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Correlation between impact factor and public availability of published research data in Information Science & Library Science journals

Rafael Aleixandre-Benavent[1]; Luz María Moreno-Solano[2]; Antonia Ferrer Sapena[3]; Enrique Alfonso Sánchez Pérez[4]

(1) Instituto de Gestión de la Innovación y del Conocimiento-Ingenio (CSIC-UPV). UISYS. Universidad de Valencia. Spain
(2) IFS, Centro de Ciencias Humanas y Sociales (CCHS). CSIC. Madrid. Spain
(3) DCADHA. Universitat Politècnica de València. Spain
(4) Instituto Universitario de Matemática Pura y Aplicada. Universitat Politècnica de València. Spain

Correspondence:

Rafael Aleixandre-Benavent

Plaza de Cisneros, 4

46003 València. Spain.

Phone: +34 963926274

E-Mail: Rafael.Aleixandre@uv.es

Abstract

Scientists continuously generate research data but only a few of them are published. If these data were accessible and reusable, researchers could examine them and generate new knowledge. Our purpose is to determine whether there is a relationship between the impact factor and the policies concerning open availability of raw research data in journals of Information Science & Library Science (ISLS) subject category from the Web of Science database. We reviewed the policies related to public availability of papers and data sharing in the 85 journals included in the ISLS category of the Journal Citation Reports in 2012. The relationship between public availability of published data and impact factor of journals is analysed through different statistical tests. The variable "statement of complementary material" was accepted in 50% of the journals; 65% of the journals support “reuse”; 67% of the journals specified “storage in thematic or institutional repositories"; the “publication of the manuscript in a website” was accepted in 69% of the journals. We have found a fifty per cent of journals that include the possibility to deposit data as supplementary material, and more than sixty per cent accept reuse, storage in repositories and publication in websites. There is a clear positive relationship between being a top journal in impact factor ranking of JCR and having an open policy.

Key words: Information Science & Library Science; Open research data; Public availability; Impact factor; Correlation; Scientific journals

BACKGROUND

Research data generated by scientists are important not only for their own purposes, but also for the entire scientific community. If the data are accessible and reusable, researchers can examine and generate new knowledge[1]. Today, the rapid advances in computing capabilities provide useful tools in manipulating and exploring massive data sets[2].

Historically, however, scientists have been reluctant to share their data for various reasons, including the fear that others could make improper or fraudulent use without due recognition to the original author. Along with these difficulties of personal nature, there are others as the lack of agreements to establish rules on the format that must have data to share, as well as the contextual information that must accompany them for identification or metadata[3]. Scientists also argue extra scientific factors, such as lack of time to perform the data warehouse in formats suitable for reading and exploitation by others (curation) and poor infrastructure necessary to carry out, as there are hardly subject repositories and institutional support data warehousing to ensure their dissemination[4-7].

Despite the mentioned above, the barriers to data sharing are phased out. Some public research organizations are demanding ever more insistently that publications resulting from publicly funded projects and data that support them are also a public good and, therefore, should be published in open. To accomplish this, they publish specific policies and guidelines on data sharing and data management, as we discuss later in this paper.

Several destinations have proposed for depositing the raw data, as thematic or institutional repositories, websites and journals. Although the option of depositing in repositories seems to be the most accepted, at least from a documentary point of view, there are still not many repositories that allow the data warehouse[8]. While clarifying what is the best option, some journals offer the possibility to deposit data accompanying published papers in their web sites, usually as "additional, complementary or supplementary material".

Previous studies have analysed this possibility in journals with high impact factor[9], in Substance abuse journals[10] and in Library Science and Information Science journals[11].

The purpose of this paper is to determine whether there is a relationship between the impact factor and the quartile in Journal Citation Reports and the policies concerning open availability of raw research data in journals of Information Science & Library Science (ISLS) subject category from the Web of Science database.

METHODS

We reviewed the instructions to authors included in the websites of the 85 journals involved in the ISLS category of the Journal Citation Reports (Social Science edition, 2012). For each journal, we documented the policies related to public availability of papers and data sharing, when available.

