European Review, Vol. 20, No. 2, 182–194 © 2012 Academia Europæa
doi:10.1017/S1062798711000433

# Rich Media and Rich Science; Web Squared Cumulativity Conceptualization

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Scientists work by collecting observable evidence of different phenomena, from which they analyse and construct theoretical explanations. Consequently, science involves systematic efforts to increase human knowledge, a phenomenon that is usually described as 'cumulativity'. Most scientists would probably agree that (excellent) research should be cumulative, and by this they usually mean that scientists should accommodate and refer to the publications of other scholars. This article suggests that our perception of science would benefit from a broader and more nuanced approach to cumulativity. The article therefore provides a discussion on how contemporary scholars can approach cumulativity by adopting the fundamental ideology of the web 2.0 and web squared concepts. A proposition for an altered approach is posited through web squared cumulativity conceptualization, involving a more open and collaborative approach. The discussion provides a foretaste of contemporary initiatives that suggest the spread of this emerging trend.

## Cumulativity: Then, Now and in the Future

> … Henry Oldenburg, the editor of the newly invented *Transactions of the Royal Society* in seventeenth-century England, induced the emerging new breed of scientist to abandon a frequent long-standing practice of sustained secrecy and to adhere instead to 'the new form of free communication through a motivating exchange: open disclosure in exchange for institutionally guaranteed honorific property rights in the new knowledge given to others'. (Ref. 1, p. 622)

These words of Robert Merton describe a shift among scientists from secrecy to an open and collaborative exchange of scientific knowledge. It was a development that left the concept of the Royal Society as an invisible college behind, and instead embraced a scientific approach that facilitated cumulativity. What then is cumulativity about? The traditional concept of cumulativity refers to the understanding, often taken as read, that science should provide a systematic progression of theories and empirical results to increase human knowledge. Scientists work by collecting observable evidence of different phenomena from which they analyse and construct theoretical explanations.

https://doi.org/10.1017/S1062798711000433 Published online by Cambridge University Press

Their work is published, so that other researchers can learn from, and build on, that knowledge in their future research. It is notwithstanding a prevalent element of contemporary scientific values, as witnessed by the following:

> In science, no one can claim to be a self-made man! One's thoughts and ideas are shaped by the literature one is exposed to, the talks one hears at conferences one attends and the discussions one holds with other scientists in formal and often informal settings. (Ref. 2, p. 7)

The cumulativity concept, with its interpretation of science as accumulated truths about reality, was in the early days put forward by science theorists in the positivistic tradition. Cumulativity is central to scientific realism and convergentist explanations, working on the idea that science converges towards truth by incorporating earlier reports on the truth. In other words, science is processed as it converges toward the 'truth' by making use of the established scientific knowledge base.[3] The notion of cumulative progression has indeed met influential criticism, for instance Kuhn's classical work on the structure of scientific revolutions.[4] Also, in contrast to treating truth from the stance of realism or positivism, the constructivist rather views science as accumulated constructions of reality, putting an emphasis on the relative subjectivism of these constructions. This partly derives from the insight that it is difficult to demonstrate convincingly that science is accurate. In line with the theory of falsifiability, Karl Popper argued that a theory or result must be possible to falsify (in theory and practice), to demonstrate whether it is false or not. This does not mean that one confirms a theory or result, but rather that as long as no one can falsify it, it may be correct.[5]

One can argue that one difficulty with the cumulativity concept is that researchers may build their work on science that is a bad representation of reality. Some scientists have argued that bad science creates false knowledge, which other scientists may build their work on, creating a deception in research. There is therefore a call for more transparency about science.[6] Meanwhile, through the *negatively cumulative argument*, it is acknowledged that science advances by learning from what went wrong, by proposing new theories and research questions. If we apply this argument, cumulativity becomes disentangled from the often criticized notion of truth.[7] Cumulativity, then, involves learning from previous research, independently of how the truth is represented by scientific constructions.

