

How to Foster Open Access? An Empirical Evaluation of the Obstacles Hindering OA Publications

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1. ABSTRACT

While open access (OA) publications are fostered by politics and funders as a way to reach large audiences and widely spread the results of research, the share of OA publications remains low. To foster OA, it is crucial to know the reasons hindering the diffusion of OA publication strategies. Therefore, we conducted a quantitative survey among researchers at the University of Münster, one of the largest universities in Germany. We tested different hypotheses focusing on several obstacles, including a low impact of OA, a low reputation of OA, and high costs of OA. Our findings show that the OA publishing rate at Münster University is low, despite the fact that OA publications are heavily used as scientific sources, OA publishing strategies receive a high rating and the reputation of OA is very positive. The willingness to pay, however, is significantly lower than the actual costs of OA publications. In addition, we identified a lack of information and a high uncertainty as supplementary reasons for a low OA rate. As expected, we found large differences between the departments. While OA publishing seems to be common in the life sciences, the natural sciences and mathematics, its usage is significantly lower in the humanities and social science, and especially in economics and law. It turns out that a researcher's low number of OA publications is positively correlated with 1) an assumedly low reputation of OA in his field of research, 2) a limited usage of OA papers as a source, and 3) a negative attitude towards OA strategies. Even though the willingness to pay is not significantly correlated with the OA publication rate, costs seem to be an important factor because the actual costs overrun the willingness to pay by far.

2. INTRODUCTION

Today, approximately 75-90% of research articles are not directly accessible, but locked behind paywalls which necessitate a subscription or enough money to pay on a per-article basis if the publisher provides this option (Cordis, 2013; Ilva, Laitinen, & Saarti, 2017; Tennant et al., 2016). It is clear that this has a negative impact on scientific progress and on the recognition of individual researchers as well. In addition, discussions about rising journal subscription prices and publisher profits arise (Odlyzko, 2013). More and more institutions and funders in higher education pursue OA policies that foster OA because of the advantages of freely available knowledge for society. This is especially the case for research financed by public funds, such as the European Union's Horizon2020 program where OA is mandatory (European Commission, 2017). In Germany, the government has published an OA strategy with the objective to turn OA into the norm of scientific publishing (Bundesministerium für Bildung und Forschung, 2016). Large scientific organizations like Helmholtz and Fraunhofer have declared that they seek to make the majority of their publications OA until 2025 (Bundesministerium für Bildung und Forschung, 2016; Bundesministerium für Bildung und Forschung, 2016). Swan et al. counted over 660 OA policies in 2015 (Swan, Gargouri, Hunt, & Harnad, 2015). The University of Münster has adopted an OA resolution in 2012 (Westfälische Wilhelms-Universität Münster, 2012) and has signed the „Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities“ (2003) like more than 550 national and international organizations. This means that Münster University encourages and supports authors to publish OA, but the authors can freely decide if they do so or not. In addition, Münster University signed the OA2020 Expression of Interest, an international initiative which

promotes the OA business model for scholarly journals (WWU Münster, 2017). In concrete terms, the university provides a fund for financing OA publications, runs an open repository called MIAMI, publishes an OA series, provides an editing system for OA journals, and offers additional support services.

Despite those measures, OA is rarely used as a way of publication among researchers by now: The SOAP (Study of Open Access Publishing) project, a large survey funded by the EU with more than 38,000 respondents, detects that only 8% of the annual output is published OA (Cordis, 2013). We intend to further investigate this phenomenon, in order to understand hindering factors that prevent authors from using OA publication strategies.

In general, there are three different strategies for publishing OA: the 'Golden Way', the 'Green Way', and the 'hybrid model' 'Open Choice'. The Golden Way is the most common strategy and means the immediate publication of an article OA, typically in a free journal. These journals are published by public organizations, nonprofit organizations, or commercial publishers, who collect article-processing charges (APCs) from authors. The Directory of Open Access Journals counted more than 11,000 OA journals with about 3 million articles (DOAJ, 2018). One of the most famous OA journals is PLOS One with more than 30,000 articles a year from all fields of research. The reputation of the golden way has been threatened recently by predatory journals which publish papers without a review process to increase the number of paying authors and, eventually, their profit (Beall, 2013).