The following data were collected for each journal: a) Journal name; b) Journal website; c) Information about the statement of policy regarding complementary material; d) Reuse policy; e) Possibility of storage the manuscript in thematic or institutional repositories; f) Policy regarding publication on the official website or by the author; g) Journal impact factor (IF) (in 2012 edition of JCR); h) Quartile. The items d), e) and f) refer to the availability of the article content, while c) is the item related to the availability of raw data. This information was collected from July 2014 to September 2014. For the items c,d,e and f, the following variables were included: A: Accepted; NA: Not Accepted; NS: Not Specified, when there is no clear information on the item.

We have used the Journal Citation Reports impact factor of 2012, the last one published when the analysis of the open data access policies was made (in 2014). This delay of two years is not relevant for our study, since our goal was not to prove a cause-effect relationship between open data policies of journals and their impact factors; in this case, the year used to analyse both aspects would be important. Our aim is to study the relationship between the prestige of the journals -which usually does not change too much from one year to another, and open data policies.

Statistical analysis

In all our analysis we have written 1 for the positive answer of the journal to each of the four items above and 0 for the negative answer. We have included the lack of information provided by the journal on some particular item as a negative answer, since it is assumed that in this case an author cannot use his research data freely. It must be said that journals having no explicit policy regarding research data are in our list more often than having a negative policy: the proportion is in average 5 journals with no policy for 1 with negative one. Therefore, our results must be interpreted taking into account that the 0 value must be understood as absence of policy better than negative one, although the final consequences for the authors are the same.

We have performed the statistical analysis using three different tools.

a) The first one is given by the graphical representation of the distribution of journal impact factor by level of openness. We provide some descriptive data and comments.

b) The second one provides a direct analysis using Chi-square test of the difference regarding each point 1 to 4 considered above on the editorial policy of the journal when the data are divided into two categories: high impact factor or low impact factor, that are defined to be the journals belonging to Q1 and Q2 (high impact factor) and Q3 and Q4 (low impact factor).

c) The last one is given by the analysis of the ordering of the journals defined by the IF when they are divided in two groups by means of the value of the storage variable of the journal considered in each of the four cases explained above. Non-parametric and parametric test are used (Mann-Whitney and t-tests on the equality of means) in each case.

RESULTS

The results obtained after analysing the four main variables are presented in Table 1. In relation to the variable "Statement of complementary material" was accepted in 50% of the journals, whereas 45% did not specify a preference and

5% refused this possibility. The results were quite similar between the first and second quartiles and between the third and fourth quartiles.

Regarding the reuse of data the following results were obtained: 65% of the journals support this possibility, 6% do not allow it and the remaining 29% did not specify. The highest percentage of response across this variable was in the journals of the second quartile that accept the reuse of data (90%).

The variable "Storage in thematic or institutional repositories", 67% of the journals specified that it was possible, whereas 32% did not specify such a possibility. That option was denied by one journal. The percentage of journals that accept storage decreases as the quartile is lower, so that in the first quartile is for the 95% of journals, while for the fourth quartile is only 40%. Logically, the percentage of journals that do not specify also increases in parallel from first to fourth quartile (see figure 1).

The publication of the manuscript in a website presented the following results: 69% of the journals accepted it, 5% did not allow it and 26% did not specify a policy on this option.

Statistical analysis

A) Dispersion diagrams

Figure 2 offers the graphical representation of journal impact factor by type of policy regarding the four analysed variables. As can be seen, journals allowing the storage of complementary material have, in general, higher impact factor. This is especially notorious for the top journals. The same behaviour that in the previous diagram can be seen regarding the possibility of “Reuse” of data: journals with higher IF allow reuse more often. Notice the starting point of the dots for the values 0 and 1 of the variable: the group of journals allowing reuse has a meaningful threshold. Concerning “storage in thematic or institutional repositories” and “publication in a website”, a similar pattern is observed.