How then can we make sure of achieving great scientific cumulativity? Much of our traditional understanding of cumulativity is based on the output of other scholars, that is, cumulativity has been understood as building on previous research results in the form of publications. Merton has argued that scientists receive their prime recognition from their qualified peers through a coinage system that acknowledges their efforts. He suggests that the scientific practice of making one's work communally accessible requires that other scientists who make use of this work should make proper reference to the author, through practices of legitimate appropriation as opposed to practices of illegitimate expropriation. In this context, some researchers may achieve cumulative advantage, by which Merton means the accumulation of symbolic and material rewards for individual practitioners of science.[1] As regards cumulativity, we can however acknowledge the Matthew effect, which is that scientists typically build on and refer to the work of already established scientists.[8] The Matthew effect of selection is perhaps not unsurprising,

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considering that scientists must make delimitations and selections as they seek to comprehend the growing body of scientific literature available. Cumulativity therefore does not involve building on all relevant research; it needs only to build on some of the relevant research. There is more to building cumulativity, however, than digesting and referring to other researchers' publications. Scientific publications are far from offering full coverage of the pitfalls and trial-and-error processes scientists undertake as they construct their research outputs.

To gain a better understanding of the processes at hand there must be improved interaction and transparency among international scholars. Open discussions and exchanges are essential to prevent scientific efforts that replicate those of others, both successes and failures. Scientists need to discuss how and why their theories and methods succeed or fail. There are clearly stakeholders already in pursuit of this, such as Academia Europaea, who strive to stimulate interdisciplinary research and interaction for an improved (European) scientific community. Conferences, workshops and other instances where scientists meet provide important occasions for interaction between scholars, where they can interact not only in terms of results but also processes and data. In this context, scientific networks and organizations are essential, such as those national and European organizations formed during the past decades that have sought to facilitate interaction between researchers from different geographical and scientific origins.[9] There are many positive gains to be had from exchange between researchers as they conduct their research. Involvement in international networks of scholars, for instance, in which researchers can discuss and exchange their ideas, is seen as a prerequisite for information and interaction.[10]

We can agree that (excellent) research should be cumulative. Meanwhile, the argument of this article departs from the understanding that our contemporary current research community does not yet adequately facilitate such cumulativity. There was clearly important progress made in seventeenth-century England with regard to the Royal Society. This article puts forward the web squared cumulativity conceptualization, and calls for a more open, collaborative and process-oriented perspective on cumulativity. It elaborates on the emergent possibilities for improved cumulativity with regard to contemporary information and communication technologies (ICTs) in relation to the attitudes and practices of researchers. Its objective is to propose a sound conceptualization of how cumulativity can progress by shifting the values, actions and interactions of our scientific community. In practice, this is carried out in the article with reference to the assistance of contemporary ICTs, and, even more importantly, the concepts used to drive their progression.

The outline of the article is as follows. In the following section the principal components of the web 2.0 and web squared concepts will be introduced and elaborated to lay the basis for multidisciplinary cross-fertilization of these concepts with regard to cumulativity. The concepts of web 2.0 and web squared form the lens through which we can adopt a new perspective on cumulativity, which is split into three phases. The following three sections are devoted to these phases of web squared cumulativity conceptualization: (1) pre-publishing, (2) publishing, and (3) post-publishing. Although each of these phases is discussed separately, the concluding section synthesizes the proposed conceptualization of cumulativity. While both web 2.0 and web squared will be discussed, and make similar concepts, the conceptualization make use of web squared as it represents more recent progress.

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## Cumulativity, Technology and Contemporary Web Ideologies

In a recent article on the future of European society, a number of researchers concluded with recommendations for policy development as a result of the digital revolution, such as reorganizing to secure access for everybody to virtual and real knowledge.[11] Scientific research both can and should improve,[12] and in many ways such scientific improvements take place in parallel with technological advancements. First, we can consider all the scientific domains that in one way or another probe technological change, for instance, science and technology studies, business studies or media and communication studies. Second, we can acknowledge that technology has become a facilitator of research as hardware and software in many cases assist in the conduct of research.[13] Research conducted with close assistance from technologies is often referred to as e-Science, e-Research or cyber-infrastructures.[14] For instance, possibilities for automated data-collecting and analysis have emerged, and there are now also advanced programs for statistical analysis paired with exceptionally robust computer processing power. Third, distribution of research has been vastly improved thanks to the internet, including email, website and blog functionalities, as well as the establishment of open-access journals. Fourth, science can progress from contemporary ideologies in the development, management and use of ICTs. The web squared cumulativity conceptualization takes the first three advances into consideration. It also refines our approach to cumulativity by making reference to the opportunities for the scientific community if it adopts the ideologies of web 2.0 and web squared. This would result in a more open and collaborative approach to cumulativity in science. That researchers have been involved in the progress of the internet has been attested by history. In this context it is worth noting that as web 1.0 emerged during the early 1990s in the form of producer to reader hypertext, academics were a driving force since they wanted to communicate with each other during their research process. Web 2.0 and web squared allow such communication between researchers to be taken further.

