Patriot printed a letter titled "AIDS may invade India: Mysterious Disease Caused by American Experiments." The manipulation was that the letter was supposedly written by a "well-known American scientist and anthropologist" in New York, and claimed that AIDS was the result of Pentagon experiments to develop new and dangerous biological weapons. For the sake of authenticity, the letter cited a range of publicly available, reputable information about the virus and the disease itself [41]. To make matters worse, Czechoslovakian intelligence launched a disinformation campaign in December 1985 by claiming that the HIV virus was about to begin spreading from U.S. military bases in Greece. It was argued that the United States had the means to cure AIDS and would sell these drugs expensively to countries affected by the AIDS pandemic [42]. The false news was spread by leaflets to get the information out to the media as well.

This misinformation was based on the fact that HIV-1 and HIV-2 viruses, like most RNA viruses, are highly variable due to recombinations during the transcription of its genetic information, the shortness of its replication cycles and thus the high production of "progeny" [43, 44]. In addition, it is affected by selective pressures due to the immune profile of the host population and the intervention of antiviral therapy [45, 46]. It is the issue of recombination that has been one of the points of contention allowing manipulation of the facts. Phylogenetic analyses of lentiviruses suggest that simian immunodeficiency viruses (SIVs) are reservoirs for human viruses and must have undergone a series of recombinations during transmission from monkeys to humans, including recombination with other retroviruses [47-49]. Although it is clear that AIDS is zoonotic in origin, it is less certain when HIV-1 and HIV-2 first entered the human population and whether interspecies transmission of the virus between primates is common; if so, this would not preclude further pandemics.

Thus, open scientific debate over facts coming from advanced genomics, proteomics, or molecular biology laboratories has become fertile ground for the emergence of information failures complicating efforts to contain

pandemics. The quote can be used that "Perhaps more threatening than pandemics is infodemia [50].

Information disorders and human health

With the current speed of information creation and dissemination, information is often outdated, corrected or replaced in people's memories. In memory, this outdated information is combined with new information and it does not matter whether the information is valid or whether it is misinformation or disinformation. It is then very difficult for humans to accept the original value of the information and to negate false facts [51]. If a person is exposed to new information that contradicts or refutes information fixed in memory, he or she very often clings to his or her original beliefs [52]. These general patterns in the reception, sorting and evaluation of information are then a source of difficulty in objectively assessing the situation, or in assessing the health problem and the possibilities of its elimination. Thus, many of the information disorders that proliferate social media may be even more popular than scientifically based truthful information. The content of these information disturbances usually influences personal opinions and provokes negative feelings. They are able to affect cognitive and emotional aspects and induce states of fear, panic, anxiety, and undermine confidence and hope, among others [53].

Closed communication within online communities can be used to disseminate and echo unreliable information regarding health problems or preventive or therapeutic procedures related to them [54]. A common type of misinformation targeting health issues is the issue of immunoprophylaxis, where misinformation regarding vaccines is couched in scientific language but without scientific evidence [55]. Similarly, misinformation related to drugs tends to promote drug use [56-58]. . Information disorders related to eating, or eating disorders, have used the symbol of beauty to promote change in the eating habits of social network users. Their content essentially promoted unhealthy practices while normalizing eating disorders [59]. And as mentioned in the previous paragraphs, misinformation on the spread of epidemics and pandemics was built on misunderstandings and doubts arising from a lack of scientific knowledge [60]. Misinformation concerning non-communicable diseases or chronic conditions usually concerns alternative methods of treatment. Non-communicable diseases or chronic conditions impose psychosocial stress on patients, which, encouraged by misinformation, can exacerbate the manifestations of the disease. Epidemiological evidence has shown that stress and emotional states can both trigger and exacerbate many skin diseases, including atopic dermatitis, psoriasis and acne [61, 62].

Infodemias, i.e., too much information, including false or misleading information, in digital and physical environments, have a strong psychosocial effect, causing confusion and risky health-damaging behaviors [63]. Infodemias in health care can impede effective countermeasures against the spread of infectious diseases, increase fear, induce panic, and promote the development of psychosomatic health disorders leading to interruption of access to health care. It can also be a means of stirring up dissent to reinforce political crises [30]. The spread and availability of social networks and information systems contribute to this. With respect to human health, then, misinformation in these systems uses certain narratives that are particularly dangerous. These include, for example, the misinformation use of studies that focus only on a group of people characterized by a certain trait, such as race, African Americans, Jews, or groups characterized by a certain level of education. Cases of iatrogenesis, or harm to the patient by any medical activity (e.g., misinterpreted findings of sophisticated imaging techniques leading to inadequate invasive procedures), have also been misused[64, 65]. All such information disorders again induce fear, anxiety and stress.

