JIS

The dark side of information: overload, anxiety and other paradoxes and pathologies

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Abstract.

This review article identifies and discusses some of main issues and potential problems – paradoxes and pathologies – around the communication of recorded information, and points to some possible solutions. The article considers the changing contexts of information communication, with some caveats about the identification of 'pathologies of information', and analyses the changes over time in the way in which issues of the quantity and quality of information available have been regarded. Two main classes of problems and issues are discussed. The first comprises issues relating to the quantity and diversity of information available: information overload, information anxiety, etc. The second comprises issues relating to the changing information environment with the advent of Web 2.0: loss of identity and authority, emphasis on micro-chunking and shallow novelty, and the impermanence of information. A final section proposes some means of solution of problems and of improvements to the situation.

Keywords: information overload; information anxiety; digital literacy; paradox of choice; satisficing; web 2.0

1. Introduction

The purpose of this review article is to identify some of main issues and potential problems—paradoxes and pathologies—around the communication of recorded information, and to point to some possible solutions.

The article is divided into five main sections. The first two deal with the changing contexts of information communication, with some caveats about the identification of 'pathologies of information', and with the changes over time in the way in which issues of the quantity and quality of information available have been regarded. The next two deal with two main classes of problems and issues: those to do with information overload, and those to do with the changing information environment with the advent of Web 2.0. The final section proposes some means of solving some of these problems and of improving the situation.

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2. Information contexts

The context in which these issues arise is the 'digital transition'; the move towards a situation in which most significant professional and scholarly information—and a good deal of information which is neither professional nor scholarly—is available in digital rather than printed form. Beginning in the 1970s, this trend has been exacerbated by the rise of the Internet, and more specifically the World Wide Web, in the 1990s, and latterly by the advent of the social networking tools of Web 2.0. These technical advances have led to a much more rich and complex information environment, with a greater amount of information available, in a greater variety of formats and types of information resource, and accessible through a greater variety of media and communication channels. This diversity of provision, however, is typically delivered through a limited number of interfaces: most usually a web browser, whether on a computer screen, a mobile device, an e-book reader or some other device. The result is a 'homogenisation' of the information, with the look and feel of different resources of the print age—a text book, a newspaper, a hand-written diary entry, a photocopy of a journal article, a printout of a data file, etc.—being largely lost. It is this 'homogenised diversity' of information communication which lies at the root of the problems discussed here, as much as the expanded volumes of information which are available.

It has to be stated at once that some of the problems and issues are identified and scoped more by anecdote and opinion than by research and systematic study. This is all the more true as the communication and sharing of information, and specifically of web-based information, becomes more central to everyday life, rather then being restricted to the scholarly and professional domains. While the academic study of human information behaviour has advanced, and extended its scope considerably, in recent years, it has not yet encompassed all of the pathologies dealt with here.

It must also be acknowledged that there is a danger of some issues being, at least in part, the creation of over-zealous information specialists, seeking problems to which they can provide the solutions. An example of this may be often-touted problem of the *digital divide*, by which it is asserted that a proportion of people are deprived of adequate access to digital information resources, by reason of age, income, location, education, etc. While this may indeed be so in some cases, it has been shown that this is, at least to an extent, the latest incarnation of the concept of the 'information poor'. This group has been identified in the library/information literature over many years, more often simply by assertion than from any evidence, and always in the context of their needing the services of library/information professions [1]. Much as the pharmaceutical industry is sometimes accused of inventing health problems for which their products can be used, or exaggerating the significance of 'real' problems, so it may be that the information professions may exaggerate the pathologies of information.

Similarly, there is some danger that information specialists may promote solutions to problems which are largely recognised only by themselves. Since the late 1990s, the information professions have recommended the development of information literacy as an important topic, and, by implication, have denoted a *lack of information literacy*, as a significant problem; see, for example, Bawden [2], Virkus [3], Andretta [4], Martin and Madigan [5] and Secker, Boden and Price [6]. As will be seen below, information literacy, or digital literacy, may be an important general consideration. But it is true to say that the topic has always seemed to be of more importance to information specialists, and most particularly to academic librarians, than to anyone else. While this may be partly a matter of terminology—'information mastery', 'information fluency', 'information competence' and even 'smart working' having been preferred in various environments—there remains a feeling that the information literacy training programmes introduced by information specialists are, from the viewpoint to those for whom they are designed, a solution in search of a problem. It is important to be as sure as possible—and such confidence can come only from systematic research—that identifiable problems are 'real', and not manifestations of professional over-enthusiasm, still less a 'librarian knows best' mentality.