The idea behind what is commonly referred to as web 2.0 signifies an evolution in terms of how different stakeholders approach the Internet. It is a concept that can enrich not only the Internet but also the particularities of knowledge management[15] as well as knowledge creation and distribution in the scientific community at large. Some of its central components will be highlighted in the following sections, and used for our discussion on cumulativity. The web 2.0 concept was formed at a conference in the Silicon Valley in 2004, and the chief protagonist was Tim O'Reilly. He has in succeeding texts shown that web 2.0 involves continuously updated applications and services that integrate creative and remixed content and services for all its users. It is a concept with a gravitational core that centres on architectures of participation and cooperation to harness the strikingly powerful dimension of collective intelligence. Gaining such intelligence from the crowds (i.e. publics and users) is done through contemporary web 2.0 services such as blogs and wikis. O'Reilly further suggests that one should design for remixability, that is, lower the barriers to remixes of content (so-called mash-ups). Database management and perpetual beta development processes are treated as synonymous with developing web services in a 2.0 era.[16] The web becomes better as more people use it, making active contributions to it through, for example, social networking functionalities. Active participation and collective intelligence are prominent principles of the

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concept,[17] which also postulate a positive attitude to openness and sharing. Other researchers have suggested that distinct features of web 2.0 are its mixture of two-way information-communication that continuously evolves in the digital sphere towards the personal, virtual and mobile.[18]

A number of features seem to be unique to web 2.0, including two-way information-communication, openness, sharing, social networking functionalities and database management. Together, these involve architectures of participation and cooperation that stimulate collective intelligence. In an analysis of the past, present and future with regard to ideology and business models of web developments, Fuchs argues that the web has always had a social object, although in different ways, and thus not in sufficient terms to define the characteristics of web 2.0. He observes that the first era of the web was predominantly characterized by human cognition, the second by human communication and the last by human cooperation. He further suggests we adopt an integrated view of sociality in which theories of structure (1.0), social action (2.0) and social co-operation (3.0) are all integrated to provide an understanding of yet another phase of the web. Perhaps more importantly, he suggests the move towards the next phase of the web and social co-operation involves not only technologies but our entire society.[19]

The move to the next phase of the web has naturally been discussed for some time. O'Reilly and Battelle have compiled a report in which they discuss the important factors and trends. They suggest web squared, claiming that progress is not only about the web, and that the web now has become the world. They argue people in the physical world have an aura in the virtual world, a so-called information shadow. It involves the use of cooperating data subsystems that use location-based, sensor-based and personalized information to tailor analysis and presentation of data to users.[20] Researchers, for instance, have information shadows through their emails, photographs, publications, university web page, lectures, conference presentations, blog posts, tweets, etc. Researchers can, however, choose to let more of themselves and their work become information shadows, including their research process and data material. It is the quality and accessibility of one's information shadows that will form the conditions for other scholars to build upon one's research, thus facilitating a promising and progressive scientific community. Looking towards the future, in the words of O'Reilly and Battelle:

> If we are going to solve the world's most pressing problems, we must put the power of the Web to work — its technologies, its business models, and perhaps most importantly, its philosophies of openness, collective intelligence, and transparency. (Ref. 20, p. 10)

Although much cumulativity can benefit from applying the concepts of web 2.0 and web squared, there are clearly a number of challenges from both an individual and collective perspective. For the sake of clarity, such challenges are discussed throughout the following sections. These sections provide a foretaste of the ways scientists can, or already have, become more open and collaborative in their approach to cumulativity.