Stress can be defined as the totality of physical and psychological reactions to an unacceptable relationship between reality and one's own personal experiences. A mild sense of stress can be normal and healthful, helping to overcome a short-term challenge that one knows one can handle. Stress becomes a problem when it is constant or out of control. And such stress has many adverse effects on the human body, which are summarized in Figure 1. The perception of information disturbance inducing stress is a signal to the hypothalamus-pituitary-

adrenal (HPA) axis, which forms one of the major neuroendocrine systems. The basis of the stress response is the release of corticoliberin (corticotropin-releasing hormone, CRH) from the hypothalamus. The latter stimulates the synthesis and release of corticotropin from the pituitary gland, followed by the growth of the adrenal cortex and the production of glucocorticoids, especially cortisol, and from the adrenal medulla the production of adrenaline (epinephrine), a member of the catecholamine family (Figure 2). These two hormones functionally oppose each other and provide a regulated response to stress signals.

Stress induced by information disturbances, but also by information that sounds unfavourable to the person concerned) can induce a state of psychosomatic disturbance, which is a condition in which psychological stresses adversely affect physiological (somatic) functions until somatic, i.e. physically felt, problems arise. It is a condition induced by the autonomic nervous system, also known as the autonomic nervous system. It maintains the optimal internal conditions of the organism, called homeostasis, without the conscious participation of the individual. The autonomic nervous system optimises the activity of the heart, lungs, stomach, including its associated glands, and controls the activity of other glands, such as the sweat glands and salivary glands. It also plays an important role in sexual intercourse, controlling sexual arousal, which is the sum of the manifestations of readiness for sexual intercourse.

The human central nervous system tends to produce integrated rather than isolated responses to cope with stress [66]. These can be divided into acute stress responses, which in healthy individuals can be adaptive and usually do not represent a health burden. In contrast, if stressors are too strong and too persistent, chronic stressors can lead to systemic diseases in individuals who are biologically vulnerable (age, genetic predisposition) or poorly able to cope with different situations [67].

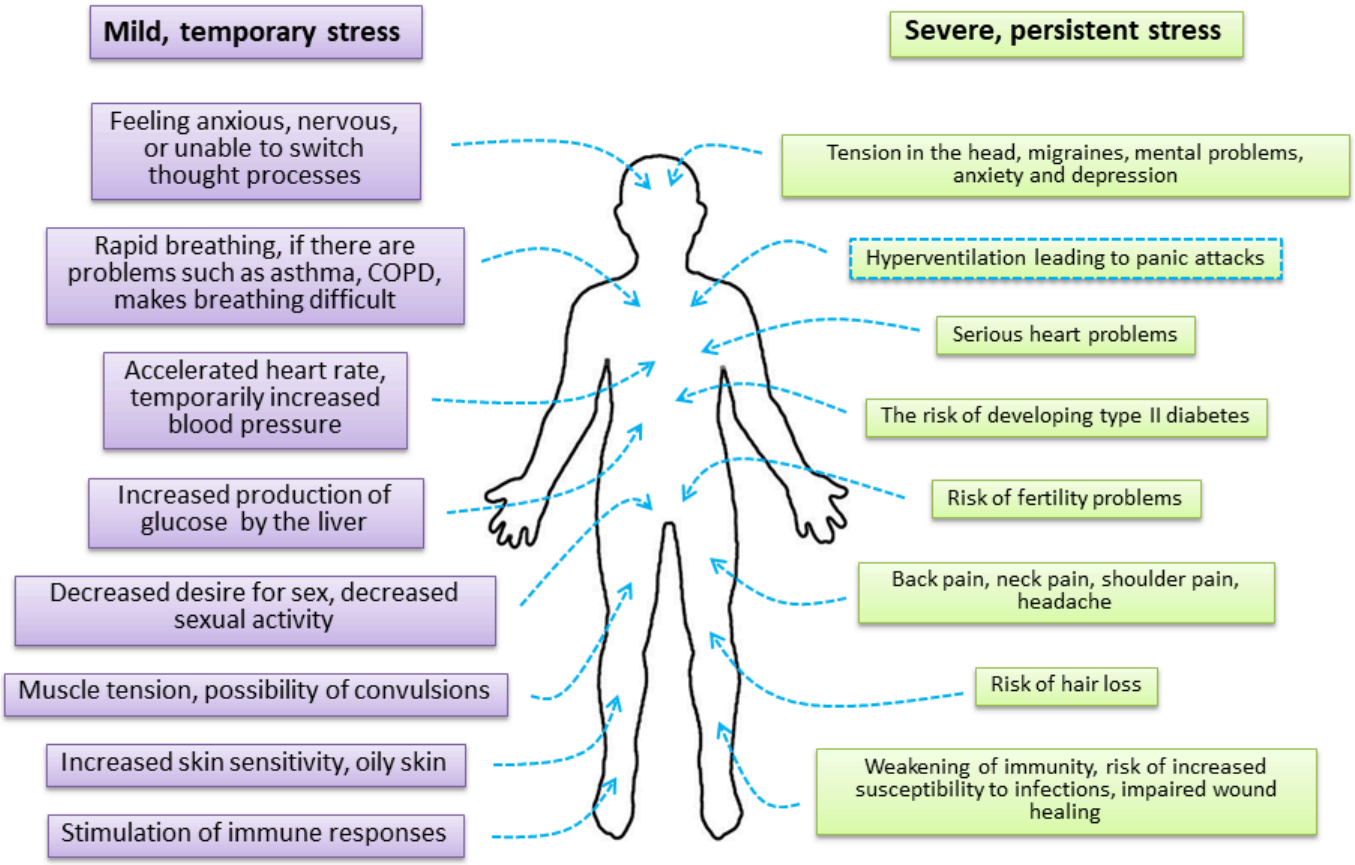

Figure 1: Possible health disorders and risks induced by stressors. Stressors can be both information disturbances and information unfavourable to the person.