The Green Way is another possibility for authors to make their work accessible. It includes a publication in an institutional or departmental repository or on an institutional or personal website, mostly in addition to a publication in a subscription-based journal. According to a study by Swan and Brown (2005), nearly half of the researchers self-archive their work in that way. At Münster University, the library is hosting MIAMI, a repository for OA publications.

The Hybrid Model (or Open Choice model as coined by the large publishing company Springer) is a model in which the author pays a fee to publish an OA article in a subscription-based journal. It is very disputed and critics argue that it is non-transparent and the publisher is paid double ('double dipping') (Björk, 2012). For these reasons, the Hybrid Model is not supported by Münster University's OA fund. With only 2% of authors choosing this option, the Open Choice model is rarely used (Cordis, 2013).

The traditional way of publication is called 'Closed Access', meaning that the reader has to pay a subscription for the journal or a fee for the article, while the author is not charged in most cases. Sometimes, there are substantial fees even for non-OA papers (e.g. fees for colored graphs or 'voluntary' procession fees), but they are comparatively rare (Gray, 2015). Closed Access is still the standard way of publishing in science (Cordis, 2013; Ilva et al., 2017; Tennant et al., 2016) - a fact that justifies our research question: *Why is Closed Access still the standard publishing model in science and what factors are hindering the diffusion of Open Access?*

3. LITERATURE REVIEW

Previous studies indicate that an author's choice for a publication model does not depend on a paper's accessibility, but on the quality of the publication (Warlick & Vaughan, 2007). While there is no inherent advantage of OA, some potential disadvantages are discussed in literature, namely low impact, low reputation and high cost, which we will discuss in this chapter.

A traditional argument against OA is that OA journals often are not indexed by commercial indexing services (Björk, 2004). This implies that their impact is low. As we learned from literature, the impact of OA publications in terms of their citation score seems to be at least as high as the impact of subscription-based journals (Antelman, 2004; Björk & Solomon, 2012; Eysenbach, 2006; Harnad et al., 2004; Norris, Oppenheim, & Rowland, 2008; Swan, 2010). McKiernan and colleagues analyzed 70 studies, of which 66% found a citation advantage of OA (McKiernan et al., 2016). This advantage strongly differs between the disciplines. Estimations of the OA citation advantage range from -5% to 600% (Swan, 2010) and from 25% to 250% (Wagner, 2010). Even if some authors describe a much smaller effect if taking into account more predictors, such as McCabe and Snyder (2015) who report only an 8% advantage, the effect still exists.

Another argument explaining the low adoption of OA is an assumedly low reputation (Swan & Brown, 2005). In this context, the current discussion focuses on predatory or fake journals (Beall, 2013; Dadkhah, Obeidat, Jazi, Sutikno, & Riyadi, 2015; Günaydin & Dogan, 2015; Hutson, 2009; Jalalian & Mahboobi, 2014; Mehrpour & Khajavi, 2014). A recent longititude study reports a huge increase of this

phenomenon and estimates that each year over 400,000 articles are published in about 12,000 predatory journals (Shen & Björk, 2015). The number of trusted journals registered in the Directory of Open Access Journals is similar, which demonstrates the threat predatory journals pose to the reputation of OA in general. In addition, journals with cheaper publication fees are suspected to have lower standards and no or no rigorous review process compared to subscription-based journals (Müller, 2009; van Noorden, 2013). Nonetheless, the results of the SOAP project do not support the thesis of a low OA reputation (Cordis, 2013).