## Conceptualizing Pre-publishing Phase Cumulativity

The pre-publishing phase is here defined as including all the research processes taking place before submission of one's work for publication. It involves formulating ideas and

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making research proposals, reading, conducting fieldwork, outlining drafts, thinking about the research and its progress, and making continuous attempts at improvements. How open are researchers in this phase, as they make use of collaboration with others to harness collective intelligence?

The answer clearly varies. In some scientific domains, such as the natural sciences, researchers tend to work in project groups where there is continuous interaction in terms of their process and results. In other scientific domains, such as the humanities and social sciences, it is also common practice for scientists to carry out individual research projects. Independently of whether they work individually or are project-based, these scholars can share their thoughts or research drafts through seminars held at their departments, or simply by interacting with other scholars they know. Some, however, prefer working individually until they desire and feel comfortable about receiving feedback.

Openness, sharing and interaction are criticized from the perspective that scientists are benefiting from being the first to publish results. Researchers are therefore keen on progressing behind closed doors until they have established their credentials by publishing their results in widely accepted scientific venues. Such values signify a scientific environment of competition rather than cooperation,[21] and these values and behaviours are likely to continue as long as researchers maintain their traditional practice of crediting work that has been published. A value transition must take place whereby the scientific community is more open to sharing, which would require acknowledging that being first on the net has significant value. Considering that the publishing process usually takes several months, even years, scientists should be keen to make some of their scholarly work available online to make their mark.

Much of the interaction of the research process taking place in the pre-publishing phase is limited to intra-departmental discussions, or to the personal networks in which researchers are engaged. The information and communication flows are not made publicly accessible on the internet, but take place through interpersonal communication. The question then is how the web 2.0 and web squared concepts can assist cumulativity in this phase. By making these information and communication flows accessible online, including research documents and instruments, these researchers not only provide other scientists with an opportunity to become aware of and learn from their ongoing processes, they can also gain greater renown as well as receive welcome feedback. Comments can clearly pour in from the scientific community, and also from the public. There are several projects, such as cybernorms (cybernormer.se), which illustrate that people are willing to read and comment on research. This implies that researchers can successfully involve the public through social and personal media directed towards internet-enabled laptops, and reading or mobile devices.

By using websites with blogging, multimedia, file-sharing, sharing, RSS and wiki functionalities, contemporary scholars have been provided with efficient tools for displaying and disseminating their research online to readers and scientists all over the world. Such practices have elsewhere been discussed as Science 2.0, and the OpenWetWare project launched in 2005 at Massachusetts Institute of Technology is a well-known example of where such scientific principles have been applied within natural science.[19] The project goes under the tagline ‘share your science’ and is described as seeking to share information, know-how and wisdom with researchers in their field. They make extensive use of web 2.0

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functionalities such as shared calendars and labs, wikis, blogs and much more. Today there are extensive lists of universities and researchers who actively make their research projects, coursework, etc, available through the OpenWetWare project. Much of the information shared focuses on how research groups are formed, the research they are undertaking, and what their thoughts are. There are also wikis on protocols, in which researchers can give their input on research procedures.

Such wikis provide valuable information on how to approach different research areas, in which researchers can comply with already explored, perhaps even formally established, procedures. With regard to interaction on procedures and research instruments, there are also contemporary examples from the social sciences that give us a foretaste of developments and possibilities concerning the conceptualization of web squared cumulativity. A widely used method in social science is to conduct surveys, online or by post, telephone or personal visits. Usually, researchers have a number of criteria to consider as they craft their questionnaire, including making valid measurements of their own particular research questions, and seeking to make possible comparisons with survey studies that have been carried out previously in their own or in other countries. From the methodology literature scientists can partake of knowledge on how to specify questions in surveys, and which types of scales and response alternatives to apply in general. In some fields there are specific, even standardized, formulas of measurement, whereas in other fields there is much uncertainty about how to measure emerging phenomena through surveys.

Until now, researchers have often had to rely on their personal networks to access information on how others' survey projects are progressing or have unfolded. We should bear in mind that the process of preparing, conducting and assembling fieldwork may take from several months to a year, and the succeeding analysis and publishing procedures will probably double this time horizon. When researchers explore new terrain it is therefore difficult to craft the questionnaires with regard to others' research, unless they make their instruments and thoughts available during the process. This would stimulate cumulativity and prevent researchers from fumbling in the dark, reinventing wheels and crafting incompatible surveys. By sharing both used and planned survey instruments, researchers could find and apply similar questions, which would facilitate comparisons over time and in cross-cultural contexts.

