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Protect our environment from information overload

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We are now exposed daily to more information than we can process and this has substantial costs. We argue that the information space should be recognized as part of our environment and call for research into the effects and management of information overload.

As humans, we actively seek information when navigating our complex world. Fears about excessive information have troubled humanity for centuries, but owing to increasing global digital connectivity the data that demand our attention have grown exponentially. For those with smartphones and an internet connection, information is now readily available on an unprecedented scale. This has created a daily 'information overload' (IOL): an abundance of data, beyond the human capacity to process them in a timely fashion. IOL limits our ability to evaluate information and make effective decisions. A 2011 commercial study estimated the annual IOL global costs at US $1 trillion[1]. IOL can decrease decision-making performance, increase tolerance of errors, reduce social activities, lower job and user satisfaction, and cause demotivation, negative emotions and compromised health[2]. In this way, IOL can be understood as a form of pollution that is akin to air pollution (Fig. 1). We simply cannot sleepwalk through the destruction of the information space as a natural environment.

A recent study summarizes IOL as a "negative psychological state in which individuals feel that they are receiving too much information, which hinders their ability to carry out their tasks"[3], although there is no universally accepted definition (owing to its overlap with cognitive overload). From a psychological perspective, IOL can correspond to cognitive load[4] but other components — such as fatigue, attention, time pressure and working-memory capacity — also need to be considered, as IOL is a multidimensional construct that entails cognitive, emotional, contextual and environmental aspects[3].

In the 20th century, the lack of easy access to scientific literature was a crucial factor that limited the development of research in many countries. The costs of journal printing and delivery were substantial and only the richest universities could subscribe to all of the journals that were needed for their researchers. Currently, with widespread open-access publishing and the proliferation of publishers, the problem is changing to one of filtering out irrelevant or low-quality work[5]. In a similar way, during the Industrial Revolution, the massive increase in iron and chemical production was considered necessary for progress, but we now understand that there are also major risks: smoke from factory chimneys can lead to the degradation of the natural environment and pose a substantial threat to mankind. The emergence of environmental protest movements has helped to change our attitudes towards exploiting nature and has forced legal and economic changes to protect our air, water, soil and food quality. For IOL, terms such as 'information pollution'[6] and 'data smog'[7] have been used since the 1990s to describe informational challenges to society, and it is essential that we now think about our information space as an additional component of our natural environment and start to develop methods to protect this space against overloading and polluting. However, first we need to understand how exactly the overload works in various settings.

Fig. 1 | Information space should be considered as an important part of our environment and be protected alongside air, water and soil. Smoking chimneys were tokens of prosperity during the Industrial Revolution, but in the second quarter of the 20th century their air pollution threat was fully acknowledged. We cannot sleepwalk through the destruction of the information space as a natural environment in the same manner.

So far, IOL has been studied from the perspective of specific problems. This has shown that there are at least three levels: (1) neural and cognitive mechanisms at the individual level, related to searching for information; (2) information and decisions at the group level, including interpersonal relationships; and (3) societal-level interactions among individuals, groups and information providers. However, these levels are not independent of each other. For example, during teamwork, information is processed at the individual level but is also exchanged among team members at the group level. We can therefore treat the flow of information as a multilevel network with nodes that represent individuals, groups, and societies and that connections reflect interactions between them, which yields a complex system with its own dynamics. Moreover, microscopic and macroscopic dynamics in a complex system are sometimes very different from one another. We can, then, hypothesize that while the transition from a manageable information flow to an IOL can be smooth in a closed system (a continuous phase transition), when coupling two or more layers together we might expect an abrupt change (a discontinuous phase transition) as it is in the case of interdependent superconducting networks[8]. In the above example, when a few team members start to suffer from IOL, it can lead to a sharp decrease in the information-processing capacity of the group and in overall performance. For the effects and causes of IOL to be better understood, it is therefore necessary to develop measures of multilevel IOL in different systems, followed by methods to model it and countermeasures to prevent it.

The question arises of what we can do about IOL. At the individual level, we can cut the abundant use of smartphones through protective applications that measure the time we spend online, to take control of our

information environments. In case of organizations, we can be trained to properly exploit the full functionality of our everyday communication tools[9]. Nevertheless, some solutions can be double-edged swords: generative AI models might help to reduce IOL by enabling content summarization and information search and retrieval. On the other hand, they can also contribute to a massive increase in publications as well as create fake news and hallucinations, and reinforce biases[10].

We advocate for organized action that is performed simultaneously in three different areas: science, education and legislation. The first requires funded calls for collaborative projects on information ecology and multilevel IOL that involve interdisciplinary research. The second, as in the case of waste recycling, is to teach information ecology at the school level. Finally, following the life-saving example of the Clean Air Act in the UK in 1956, we should now initiate a discourse on the global implementation of equivalent 'Clean Information Acts'.

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Competing interests

The authors declare no competing interests.