While there is an intensive discussion about the impact and reputation of OA, the cost aspect attracts surprisingly low attention. This is puzzling, because the APCs are substantially high, especially against the background that authors who publish in a subscribed journal do not have to pay at all. The average charge for an OA article is \$660, but the price varies strongly between \$8 and \$3,900 (van Noorden, 2013). According to the OpenAPC, a large dataset of about 50,000 OA articles from 11 countries, the average costs for an article in 2017 were €1,686 factoring in all countries and €1,610 in Germany (Open APC initiative, 2018). Only a few studies have examined the cost aspect. Solomon and Björk (2012) found an average willingness to pay of \$649 per article, ranging from \$0 to \$5,000. However, the study is limited to authors who have already published OA. Warlick and Vaughan (2007) conclude that APCs are not a hindering factor in the most cases, but their study was limited to the biomedical faculty. Coonin and Younce (2010) reported that 56% of researchers would not publish in journals that required APCs. As Nariani and Fernandez (2012) conducted a qualitative study and reported that some researchers reject the idea of paying a charge as a matter of principle and claim a wage from the publishing companies for their work.

A study of the reasons for publishing OA indicates that authors who publish OA have a rather positive attitude towards the principles of OA (Swan & Brown, 2005). This leads to the assumption that a low rating of OA strategies in general could be another relevant factor hindering OA. The SOAP project, however, reports that 89% of researchers would say that OA is beneficial for their field of research (Cordis, 2013).

Based on the previous work, we need to test the influence of the factors perceived impact, perceived reputation, acceptable costs and general attitude on the publishing behavior. We assume that there are significant differences between the departments.

4. METHOD

By conducting a quantitative user survey among the researchers of Münster University, we opted for a researcher-centered approach in outlining potential barriers for OA and possible options to overcome them. Münster University's researchers are from the natural sciences, the life sciences, mathematics, the humanities and social sciences, and from economics and law. This gives us the opportunity to examine differences between the departments. The survey was conducted as an online survey during November 2017. In total, 353 questionnaires were completed which is about 6% of the population.

The survey centers the following questions:

- 1) Do the participants publish OA? (Usage)
- 2) Do the participants use OA articles as a scientific source? (Impact Factor)
- 3) How do the participants rate the reputation of OA publications in their field of research? (Reputation Factor)
- 4) How much are researchers willing to pay for an OA publication? (Cost Factor)
- 5) How do the participants rate the different OA publication models? (Attitude Factor)
- 6) If participants never have published OA - what are their reasons? (Test for additional factors)