One example where such sharing has been made possible is the Swedish National Data service (SND), which is an institution operating on a mission from the Database InfraStructure Committee (DISC) and the Swedish Research Council. SND provides descriptions of numerous research projects, related publications, data material and their documentation (such as survey instruments). As of mid-2010 there was a beta-version of an online repository with survey questions, with user-friendly navigation and search instruments. The search results were given both in Swedish and in English, in html or PDF, and users could easily download original questionnaires as well as share the information through embedded social network functionality. This initiative by SND will clearly grow in value and impact as more researchers deposit their data instruments and thoughts, building on collective intelligence. That SND proposes it as a beta-version is in line with the idea of continuous improvements, as discussed in web 2.0. Institutions such

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as SND are of course also welcomed on a European and international level. The Council of European Social Science Data Archives (CESSDA) offers what it calls a seamless interface to datasets from social science data archives across Europe. Furthermore, we can also acknowledge the European Portal on Research Infrastructures' Services, under the wing of the European Strategy Forum on Research Infrastructures (ESFRI). They claim that they provide information on a large number of research infrastructures (RIs) of pan-European interest in all fields of science. At present both the European and national examples given here are limited in terms of content and functionalities, as viewed from the perspective of web 2.0 or web squared ideologies.

## Conceptualizing Publishing Phase Cumulativity

In an ideal world, researchers have the resources, time and ambition to become familiar with all relevant published research prior to conducting their own study. In reality, this is very difficult to accomplish. With regard to the publishing phase, this article suggests we give our attention to two critical access-related issues that can constrain our goals for cumulativity; namely the power of language and publishing accessibility modes. These issues clearly affect research cumulativity in general. This means that they affect the conditions for researchers at universities with more limited resources, particularly non-English individual researchers.

When it comes to the power of language, we can conclude that much research is published in international journals, in English. When researchers publish in English it allows researchers from various countries to access and draw upon each other's work – that is, if they have the competence to master English. We should note that in some countries and research disciplines the main output of work takes place in the native language. It is fair to say that improved cumulativity would be achieved if more researchers published their work (also) in English. To stimulate such goals, researchers unfamiliar with publishing in English must be given (increased) support with the editing of their manuscripts.

With regard to publishing accessibility modes the dimension of free or fee-based publications has considerable influence on the possibilities for cumulativity. Journal articles have traditionally been published through a business model where universities and other stakeholders have to pay subscriptions to grant their employees access. Advances in technology have enabled online distribution at low cost. Parallel with the emergence of web developments during the mid-1990s is, unsurprisingly, an open-access movement. The basic concept of open-access publishing emerged as a means to secure improved access to science among the public and scientists. It has been assumed that open-access journals will result in improved dissemination of science, leading to expansions in scientists' stock of knowledge, as well as making possible greater levels of cumulativity. There are those who argue that the open-access publishing model stimulates the diffusion and impact of research. Many have maintained that open-access journal articles are more frequently cited than traditional journals.[22] A recent article in *Science* discusses and modifies this perception, as the authors conclude from their extensive empirical analysis that the differences are somewhat higher than for traditional

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journals.[23] Citation is related to the impact factor of the journal, and in the long run the success of the individual researcher. The relatively low impact factor of Open Access (OA) journals is largely explained by their relatively short history, which means that there has not yet been enough time to accumulate significant numbers of references. It should also be borne in mind that those who manage the indexes of impact are commercial companies with a stake in maintaining copyrights for journals. For instance, the well-established Institute for Scientific Information (ISI) has become part of the international US-based information company Thomson Reuters, a company with a Canadian family as majority owners.