B) Fitting binary classification variables

In this second step, we divide the impact factor list in two parts with an equal number of journals. The top part, represented with the value 1 of the variable,

and the low part, labelled by 0 (table 2). Chi-square analysis has been done, and the results are clear and concise: with an almost 1 probability, top journals agree with the value 1 of four the storage-and-use-policy variable.

The value of the Pearson Chi-square value is 11.318; the significance level (of the null-H) is 0.001. Thus, we conclude that there is a positive relationship between being a top journal and having an open policy regarding upload of complementary material.

In Allowance of reuse of the research data (table 3), again, the consequence is clear. With a value of 19.888 of the Pearson Chi-square value, the significance level (of the negative answer) is 0.000, and so there is an association between type of journal (low/high impact factor) and reuse policy.

3) Allowance of storage in institutional repositories. The result is similar to the ones of the previous variables. In this case, the value of the Pearson Chi-square value is 13.080, that corresponds to a 0.000 significance level for the null hypothesis.

4) The same result is given regarding the variable allowance of uploads in personal websites. The value of the Pearson Chi-square value is 17.350 (0.000 significance level for the null hypothesis).

C) Analysis of impact factor by type of policy regarding storage and reuse of data.

In this section, a non-parametric analysis based on the U-test of Mann-Whitney is performed and complemented by using the t-test, although a priori it does not seem to be reasonable to assume that the usual hypothesis for the application of the second test is satisfied. Again, the (ordering) variable derived from the impact factor is studied when two subgroups are defined. This division is made using the storage and reuse variables explained in 1) to 4) of B).

Let us analyse first the case when the impact factor list is divided using the policy of the journals regarding the possibility of uploading the complementary material as grouping variable. The difference of the groups defined in this way is confirmed by both the non-parametric Mann-Whitney U-test and the Student t-

test.

This variable divides the group in two subgroups of 43 and 42 journals. The value of the mean of the first group is 1.28305, and the mean of the second group is 0.68857. When the difference of means is analysed by using the t-test, a level 0.003 of significance for the hypothesis of equality of means is obtained. Thus, it can be concluded that journals with higher IF allow to upload complementary material more than the ones with low IF. Regarding the U-test, the value obtained of the U of the Mann-Whitney test is 535.500, and the value of the W of Wilcoxon is 1438.500, given a level 0.001 of significance of the negative answer on the existence of difference of the distributions in both groups.

The results of the analysis corresponding to the other variables that we are considered -possibility of reusing the data, storage in institutional repositories and in personal websites- are similar. In all cases, the tests show that there is a meaningful difference of the IF of journals with different policies regarding storage and reuse of data. The worst significance level is given in the forth case, when the allowance of uploading the data to personal websites is considered. In this case, the t-test gives a significance level of 0.007 for the equality of means when no coincidence of variances is assumed.

DISCUSSION

This work has allowed knowing the policies regarding the availability of raw data in journals on ISLS subject category of the Web of Science, and its relation with the impact factor and quartile as ranked in Journal Citation Reports-2012 edition.

ISLS is a constantly evolving area, whose journals have improved their representation and impact in Web of Science in recent years. The number of journals included in this category has increased from 56 in 1997 to 85 in 2012. It has also raised the maximum impact factor, since in 1997 was 2.164 for the *Journal of the American Medical Informatics Association*, while in 2012 was 4.659 for the journal *MIS Quarterly*.

The advantages of publishing in open access both papers and research data so they can be reused have been described in the literature and are well known. These advantages not only can benefit other potential researchers, but also to holders. The main described benefits of sharing research data are: researchers have greater opportunities to discover new knowledge; stimulates additional discoveries; increases the number of statistical analyses masked; avoids repeating costly projects; enables the reproducibility of the work and readers' understanding of how the results were obtained. In short, allows many projects can be made with minimal costs by leveraging existing data, achieving better use of resources[4-5,12-14]. Furthermore, publishing raw data provides additional advantages to the owner of the data that improves visibility and accessibility to papers. According to some studies, it could be an increase of the citation and the impact of journals[15-16], achieving a competitive advantage over other journals. Moreover, the researchers establish more contacts with colleagues and can rise to new collaborative work. Although the process involves a greater initial effort made by researchers to label their data, the end result is either beneficial, since they have the information and data better organized[3,6]. Researchers could efficiently create more opportunities without the burden of data collection and repetition of efforts[4-5].