5. FINDINGS

5.1. Status of Open Access

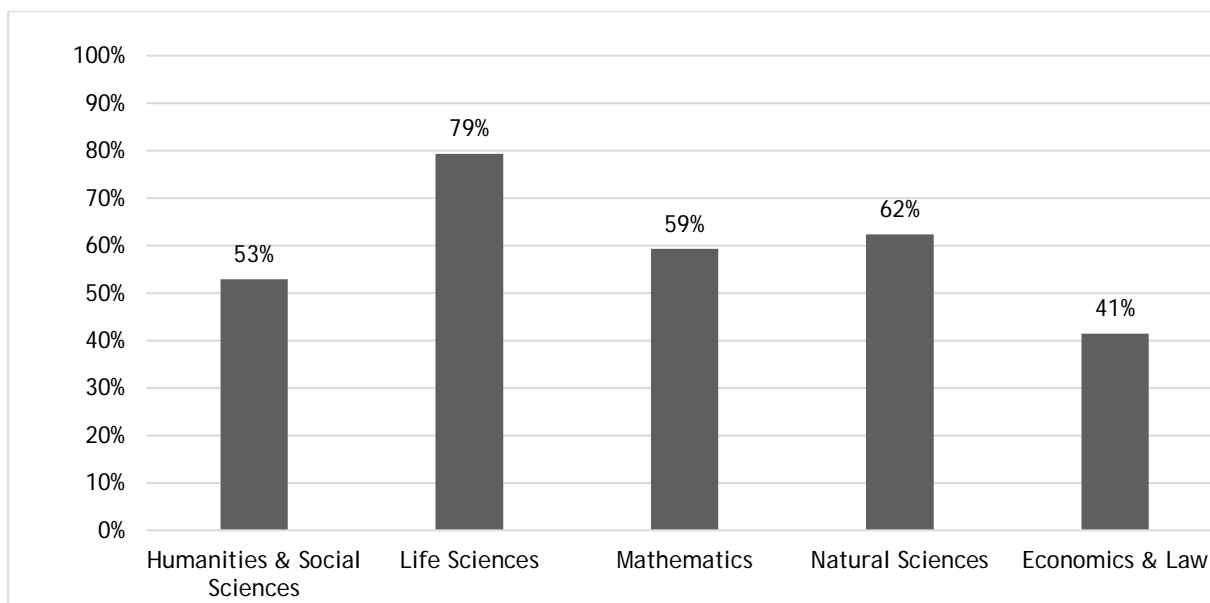


Figure 1: Share of researchers who have already published Open Access

Despite the promotion of OA by funders and politics, there is still a very high share of researchers at Münster University who have not yet published OA in their scientific career (40%). Factoring in the professional status, the picture changes: While professors usually have published OA, members of the mid-level faculty have not. One possible reason is that professors generally have a larger number of publications, making it more likely that they already published OA. In this context, it would be helpful to know the exact share of OA publications in their work. Another possible explanation is that there are a lot of PhD candidates among the mid-level faculty members who have no publications yet.

When comparing the disciplines, the highest OA publication rate is in the life sciences (79%) where the percentage is nearly twice as high as in economics and law which has the lowest rate (41%) and is the only discipline where the majority has never published OA (see Figure 1).

When it comes to publishing in the central OA repository of Münster University, MIAMI, only 6% have used this possibility to publish their work. Over two-thirds of the sample never heard of it.

In total, the results show that OA is not as established as it should be bearing in mind the recommendations of funders and politics. This is in line with other studies that report a low OA rate (Cordis, 2013; Ilva et al., 2017; Tennant et al., 2016). In the following chapter, we will examine possible reasons for this situation.

5.2. Rating of Publication Models

As described above, there are four different publication models: Closed Access (publication in a subscription-based journal or a book), Golden Access (immediate publication OA), Green Access (republication of a closed publication in an open repository) and Open Choice (publication of an OA article in a subscription-based journal by paying a fee). We wanted to know how researchers evaluate these different options in direct comparison. If the traditional Closed Access model receives a better rating than the OA strategies, this would be a strong hint for a general problem of OA. The results, however, show that this is not the case (see Table 1). The traditional Closed Access approach is considered useful by only 13% of the participants, while 71% reject it (16% 'can't say'). Even in departments where OA has a comparatively low reputation (see the following sections) and the usage rate is low, the majority does not support the traditional publishing way. By contrast, Golden Access is rated best with about 75% approval. The rating for Green Access is nearly as high as for Golden Access, while Open Choice is as unpopular as Closed Access. These are interesting findings, because they indicate a high

consent with the general principles of OA and a high discontent with the traditional publication strategy of the major publishing companies. Regarding the figures, we would expect a high rate of OA publications among researchers. As we found out, this isn't the case. Therefore, we will continue to search for hindering aspects.

Model	Total		LS		NS		MA		HS		EL	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Gold	1,94*	,235	2,00*	,000	1,99*	,106	1,89	,315	1,93	,265	1,78	,428
Green	1,90	,303	1,81	,397	1,92	,267	1,92*	,282	1,89	,311	1,95*	,213
Hybrid	1,34	,476	1,26	,445	1,37	,485	1,24	,437	1,37	,486	1,43	,507
Closed	1,15	,359	1,03	,167	1,17	,378	1,21	,419	1,14	,349	1,25	,442

Table 1: Rating of different publication models

LS=Life Sciences, NS=Natural Sciences, MA=Mathematics, HS=Humanities & Social Sciences, EL=Economics & Law; Scale 1 (refusal) to 2 (acceptance). Highest scores are marked.

5.3. Impact of Open Access

A possible reason for a low OA publication score is a low impact, i.e. a low number of citations which reflect the attention of the scientific community and the importance accredited to the publication. Our results show that this concern is unfounded: Scientific papers in OA-Journals are the participants' most commonly used scientific source (see Table 2). This is in line with previous findings (McKiernan et al., 2016).