Despite these results, the support for open-access publishing seems to increase several declarations and signature campaigns testify to the worldwide support for the OA movement and its interest in making science easily accessible.[12] Another indicator of the breadth of the OA movement is the number of available OA journals. As of 1 September 2010, when the first draft of this article was submitted, 5313 journals were indexed in the Directory of Open Access Journals (DOAJ). When the revised version was submitted on 13 December, the number had increased to 5867, which demonstrates a significant growth in the OA movement. Although, however, many scientists are positive about the concept of open access publishing, they are reluctant to publish in such venues themselves because of the typically more limited impact of these journals.[24] Such attitudes and experiences are currently being investigated in a project called SOAP (Study of Open Access Publishing), organized by the European Commission, SAGE and others. Their preliminary results demonstrate that about 8 to 10% of all journal articles are published by open access journals. From their survey with researchers they see that nine out of ten think open access is beneficial to their own field, and makes a contribution to the scientific community. The main barriers to publishing in OA journals are lack of funding and the inferior lack of prestige of these journals.[25] This delicate issue is one of great importance for how open access will continue to unfold. As a compromise, some fee-based journals have started to allow their authors to make almost complete versions of their journal articles available on their personal websites/blogs as well as the online repositories at their universities.

## Conceptualizing Post-publishing Phase Cumulativity

Research is an interactive process in which we go back and forth between theory and data. In many research projects it is said to make a particular contribution to science by addressing specific research questions, collecting and analysing data, and reporting the conclusions through publications. When this has been accomplished the researchers enter what is here referred to as the post-publishing phase. Traditionally, the data are kept with the individual researcher or her/his research project. Meanwhile, there are many advantages of sharing data files with others.[14,26]

The data that have been collected and analysed in research projects are usually stored among the researchers involved. Once a research project has been completed, these researchers will most likely not analyse the data further. Such data sources can, however, be used in numerous additional ways, if they were made available for analysis to other

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researchers. Other researchers may, for example, perform analysis with other theoretical approaches, explore other methodological analyses, or explore the data for cross-cultural and/or longitudinal analysis. Making the data available, or offering to collaborate on them, unfolds more opportunities for cumulativity. Such procedures enhance transparency, and therefore also limit research misbehaviour. In his analysis of research integrity and misbehaviour, Drenth calls for principles of open communication in which researchers also store and share their data with other scholars.[6]

Borgman states that data-handling and data-sharing practices and conditions vary between disciplines; in natural science, the sensitivity with regard to humans is low, but the economic value for reuse can be high. Within social science and medicine, sensitivity is higher whereas the economic value of social science data is defined as less than that of natural sciences.[27] Today, research indicates that the attitude among researchers towards accessing data sources is more positive than the attitude towards making their own data available.[28] If this attitude changes, we will achieve improved cumulativity when it comes to using data sources. To facilitate such changes there is a need for institutions, preferably on both national and international levels, that collect, manage and make data available to other researchers. Such institutions should also assist researchers in the legal matters of concern in such procedures, as well as making sure that the integrity of individuals participating in the research projects is handled with care.

The Swedish National Data service (SND) is one institution seeking to carry out these principles, but there are two other examples that shed light on the initiatives taken to make data available to researchers. The first example is the World Bank, who launched open access to their enormous database through their open data initiative during the spring of 2010. According to their measurements of the number of visitors and downloads of data, the initiative definitely marked a significant increase with regard to diffusion of data. A second example is the Quality of Government (QOG) Institute at the University of Gothenburg. The institute focuses on political science research from an international perspective, and has tried to enable cross-cultural comparisons. It has compiled an extensive list and description of institutions that have released their datasets for open access. Furthermore, visitors to its website can easily access and download their own datasets. No terms of usage have to be signed; users are simply encouraged to follow standard codes of conduct in science by making a reference to the QOG Institute when they make use of the data.

## Making a Future Transition to Web Squared Cumulativity?

This article has described the web squared cumulativity conceptualization and its three phases, elaborating on several examples of emergent scientific practices. The article provides a perspective for consideration and action not only for individual scholars but also institutions such as Academia Europaea, COST and other research-related bodies. Although the concept outlined proposes improved openness and collaboration, the discussion has highlighted issues that currently constrain such a transition. It is very likely that extensive efforts and time will be required before the broad mass of international scholars has adopted the practices related to the web squared cumulativity conceptualization, but we can definitely see that there are a number of alpha geeks, even early adopters, who are paving the

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way. Meanwhile, we must ask what is required to make other scholars also participate in this through their actions.