One of the main obstacles to data sharing is the fear from researchers to have their data copied without recognition of their authorship. This can be solved by assigning identifiers to data sets and by citing these identifiers by researchers that use them[3]. Moreover, this system of citation make possible to evaluate the impact of data sets, in a similar way to the current use of citations in the assessing the impact of publications. Other problem usually argued by researchers refers to the need of protection of some kinds of data for reasons of confidentiality[7,17]. On the other hand, it is necessary to create infrastructures that hold and curate the data in a systematic way and guaranty its durability, as well as the necessary support for scientists in the preparation and management of data because today most electronic row data are poorly suited for data sharing[18]. Not less important is the need to establish universal standards of open data enabling universal use without hindrance[19]. However, currently data

release by governments is still novel and there is little experience and knowledge thus far about its benefits, costs and barriers.

In recent years there have been many domestic and international initiatives coming from public and private institutions in support of open access to publications and raw data access from several points of view. These initiatives aim to publicize the benefits of sharing information and data among different stakeholders such as researchers, policymakers and the public in general. Together, these initiatives contribute to a general cultural shift from traditional patterns of dissemination of information, based largely on data ownership, to new models for data exchange, dissemination and use[10,20]. We discuss below some of them.

One example in United Kingdom is the Royal Society, which open data policy states that to allow others to verify and build on the work published in Royal Society journals it is a condition of publication that authors make available the data and research materials supporting the results in the article. Where no data-specific repository exists, authors should deposit their datasets as supplementary material[21]. In the United States, the National Science Foundation (NSF) states that investigators are expected to share with other researchers the primary data, samples, physical collections and other supporting materials created or gathered in the course of work under NSF grants[22].

In health sciences, an area where sharing research data is specially relevant, the National Institutes of Health (NIH) from de United States considers data sharing essential for expedited translation of research results into knowledge, products and procedures to improve human health. NIH published in 2003 a Statement on sharing research data, where endorses the sharing of final research data to serve these and other important scientific goals and expects and supports the timely release and sharing of final research data from NIH-supported studies for use by other researchers[23]. In a similar way, the European Commission published the "Guidelines on Open Access to Scientific Publications and Research Data in Horizon 2020", that provide context and explanation for the rules on open access applicable to beneficiaries in projects

funded under the Horizon 2020 research program. These guidelines state the benefits to the scientific community and society of open access to publications and data: foster collaboration; accelerate innovation; greater efficiency; improving the transparency; engaging society with the scientific process. The guidelines propose the use of Data Management Plans detailing what data the project will generate, whether and how it will be exploited or made accessible for verification and re-use, and how it will be curated and preserved[24].

The policy on data management and sharing of Wellcome Trust, a global charitable foundation dedicated to improving health by supporting bright minds in science, the humanities and social sciences, and public engagement, states the expectation that all their funded researchers should maximise access to their research data with as few restrictions as possible. It requires applicants whose proposed research will generate data that hold significant value as a resource for the wider research community to submit a data management and sharing plan as part of the application process[25].

There also are being developed projects exploring opportunities, analysing possibilities and developing systems and guidelines to curate and share raw data. One example is the Digital Curation Centre (DCC), a centre of expertise in digital information curation with a focus on building capacity, capability and skills for research data management across the higher education research community[26]. It provides expert advice and practical help to anyone wanting to store, manage, protect and share digital research data. The centre also provides consultancy and support with issues such as policy development and data management planning. Another example is JORD, a project in which one of its main objectives is to address the problem of access to research data trough data sharing policies in journals[27].