There are interesting differences between the disciplines, reflecting their respective cultures. While OA journals are highly relevant as a source in the life sciences (e.g. medicine) and are also common in the natural sciences, the humanities and social sciences, and mathematics, their use is very unusual in economics and law. Such differences are evident not only in the use of open and closed content, but also in the use of online and printed materials. In disciplines with an accelerated progress in research and fast publication processes, such as natural sciences, life sciences and mathematics (which includes informatics as well), the usage of printed material is very low. In the humanities and social sciences and in economics and law, on the other hand, printed books are the most cited source. The use of e-books is comparatively low in all disciplines.

Interestingly, Green Access, which means publication without the involvement of publishing companies (e.g. conference talks, discussion paper), does not play an important role in any discipline. This shows that publishing companies are still very important gatekeepers to the scientific community (Table 2).

	Total		LS		NS		MA		HS		EL	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
OA journals	3,95*	1,221	4,56*	,0896	4,07*	1,190	3,89	1,197	3,85	1,200	3,17	1,221
Closed online journals	3,66	1,434	3,29	1,453	3,86	1,426	4,07*	1,359	3,50	1,420	3,63	1,437
Printed Journals	3,38	1,449	3,07	1,385	2,94	1,502	2,62	1,208	4,06	1,122	3,74	1,521
Printed Books	3,52	1,232	2,34	,911	3,07	1,063	3,72	,996	4,27*	1,000	3,91*	1,245
E-Books	2,80	1,244	2,44	,950	2,54	1,180	3,18	1,362	3,14	1,297	2,77	1,215
Non-publisher	2,31	1,155	1,97	1,052	2,10	1,108	3,16	1,546	2,42	1,029	2,42	1,232

Table 2: Usage of different publication types as a scientific source

LS=Life Sciences, NS=Natural Sciences, MA=Mathematics, HS=Humanities & Social Sciences, EL=Economics & Law; Scale 1 to 5. The highest scores are marked.

In summary, we can assert that the impact of OA sources is high in all disciplines except economics and law. In natural sciences, life sciences, and mathematics even an OA citation advantage is visible. This means that the low OA publication rate cannot be explained with a low impact, except in the field of economic and law where researchers rely mostly on traditional printed sources.

5.4. Reputation of Open Access

As the previous chapter has demonstrated, OA literature is widely used for research. However, the reputation of OA has suffered due to some dubious publishers of fake and predatory journals. At Münster University, researchers disagree on the issue of OA reputation: While one half attests OA publications a similar or even better reputation compared to Closed Access publications, the other half supports the statement that the reputation of OA is lower in their field of research. Again, there are significant differences between the disciplines. Researchers from economics and law assume that OA has a low reputation in their field which also might explain their rare use of OA sources. In comparison, researchers from the other disciplines who use OA sources significantly more often attest OA an explicitly higher reputation. Not surprisingly, reputation and the use as a source are positively correlated: The better the perceived reputation of OA, the more likely a researcher will cite OA literature (and vice versa). An interesting additional finding is the high percentage of respondents who are unable to assess the reputation of OA in their discipline (20%). This means there is a lot of uncertainty about the quality of OA journals.

5.5. Costs of Open Access Publication

As our findings show, the overall reputation and the impact of OA are quite good. In consequence, these factors do not explain the low rate of OA publications and costs have to be examined as another possible reason. On average, participants who are publishing OA pay €1,784 a year for these publications. This is a relatively low amount bearing in mind that €1,610 is the average price for publications of a single OA article in Germany (Open APC initiative, 2018). The average costs at Münster University fluctuate between €234 in the humanities and social sciences and €3,576 in the life sciences. In the humanities and social sciences, economics and law, and mathematics OA publication is often free of charge. Low costs are correlated with a lower reputation of OA in these disciplines - a result which is in line with the findings of van Noorden (2013) who reported on a correlation between price and reputation. More expensive journals have more money they can spend on a rigorous review process.

Usually OA costs are paid from project funds or an institution's general budget. Special institutional funds for OA were not mentioned. Consequently, the costs of OA compete with other costs for research. The only alternative is an OA fund of the university library (ULB) which is available for articles in OA journals with costs up to €2,000, for OA monographs up to €6,000, and chapters in OA edited volumes up to €2,000. This fund is used mostly by researchers from the life sciences and the humanities and social sciences. Some researchers from the natural sciences report that the costs of prestigious journals exceed the limit of the ULB fund (e.g. €3,700 for Nature Communications, \$2,900 for Physical Review X), so they cannot benefit from this offer. Due to its limitation and a low awareness level (40%) only 8% of the participants have ever used the ULB fund.