We can draw a parallel here with the newspaper industry and how the perceived superior value and status of the written word meant that online journalism evolved slowly. Newspaper journalists had long been accustomed to the format and deadlines of printed newspapers. The idea of publishing their articles online prior to publishing in print was deemed a threat during the 1990s since other news outlets would be able to offer the same news stories. In other words, journalists resisted making good use of the new medium because of old habits and the perception that others were going to find their story newsworthy and try to publish it as well. Being first online was not credited enough at the time, so they saved articles for print. Things have changed, and it has become common practice to publish immediately for the internet and mobile devices, as this actually gives newspapers 'street cred', and also disseminates their stories.

Scientists should therefore ask themselves whether it would not be better to adopt the web squared cumulativity conceptualization in their scientific practices. This would probably improve awareness about, and reference to, their research. The bottom line is that such practices would facilitate improved cumulativity, and would also enable improved communication with the public. The web squared cumulativity conceptualization has the potential to facilitate both one- and two-way information-communication about research, not only in terms of results but also with regard to the pre- and post-publishing phases. This does not mean that scientists will let go of the current reviewing system associated with publishing in journals. It means broadening the perspective on respectable venues for publication, and also making their work and thoughts available for peer-preview in the pre-publishing phase, and available for peer-re-review in the post-publishing phase. Through such practices, the quality of cumulativity would indeed increase. Meanwhile, we must acknowledge that there are strong forces that constrain such developments.

Robert McChesney[29] has suggested that rich media lead to poor democracy. This article provides a different view on what rich media can result in. Embracing the web squared cumulativity conceptualization, scientists will communicate their research process, results and data in new ways. Rather than only publishing books, reports and articles alongside presentations, there are now numerous ICTs that reach out to new publics and additional target groups, as well as facilitating other dimensions of media richness. Web 2.0 and web squared media offer the means to develop personalized and multimedia experiences on the internet, mobile devices, tablets such as the iPad, etc. It therefore makes sense to suggest that rich media contribute to rich science. The bottom line is that to achieve rich science the research community has to strive to achieve and maintain research cumulativity. Although we can rejoice at the fact that such values are often obvious to scientists, there is unfortunately still much inconsistency in the ways in which the notion of cumulativity is approached.

If we redefine our approaches to research through the web squared cumulativity conceptualization, science will see improved collaboration, access and visibility. Such practices may, for instance, help researchers identify others who are in the process of investigating similar research questions. Furthermore, they stimulate reflection about contemporary publishing and peer-recognition systems, and could also provide better means for making use of existing data sources.

https://doi.org/10.1017/S1062798711000433 Published online by Cambridge University Press