There are also institutions promoting openness, as the Open Knowledge Foundation, a worldwide non-profit network of people passionate about openness, using advocacy, technology and training to unlock information and enable people to work with it to create and share knowledge. Open Knowledge Foundation hosts and supports the “Open Data Day”, a gathering of citizens around the world to write applications, liberate data, create visualizations and

publish analyses using open public data to show support for and encourage the adoption open data policies by the world's local, regional and national governments[28]. Another example is the Committee on Data for Science and Technology of the International Council for Science (ICSU), that with the program “Data strategies for international science”, supports scientific programmes to address data management needs, particularly concerning policies processes and standards necessary to assure data legacy. In partnership with the ICSU World Data System, CODATA is organizing SciDataCon 2014, the International Conference on Data Sharing and Integration for Global Sustainability, which will examine the state of the art of data science, and consider its role in addressing the most important challenges in international research for the good of society[29].

No less important in this topic are the repositories or registries for research data. On example is re3data.org (Registry of Research Data Repositories) a global registry that covers different academic disciplines for the permanent storage and access of data sets to researchers, funding bodies, publishers and scholarly institutions[30].

Another example of the importance given to this topic is the publication from 2006 of the *International Journal of Digital Curation* (http://www.ijdc.net/index.php/ijdc/index), a journal entirely devoted to papers, articles and news items on curation of digital objects and related issues.

Our results show that, of the four variables analysed, three have an acceptance rate close to 70% (reuse, publication of the manuscript in a website and storage in thematic or institutional repositories), while the percentage of journals that include the ability to deposit data as supplementary material is lower (50%). These percentages are somewhat higher than those found in a previous study that analysed public availability of published research in Substance abuse Data journals[10], especially in the variable publication of the manuscript in a website, which in our case was 69% compared to 41% in Substance abuse journals. In another study that analysed the same variable in high-impact journals[9], 88% had a statement in their instructions to authors related to public availability and sharing of data, a percentage 38 of points above the average found in the ISLS

journals (50%). However, if we consider only the journals of ISLS of the first quartile, the percentage is closer. A 2003 review of policies of 56 most frequently cited life sciences and medical journals found that 39% of journals had a policy regarding sharing of materials. Forty-one percent of these journals had a statement about depositing data, while 45% had no policy regarding sharing of materials or software, or data deposition[31]. In other study examining the policies of 70 journals publishing studies using microarray data, 34% of journals had a general statement about data sharing The strength of a journal data sharing policy was associated positively with impact factor and open access status[32].

We have found a positive relationship between being a top journal in JCR and having an open policy. These results have been confirmed by the two different statistical tests used. Our data show that the most prestigious journals are more aware of the importance of having a policy regarding public accessibility of published articles and that they are more likely to accept supplementary material. We haven't found other published series in the literature that allow us to compare our results. It has been already observed in previous works that journals in the top part of the JCR lists have a clear Open Data policy, and conversely, journals with low impact factor often have no Open Data policy at all[33]. Moreover, among journals of general scientific disciplines with explicit Open Data policy, some different categories can be considered[33], where the categories "strong", "weak" and "optional" are defined and used). However, in our study we have observed that these differences are not determinant, since in general the journals of Information Science simply claim that they "accept" supplementary data, or supplementary material "can be" uploaded, in the case that they have an active Open Data policy. The differences may become relevant for further studies, but we decided to consider only two categories, "accept" for the positive, and "no data policy" in the negative case. However, it is interesting to note that some of the highest impact factor journals in ISLS were published by large publishing houses and that large publishers were more likely to have a policy regarding the publication of supplementary material in the study of Borrego and Garcia[11]. It seems that large publishers are more able to adapt to the fast changing context of scholarly communication as well as to support

authors in complying with funding agencies requirements about public accessibility of research data.