Finally, we must acknowledge that there is an element of fashion in the choice of the information pathology *du jour*. Information overload, for example, with the TMI (too much information) phenomenon, was at centre stage around the turn of the millennium, but has retreated in public consciousness since.

With these caveats, we may go on the acknowledge that information problems and pathologies are real and that, furthermore, they are not—contrary to general opinion—recent phenomena, due solely to the influence of the web. Rather, they are perennial problems, identifiable back through many years, though given fresh "bite" by recent developments in technology. They are associated with the two fundamental criteria of information management: the quantity and quality of information provided.

3. Quantity and quality criteria

The issue of quantity of information supplied has undergone a sea-change, relatively recently in terms of the history of the communication of recorded information. For most of this history, the issues, or problem, has been the ability to find, or to provide, a sufficient quantity of useful information. This as been so from the earliest "information products" in the civilisations of Egypt and Sumeria, where a combination of written scripts with papyrus scrolls and clay tablets respectively, enabled recorded information to be communicated across space and time. It was so through the era of the hand-written manuscript, and equally so for most of the era of the printed book and journal. Although some quotations from these times may be used to indicate an early outbreak of information overload, these are usually in the context of a regretted inability to read all that had been written. It is only in the nineteenth century, with the great expansion of professional and academic, as well as general, publication, that the modern form of overload begins to appear, with regrets that one can no longer keep up with the literature of one's own subject. Even so, the problems of information services were still largely concerned with finding enough appropriate material. It is only around the 1990s, with the expansion of digital information, most particularly in the form of the internet, that the situation changes, and the major task for information service providers becomes one of filtering and selecting, given that information, usually in large quantity, can easily be found on almost any topic.

The issue of quality of information is another very long-established issue, given added significance by recent technological developments. The establishment of printing in Europe was accompanied by criticisms of the quality of the material being produced, which evokes a striking resonance with recent views of the quality of web resources [7,8]. Questions of authority—who has produced this, and how do we know they are who they say they are—exercised the readers of early printed resources, as much as readers of blogs and web pages five centuries later. Even when the originator is known without doubt, queries of the veracity and reliability of what is presented run unbroken from the propaganda pamphlets of seventeenth century wars and religious strife to the web-cams of the politicians of the twenty-first century.

It would, of course, be facile—and wrong—to suggest that the issues and problem are "the same" over time. They are not. The context changes greatly, as does the "mind set" of those involved. Of particular relevance to the situation in the first decade of the new millennium is the rise of the "Google generation": used to immediate and easy access to information, and with consequent expectations that may be difficult for 'traditional' information services to meet [9–11].

With these thoughts on the historical context of issues of quantity and quality in information provision in mind, we turn to some specific information problems.

4. "Too much information", and the paradox of choice

The idea that there is too much information to hand, exacerbated by the multiple formats and channels available for its communication, has led to the concept of information overload, perhaps the most familiar of the "information pathologies". Other consequences incluse conditions termed infobesity, information avoidance, information anxiety and library anxiety. They may be understood in terms of a general "paradox of choice".

There is no single generally accepted definition of *information overload*. The term is usually taken to represent a state of affairs where an individual's efficiency in using information in their

work is hampered by the amount of relevant, and potentially useful, information available to them. The information must be of some potential value, or it could simply be ignored, and it must be accessible, or the overload will only be potential, not actual. The feeling of overload is usually associated with a loss of control over the situation, and sometimes with feelings of being overwhelmed. In the extreme, it can lead to damage to health. Various psychological conditions have been described associated with this, such as *continuous partial attention* [12], a focus on being "in touch" and "connected" which results in stress, and *attention deficit trait* [13], a distractability and impatience due to too much mental stimulus. Kirsch [14] identifies a condition of *cognitive overload*, when information overload is added to multitasking and interruptions, while West [15] identifies overload as a contributor to *technostress* in library settings.

This can be all summed up by the idea that information overload occurs when information received becomes a hindrance rather than a help, even though the information is potentially useful. For reviews of the topic, see Eppler and Mengis [16], Bawden [17] and Bawden, Holtham and Courtney [18]. For the related topic of *reference overload*, caused when a library inadvertently offers too many relevant resources to users, see Reichardt [19].