## References


1. R.K. Merton (1988) The Matthew Effect in science, II: cumulative advantage and the symbolism of intellectual property. *ISIS*, **79**, pp. 606–623.
2. S. Arunachalam (2008) Open access to scientific knowledge. *DESIDOC Journal of Library and Information Technology*, **28**, p. 7.
3. C. Piscopo and M. Birattari (2008) *The Explanation of the Success of Science*. IRIDIA Technical Report Series 013. (Brussels: Université Libre de Bruxelles).
4. T. Kuhn (1962) *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press).
5. A.F. Chalmers (1999) *What is this Thing Called Science: An Assessment of the Nature and Status of Science and its Methods* (Buckingham: Hackett).
6. P.J.D. Drenth (2010) Research integrity; protecting science, society and individuals. *European Review*, **18**, pp. 417–426.
7. C. Piscopo and M. Birattari (2008) *The Explanation of the Success of Science*. IRIDIA Technical Report Series 013. (Brussels: Univesité Libre de Bruxelles).
8. R.K. Merton (1968) The Matthew Effect in science: the reward and communication systems of science considered. *Science*, **159**(3810), pp. 56–63.
9. A. Burgen (2010) Academia Europaea: origin and early days. *European Review*, **17**, pp. 469–475.
10. J. Stamm (2010) Women in science – why networking matters. *European Review*, **18**, pp. 121–131.
11. S. Arnaldi, F. Boscolo and J. Stamm (2010) Living the digital revolution – explorations into the futures of the European society. *European Review*, **18**, pp. 399–416.
12. M. Pautasso and C. Pautasso (2010) Peer reviewing interdisciplinary papers. *European Review*, **18**, pp. 227–237.
13. C. Franzoni (2008) Research instruments and operating tools: how open science contributes to technology. *Innovation Studies Working Paper (ISWoP),* no. 3/2008. (Pyltechnic of Turin, Italy).
14. A-S. Axelsson and R. Schroeder (2009) e-enabled data-sharing in Sweden. *Acta Sociologica*, **52**, pp. 213–225.
15. M. Levy (2009) Web 2.0 implications on knowledge management. *Journal of Knowledge Management*, **13**(1), pp. 120–134.
16. T. O'Reilly (2007) What is web 2.0: design patterns and business models for the next generation of software. *Communications & Strategies*, **65**, pp. 17–37.
17. J. Musser, T. O'Reilly (2006) Web 2.0 principles and best practices. *O'Reilly Radar*, http://oreilly.com/catalog/web2report/chapter/web20_report_excerpt.pdf
18. G. Vossen and S. Hagemann (2007) *Unleashing Web 2.0: from concepts to creativity,* (Boston, MA: Morgan Kaufmann).
19. C. Fuchs (2010) Social software and web 2.0: their sociological foundations and implications. In S. Murugesan (ed.) *Handbook of Research on Web 2.0, 3.0, and X.0: Technologies, Business, and Social Applications. Volume II* (Hershey, PA: IGI-Global), pp. 64–789.
20. T. O'Reilly, J. Battelle (2009) Web squared: web 2.0 five years on. Paper presented at the Web 2.0 Summit Special, Oct 20-22 2009, San Francisco, CA (http://assets.en.oreilly.com/1/event/28/web2009_websquared-whitepaper.pdf).
21. M.M. Mitchell (2008) Science 2.0. *Scientific American*, **298**, pp. 68–73.
22. G. Eysenbach (2006) Citation advantage of open access articles. *PLoS Biol*, **4**, pp. 0692–0698.
23. J.A. Evans and J. Reimer (2009) Open access and global participation in science. *Science*, **323**, p. 1025.


https://doi.org/10.1017/S1062798711000433 Published online by Cambridge University Press

24. F. Mann, B. Von Walter, T. Hess and R.F. Wigand (2009) Open access publishing in science. *Communications of the ACM*, **52**, pp. 135–139.
25. S. Dallmeirer-Tiessen, B. Goerner, R. Darby, J. Hyppoelae, P. Igo-Kemenes, D. Kahn, S. Lambert, A. Lengenfelder, C. Leonard, S. Mele, P. Polydoratou, D. Ross, S. Ruiz-Perez, R. Schimmer, M. Swaisland, W. van der Stelt (2010) First results of the SOAP Project. Open access facts: what publishers offer, what researchers want, Presentation at the Fifth UNICA Scholarly Communication Seminar: 'Find it, Get it, Use it, Store it', 7–9 November 2010, Lisbon, Portugal. (http://www.slideshare.net/ProjectSoap/soapfall2010).
26. A.J. Vickers (2006) Whose data set is it anyway? Sharing raw data from randomized trials. *Trials*, **7**(15), pp. 1–6.
27. C.L. Borgman (2007) *Scholarship in the Digital Age: Information, Infrastructure, and the Internet* (Cambridge, MA: MIT Press).
28. E-mail correspondence with Swedish National Data Service, May 2010. The results are based on a survey with 544 professors and 1147 PhD candidates in Sweden during spring 2009.
29. R.W. McChesney (1999) *Rich Media, Poor Democracy – Communication Politics in Dubious Times* (Urbana, IL: University of Illinois Press).

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**Oscar Westlund** (PhD in Journalism, Media and Communication, University of Gothenburg, Sweden) is an interdisciplinary researcher with an academic background that involves an MSc in Media and Communication Studies and a MSc in Theory of Science. His research has focused on the transformations and relationships between old and new media. He has specialized in qualitative and quantitative longitudinal studies of media organizations, media content and services, as well as usage patterns. He researches the evolving dynamics and interplay of journalism, the internet and ICTs in general, and the intersection of newspapers and mobile media in particular. Among the international journals in which he has recently published are *Northern Lights, International Journal on Media Management, Behaviour & Information Technology, New Media and Society, International Journal of Communication and Canadian Journal of Communication.*

https://doi.org/10.1017/S1062798711000433 Published online by Cambridge University Press