5.6. Willingness to Pay for Open Access

When examining researchers' attitude towards OA, their willingness to pay is a relevant indicator (see Figure 2). At Münster University, the average willingness to pay is €362, deviating between €92 in economics and law and €630 in the life sciences. Even the maximum is clearly below the average price for an OA article (€1,610). Even if we eliminate all cases with a value of €0, the picture stays the same with an overall average of €792 which is not even the half of the actual costs. Comparing the disciplines again, the highest willingness to pay is in the life sciences (€1,089), while the others are vary between €550 and €700. These results are in line with the findings of Solomon and Björk (2012).

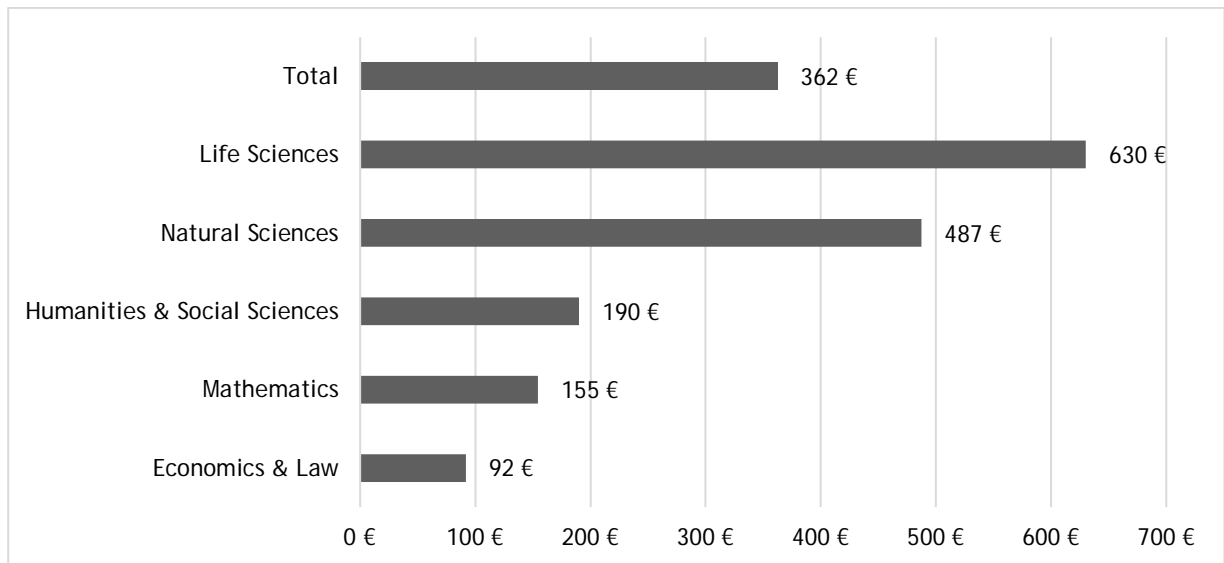


Figure 2: Willingness to pay for an Open Access article

Overall, the findings suggest that costs are a very important factor hindering the diffusion of OA. There are two possible explanations for the participants' low willingness to pay: On the one hand, researchers might expect to benefit less from an OA article compared to an article in a subscription-based journal. On the other hand, researchers might be unable to pay more because of a lack of funds for OA publication in their disciplines. Either way, OA has a big economic disadvantage from the researcher's perspective: While publishing the traditional way in a renowned journal with a known impact is free of charge, he has to pay a substantial sum for publishing in an OA journal with an unclear reputation and an unknown impact.