The concept of information overload is by no means new. Wurman [20] identifies the first commentator to recognise the concept in its modern sense as George Simmel, a turn-of-the-century sociologist, but its roots can be traced much further back. The writer of Ecclesiastes, who remarked that 'of making many books there is no end; and much study is a weariness of the flesh' (ch 12, v 6), was the first of a long line of commentators who saw the proliferation of information as a detriment to effectiveness and efficiency.

Innovations in information technology, such as the printed book, the periodical magazine or journal, the abstracting journal and the computer, have all led to complaints that it is impossible to keep up with the amount of information available. Such complaints have increased steadily over time. In 1852, for example, the annual report of the Secretary of the Smithsonian Institution in Washington drew attention to the fact that 'about twenty thousand volumes.. purporting to be additions to the sum of human knowledge, are published annually; and unless this mass be properly arranged, and the means furnished by which its contents may be ascertained, literature and science will be overwhelmed by their own unwieldy bulk'.

Overload was acknowledged explicitly as a problem at the Royal Society's influential Scientific Information Conference held in 1948 [17]. As Maurice Line commented:

> "Not for the first time in history, but more acutely than ever before, there was a fear that scientists would be overwhelmed, that they would be no longer able to control the vast amounts of potentially relevant material that were pouring forth from the world's presses, that science itself was under threat." [17]

and, as a participant said at the time:

> "Torrents and rivers of current literature pour themselves into libraries, adding, without cease, to what is already there … The scientist's time and power of attention are precious things which need to be husbanded; to do this we need techniques of controlled selectiveness in supplying his needs." [17]

By the late 1950s and early 1960s, with an exponential expansion of publication, particularly in science and technology, and the increasing take-up of mechanised documentation and computerised information handling, information overload was generally accepted as a problem. The situation worsened, for those dealing primarily with academic and professional publications as information sources, due to the increase in volume of the primary literature throughout the 1970s and 1980s. A commentator on medical information in 1986, concluded that:

> "Many [medical practitioners] have abandoned "keeping up with the literature". They are paralysed by the sheer enormity of the task: more than 20,000 journals in biomedicine are published each year and a consultant in a single medical sub-speciality may need to read fifteen to twenty publications a month to keep up to date". [17]

Eugene Garfield [21], two years before, had described it as an "already well-defined disease".

By the 1990s, information overload began to be referred to as a major problem, in the business world as much as in academia and the professions, and even more so with the influence of new technologies,

particularly electronic mail and the internet. This was crystallised by a series of reports of large-scale surveys, notably that of Reuters, and influential books such as that of Shenk [22], which indicated that information overload was a major problem for individuals and for organisations, and that the techniques and "coping strategies" used in the past were no longer effective. The problem was affecting the effectiveness, and even the health, of professional workers, particularly managers in businesses, and was severely affecting the efficient working, and productivity, of organisations. The Reuters survey of business managers, "Dying for information" revealed a number of startling statistics [17]:

- two thirds of managers believed information overload had caused loss of job satisfaction
- two thirds believed it had damaged their personal relationships
- one third believed it had damaged their health
- nearly half believed important decisions were delayed and adversely affected as a result of having too much information

While it is true to say that overload has been recognised most clearly in the business and commercial sectors, and in specialist areas such as science and healthcare, it has been a matter of concern to information specialists in all environments, including academic and public libraries.

It may be argued that information overload is the natural and inevitable condition of the human species. There has been a consistent viewpoint suggesting that the issue is exaggerated, or even imagined: see, for example, Savolainen [23]. Our senses, particularly the visual sense, are able to handle a huge amount of input, and to identify significant patterns within it. The modern information environment, however, presents us with information in forms with which our senses, and prior experiences, are ill-equipped to deal. The causes of overload, in this sense, are multiple and complex; hence the difficulty in providing any single "quick fix" solution.

It is tempting, and usual, to assume that a major contributing factor, if not the only significant factor, in information overload is the TMI effect: "too much information". This is readily supported by statistics of the sort often quoted [17]:

- a weekly edition of the New York Times contains more information than the average person was likely to come across in a lifetime in seventeenth-century England
- the English language of the late 20th century contains about 50,000 words, five times more than in Shakespeare's lifetime
- the collections of the large US research libraries doubled between 1876 and 1990
- over one thousand books were published each day across the world during 1990
- more information has been created in the past 30 years than in the previous 5,000 years
- the number of records in publicly available online databases increased from 52 million in 1975 to 6.3 thousand million in 1994
- the number of documents on the Internet doubled from 400 million to 800 million from 1998 to 2000
- it would take over 200,000 years to 'read all the Internet', allowing 30 minutes per document.