One of the observed characteristics that stand out is the variability in the requirements of the journals, going from requiring the sharing of all primary data related to the research to just including a statement in the published manuscript that data can be available on permission. However, in the case of accepting the reuse, the most common requirements are: properly acknowledge authorship; indicate whether changes have been made in the manuscript or data; not use the material for commercial purposes. A previous paper pointed out that, despite the willingness of some journals to accept supplementary materials, policies, when present, were weak[11,34].

Limitations

This work has some limitations that have taken into account. First, we have only analysed 85 journals of ISLS included in JCR from WOS, and it is possible that other journals not indexed in this database has other different policies. But WOS is the only bibliographic database that provides the impact factor numbers, so it has been critical to achieve our goal. Second, this work analyses only journal policies as stated in the instructions for authors, so we don't known the effective rate of papers that really provide data to share. A previous work has showed that the majority of supplementary materials provided in ISLS articles were extended methodological explanations and additional results in the form of textual information in PDF or Word files[11]. Third, It is known that the degree of implementation of the culture of Open Access varies according to the disciplines and that the multi assignation of several categories to a journal can play a key role in the policy of Open Access. However, it is noteworthy to highlight that most of the journals analysed in this study (76%) are assigned only to the IS&LS subject category, a percentage that in our opinion is significant enough for providing an overall picture of the field. On the other hand, 13% of the journals are assigned both to IS&LS and Management subject category, an area closely related to the performance of libraries and information services. Finally, we don't know if researchers reuse effectively published data deposited[35].

Conclusions

We have found a fifty per cent of journals in ISLS of JCR that include the possibility to deposit data as supplementary material, and that there is a positive correlation between being a top journal in impact factor ranking of JCR and having an open policy. To promote and practice data sharing among researchers, it would be desirable to establish standards and best practices, and promote a scientific culture that includes data sharing among its principles. As future research, it will be interesting to analyse other journals belonging to ISLS and other non-ISLS areas not included in JCR to compare our present results. It will be also noteworthy to investigate the rate of papers that really provide data for reuse, the nature of materials deposited as well as to know if other researchers actually make use of them for research purposes.

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Figure 1. Journals supporting each variable by quartile (Q)

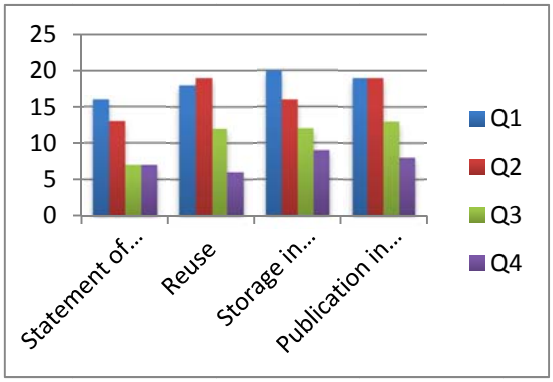

Table 1.

Quartile *	Statement of complementary material			Reuse			Storage in thematic or institutional repositories			Publication in website		
	A	NA	NS	A	NA	NS	A	NA	NS	A	NA	NS
	n (%)	n (%)	N (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
1	16 (76%)	-	5 (24%)	18 (86%)	-	3 (14%)	20 (95%)	-	1 (5%)	19 (90%)	-	2 (%)
2	13 (62%)	-	8 (38%)	19 (90%)	1 (5%)	1 (5%)	16 (76%)	-	5 (24%)	19 (90%)	1 (5%)	1 (5%)
3	7 (33%)	2 (10%)	12 (57%)	12 (57%)	3 (14%)	6 (29%)	12 (57%)	-	9 (43%)	13 (61%)	2 (10)	6 (29%)
4	7 (32%)	2 (9%)	13 (59%)	6 (27%)	1 (5%)	15 (68%)	9 (40 %)	1 (5%)	12 (55%)	8 (36%)	1 (5%)	13 (59%)
Total	43 (50%)	4 (5%)	38 (45%)	55(65%)	5 (6%)	25 (29%)	57 (67%)	1 (1%)	27(32%)	59 (69%)	4 (5%)	22 (26%)
	85			85			85			85		

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