5.7. Reasons Against OA Publications

It turns out that nearly one third of the researchers who mentioned that they never published OA are PhD candidates with no publications at all. Since this is not a reason against an OA publication, these cases were ignored and the following reason came to the fore: a lack of information about a suitable OA journal. This is even true for disciplines with an OA-friendly culture where OA publications are common (e.g. mathematics or natural sciences). The second important reason is an assumed low impact of OA publications (34%). Apart from that, costs seem to be a problem in mathematics (50%), in the natural sciences and the life sciences, while this reason is rarely mentioned by researchers from the humanities and social sciences (total: 31%). We assume that the APCs in this field are considerably lower or absent. It seems to be mainly a problem in the natural sciences and in economics and law. A low quality of OA journals was named by 26% of the researchers, mainly from the life sciences and economics and law.

In total, the sample of researchers who never published OA is too small for reliable results. Nevertheless, the importance of a lack of information about suitable OA journals is helpful to explain the low OA publication rate. From an economic point of view, search costs are costs as well which individuals try to avoid if the benefit is low or uncertain.

6. CONCLUSION

At Münster University, the share of researchers who publish OA is very low. To identify reasons, we tested four different hypotheses: 1) a general refusal of OA publication strategies, 2) an assumedly low reputation of OA in the respective field of research, 3) an assumedly low impact of OA, and 4) cost of OA that exceed the willingness to pay. We are aware that our findings reflect the specific situation at Münster University in Germany and that the sample is not very large. However, they are in line with the results of previous work in the same field and the conclusions can serve as a starting point for further research.

Our findings show that there is a high level of agreement with the concept of OA, while the traditional Closed Access model and the Open Choice model favored by big publishing companies are largely rejected. Moreover, the reputation and the impact of OA articles seems to be comparatively high in most disciplines. The only clearly negative aspect of OA seems to be the costs for article-processing charges (APCs) which considerably overrun the researchers' willingness to pay. Another important obstacle we discovered in answers to open question is a high uncertainty about OA and a lack of information about existing OA journals, publication models, reputation and funding options. This uncertainty leads to higher search costs for OA publications which researchers simply avoid by sticking to closed journals. Since their impact and reputation is at least as high as that of OA journals, there is a clear cost-value advantage on the part of the traditional Closed Access model. Unlike previous studies, this survey allowed to examine different disciplines and discover their heterogeneity in terms of OA. While the life and natural sciences already have an OA-friendly culture and their researchers often use OA journals as a source and as a way of publishing, the humanities and economics and law very often use rather traditional materials such as printed sources that are not suitable for OA. In addition, the conditions in view of funding and APCs, the reputation and impact of OA-journals, the relevance of the publication speed, and the discipline's culture vary considerably, resulting in a different usage of OA. This leads to the conclusion that a one-fits-all OA strategy for all departments is not very promising.

Nonetheless, our findings also reveal some opportunities to foster OA in general. From an author's point of view, one main problem of OA is the cost disadvantage: Publications in a closed journal are free of charge, while OA publications cost about €2,000 on average which is a substantial amount for many researchers. For this reason, we recommend non-bureaucratic and interdisciplinary ways of funding for OA publications such as a national or European fund as already suggested by others (Cordis, 2013; Nariani & Fernandez, 2012) and campaigned for by the OA2020 initiative (WWU Münster, 2017). Based on the results, these fund should only support Golden and Green Access, not the hybrid model Open Choice. In addition, funding amounts should not be limited in a way that excludes high quality journals with a costly review process on principle.

In addition, the uncertainty about OA has to be reduced. There are lot of untrustworthy publishers and fake journals with no review process which exploit the principles of OA for profit and, thereby, corrupt the image of OA (Dadkhah et al., 2015; Günaydin & Dogan, 2015; Hutson, 2009; Jalalian & Mahboobi, 2014; Mehrpour & Khajavi, 2014). Especially for researchers with little experience it is hard to distinguish between quality journals and predatory journals. For this reason, we recommend a seal of approval for high quality OA journals awarded by trustworthy non-commercial institutions, such as the German Research Foundation or similar public organizations. Approved journals should be listed publicly on the Internet, like the Beall's list for predatory journals ("Beall's List of Predatory Journals and Publishers"). Funders should only pay for articles published in these whitelisted journals.

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