Increasing diversity of information can also lead to overload, partly by virtue of a consequent increase in the volume of information on a given topic, which may come from varying perspectives, but also because of an intellectual difficulty in fitting it within a cognitive framework appropriate for the use and the user. Diversity may occur both in the nature of the information itself, and in the format in which it appears, with a typical business user having to deal with paper, e-mail, voicemail, traditional websites, and so on, to which the newer blogs, wikis and the like must be added.

New information and communication technologies, aimed at providing rapid and convenient access to information, are themselves responsible for a high proportion of the overload effect: see, for example, Allen and Shoard [24]. Certain kinds of technology are generally highlighted in this respect, particularly "push" systems, which actively deliver information to the user without any request for it. While the

volume of information available for search and retrieve at the user's discretion—"pull"—may be so large as to be daunting, there is not the same sense of information constantly arriving without being under the user's control as with the active delivery systems. E-mail is usually regarded as the worst offender, particularly with overuse of "blanket" e-mail or needless "cc-ing" of messages.

Although information overload is the most widely recognised problem of its kind, it is worth noting some other "pathologies of information": seemingly strange behaviours exhibited when people try to cope with changing information environments, particularly when a large amount of diverse information is available.

Information anxiety, a term coined by Saul Wurman [20]—see also Kennedy [25]—is usually taken to be a condition of stress caused by the inability to access, understand, or make use of, necessary information. The cause of this may be either information overload or insufficient information; it may equally be due to poorly organised or presented information, or a variety of other causes, including a lack of understanding of the information environment in which one is working. The rather similar condition of *library anxiety* was recognised and named as far back as 1986, and has been analysed further since [26–30]. This is a type of anxiety which leads to a sense of powerlessness when beginning an information search in a library, and in feelings of being lost, unable to find one's way around, and afraid to approach the library staff.

Infobesity is a term increasingly used to denote a situation of personal information overload, particularly if caused by a diet of information, akin to feasting on fast food [31, 32]. It is often dealt with by the simple, if brutal, tactic of *information avoidance*: ignoring relevant information and useful information sources because there is too much to deal with [33, 34]. Savolainen [23] identifies the similar phenomenon of *information withdrawal*, keeping the number of sources considered to a minimum, as well as more nuanced filtering strategies, with a rapid weeding of material of limited use.

Satisficing is a popular heuristic way of coping, taking just enough information to meet a need, rather than being overwhelmed by all the information available: just enough information is good enough. This form of behaviour, also known as "bounded rationality", was identified by the economist Herbert Simon [35]; for a more recent overview, see Gigerenzer and Selten [36]. It is a way of making decisions and choices when the full spectrum of options may not be known, and when it is not feasible to compare fully the benefits of each. In information seeking terms, it implies choices of information sources, and selection of information from within them, so that the information found is good enough, even if not the best available. The theory was popularised fifty years after its appearance by the psychologist Barry Schwartz [37], who argued that the wide choices available in modern life caused anxiety, and that satisficing was a valid approach, and tended to increase happiness. (For a popular account of similar issues, including the inhibitory effect on the purchase of jam if supermarkets offer too many kinds, see Gigerenzer [38].)

The information environment of the early twenty-first century certainly seems to offer a large enough variety of choices to make satisficing a sensible option, and indeed the use of satisficing tactics, and the judgement of what is "enough information", in information seeking has been investigated by a number of researchers: see, for example, Agusto [39], Zach [40], Prabha, Connaway, Olszewski and Jenkins [41], Parker and Berryman [42], Mansourian and Ford [43], Mansourian [44] and Berryman [45]. It is clear that this is a common, if not ubiquitous, way of dealing with a complex information environment. However, it is important to note that satisficing must be carried out rationally; there must be some clear rationale as to why decisions are being taken. If this is not the case—and one must suspect that often it is not—then this behaviour reduces to information avoidance, or a random and contingent selection of sources and material. We may distinguish these two cases as appropriate (good) satisficing and inappropriate (bad) satisficing respectively.

5. Web 2.0 and the end of civilisation

Following the issues of quantity and diversity of information, leading to overload and related issues, the second apparent cause of current information pathologies is the changing information environment commonly denoted as Web 2.0.

There is no clearly accepted definition or explanation of exactly what Web 2.0 is. It is generally taken to encompass a variety of sites and tools for shared information creation and updating, and social networking and communication. Generally subsumed within this are blogs, wikis, RSS feeds, podcasts, sites for sharing photographs and videos, sites for social interaction and social bookmarking, and virtual worlds. Though the initial usage of such tools and resources was largely for social, recreation and popular culture purposes, a professional and "serious" dimension has emerged: see Bradley [46], for an account of Web 2.0 applications in libraries and information services.