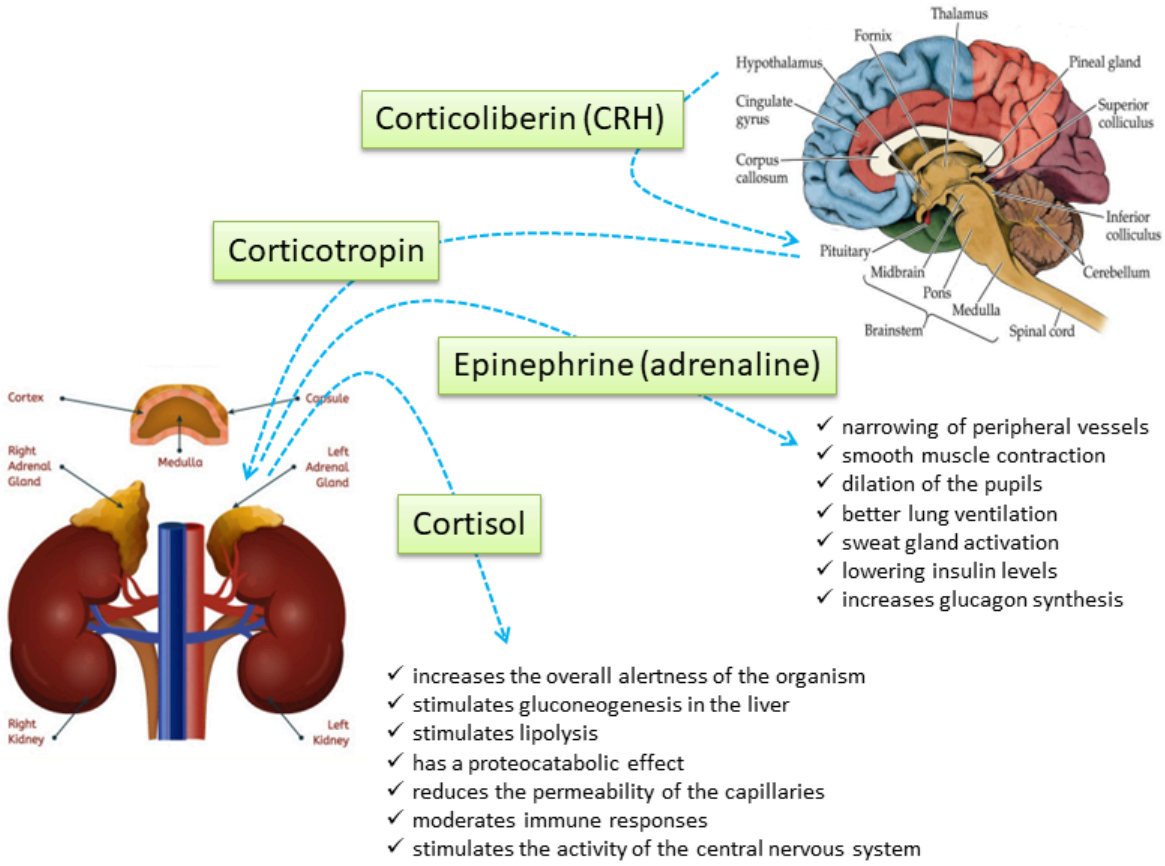

Figure 2. Simplified diagram of the hypothalamus-pituitary-adrenal axis and its physiological responses to stressors. Cortisol and epinephrine act in opposition to each other, and even during a stress response, when they determine the intensity of physiological reactions to stress.

Final word

This text does not pretend to be a complete review of the subject, its aim is to highlight the truly deleterious effects of information disorders on human health. Currently, people are under very strong psychological pressures from their jobs and from their health care, and this is compounded by misinformation targeting current issues, whether political, economic or health. But all of them affect a person's psyche. Defending against misinformation and disinformation is very difficult nowadays with the existence of social networks. It is therefore necessary to choose a basic and very effective defence consisting of education and training, from the youngest children to the elderly. However, it is necessary to create a true picture of the situation

for each story, on the basis of which it will be possible to counter misinformation. This is a very difficult problem because 'change is constant and everything is fluid, because truth is not always reality and reality is not always truth, and because truth is unpredictable and a lie can become truth'. We have therefore taken the liberty to conclude by quoting the abstract of a paper dealing with this problem and proposing one possible system of security methodology to address this oxymoron, i.e., a contradiction based on holism, omnidirectional (ambient) intelligence, triangulation and stigmergy [68].

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