The variety and diversity of novel forms of information and communication resources within Web 2.0, and their sheer number, clearly contribute to the overload and other issues noted above. However, the nature of these resources contributes some additional issues. These are not entirely new; rather they are extensions of issues already seen with the older web.

The whole *raison d'etre* of tools such as wikis—of which the best known open access example is Wikipedia—is that they may be rapidly and readily extended and amended by any user. Similarly, the whole point of weblogs is to enable any writer to express themselves fully and rapidly. This clearly leads to issues of quality control, arguably more serious than those found previously: Cronin, for example, has written in strong terms of the unacceptable content of much of the "blogosphere" [47].

A specific concern is the *loss of identity* inherent in tools which allow anonymity and pseudonimity in their contributors. There are numerous anecdotal accounts of contributors to wikis making false claim to qualification and authority, and of authors of blogs adopting false personas. This makes it particularly difficult to assess the validity of the information presented, and has led some commentators to claim that this aspect of Web 2.0 so attacks the basis of the authority of any recorded information as to amount to the end of Western culture and civilisation. The proliferation of social bookmarking and tagging may also be interpreted as a loss of identity and authority, as subjectivity replaces an objective (albeit imperfect) knowledge organisation through established public taxonomies, thesauri and similar tools. For detailed discussion of these issues, see Keen [48] and Anderson [49]. For a more positive view of Web 2.0 tools for information management purposes—essentially that users can perfectly well find what they need, can judge quality for themselves, and place an absolutely premium on ease and enjoyment—see Tebbutt [50]; similar points have been made about web search engines [51].

The mutable nature of Web 2.0 information, even more than that of the older web, leads to issues of *impermanence of information*. If an encyclopaedia or a textbook in wiki form can be altered from day to day, or even hour to hour, by any of its users, what meaning can be given to its "original" or "final" form, and at what point could, or should, such a resource be archived?

The nature of web 2.0 tools also promotes an information landscape based on *shallow novelty*. Because the tools allow, and encourage, rapid updating and posting of new material, there emerges an expectation of constant novelty. Because genuinely significant new material is as hard as ever to discover or produce, this expectation can be satisfied only by the re-using of existing material, by linking or re-packaging, or by the generation of shallow and ephemeral material. Furthermore, the nature of the tools themselves—consider RSS feeds and podcasts as examples—are well suited to "soundbites" and "microchunks" of decontextualised information. Naturally, these are easier and quicker to produce, and to assimilate, than more thoughtful and deeply researched material; see Brabazon [52] for a trenchant critique.

6. Cures and solutions

The response of information specialists to the kind of problems and issues noted above is to seek to solve, or at least to minimise, them. Commendable though this attitude may be, some caveats should be borne in mind.

It may be that some of these problems are more of concern to information professionals than to those whom they are supposed to afflict, or may simply be ephemeral, "fashionable", concerns, which will disappear of their own accord with time. This possibility was noted above for both information illiteracy and information overload. Identifying the really significant problems is an essential first step.

Those problems which are real may not be fundamentally information problems. What is perceived as information overload may, more fundamentally, be work overload. "Too much information" may actually reflect "too much to do": too much activity, or too many diverse duties. Societal trends such as work-life balance, or the "slow movement" [53], may be a more fundamental solution than information solutions *per se*: Levy discusses how the "slow time" needed for scholarship reflects on libraries and information supply [54]. That is not to say that a consideration of how information is communicated and sought may not contribute to improvements in this broader picture.

Similarly, a quest to improve information literacy may simply be covering up a more fundamental need for improved literacy itself, as a part of a better general education. Again, the way in which information is communicated, and knowledge resources accessed, may be an important part of this, but cannot be the whole.

Turning to those solutions, or parts of solutions, which are the province of information science and information management, it seems clear that what has been presented so far are a series of pragmatic proposals, based on greater or lesser extent of fundamental understanding.

Solutions to information overload, for example, generally revolve around the principle of *taking control* of one's information environment [17, 18]. This not only avoids the effect that one is controlled by the information, but avoids the feelings of powerlessness which we noted above as being aspects of the "anxiety" pathologies. The methods by which this is done are often rather "traditional", and not necessarily strongly associated with information management *per se*: they include time management, desk management, critical thinking, information presentation, better information organisation (including good use of metadata), and cultivation of a rational personal information management style. Appropriate use of information technology, by use of techniques of filtering and personalisation, and the avoidance of over-much "push" technology, is also often presented as a solution. To an extent, the Web 2.0 tools mentioned above should assist in this.

This approach must, to be effective, be rational and personalised. Rationality will avoid some of the pointless "knee jerk" solutions proposed, such as "e-mail free Fridays". Personalisation will respect the fact that information use is individual and contextual: in terms of information and knowledge, one person's overload is another's lifeblood.

In one way or another, most people, most of the time, will of necessity practice a satisficing approach to information acquisition and use: there is simply too much choice of potentially relevant diverse information readily available for a "perfectionist" approach to be feasible, except in the most unusual circumstances. The important point is that this satisficing must be practised rationally, rather than arbitrarily or thoughtlessly, as anecdotal evidence suggests is all too often the case.

Putting these solutions into practice requires an awareness on the part of the individual information user of their circumstances, needs and preferred way of working with information. These amount to three of the characteristics of an "information literate person", as proposed by Christine Bruce [55]: has a sound knowledge of the world of information; approaches information critically; and has a personal information style that facilitates his or her interaction with the world of information. This shows the close link between a need for information literacy, in Bruce's sense, and the overcoming of the problems identified here. In particular, critical thinking has been noted as a kind of antidote to library anxiety [28–30].

As noted above, however, the usual view of information literacy is highly "library-centric". Furthermore, the most commonly used and cited models of information literacy [27ndash6, 56], involve some variation on linear stages of "recognising a need for information—choosing the best sources—accessing information—evaluating information—organising and storing information—communicating and using information". While this view is useful for organising training [6, 57, 58], it does not respect the true complexity of information behaviour, even of the core stages of information seeking and retrieval: see, for example, Foster [59] and Ingwersen and Jarvelin [60]). Still less does it account for the exotic behaviours found by researchers: from bouncers and checkers [61] to fast surfers and deep divers [62].

This linear model is even less suitable for capturing the behaviours appropriate to the interactive tools of Web 2.0. Broader and more general models, such as Bruce's "seven faces" [55], and Gilster's conception of "digital literacy" [63–65], are likely to prove more helpful in understanding, and

promoting, the competences and attitudes needed to avoid current and future information pathologies. These include not only skills-based literacies, such as computer and media literacy, but also the wider understanding of the information environment.

In turn, this points to the need for deeper understanding of the nature of human information behaviour. It is the interaction of this poorly understood behaviour with rapidly developing information and communication technologies which is the ultimate cause of all the issues and problems noted here. A better understanding of this behaviour is a *sine qua non* for dealing with them.

A very wide variety of theories and models has been proposed to describe various aspects of human information behaviour [66], indicating that, despite the widespread adoption of certain of them—in particular the family of models originated by Wilson [67, 68]—there is no generally accepted detailed theoretical framework for explaining and predicting the variety of such behaviour. Indeed, the only genuinely fundamental models which we have are so general as to be of limited value in explaining specific aspects of behaviour—most notably Zipf's principle of least effort [69, 70]. Improved theoretical understanding is an essential task for academic information science, to complement the pragmatic recommendations of information managers.

Finally, it is worth noting that, as has been mentioned at several points above, many of the issues and concerns mentioned here have a long history—albeit in different contexts—and reappear, sometimes with added force, as technology and the social environment change. Learning from the past may be essential, if we are not to continue perpetuating and suffering the pathologies of information noted here. The new discipline of information history [71, 72], focusing on the development of the communication of recorded information in its historical context, will be a valuable resource.

7. Conclusions

No set of solutions to the problems identified in this article can be regarded as finally satisfactory, if only because new "pathologies of information" will emerge as the information environment changes, primarily under the influence of new technologies. New solutions will always be needed, although it will be vital to be selective in determining which new patterns and modes of information communication and use are truly problems in need of solutions.

The solutions which emerge are not likely to be purely "informational", still less associated solely with formal information services and information management. Rather, information aspects will comprise part of solutions involving much wider issues of education, the nature of work, and individual responses to an increasingly complex, and largely digital, information environment.

Information managers will, no doubt, continue to devise and promote pragmatic solutions to these continuing and emerging issues. But satisfactory progress will depend on a better understanding of the fundamentals of human information behaviour, and the ways in which it changes over time; this is, perhaps, the most basic challenge for information science over the next decades.

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