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Drivers and Obstacles of Open Access Publishing. A Qualitative Investigation of Individual and Institutional Factors

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Open Access (OA) is an evolving publication model that is heavily supported by politics and science organizations aiming to make scientific knowledge more accessible to a wider audience. Whether it will indeed alter scholarly communication, however, depends on researchers' underlying attitudes, motivations, and needs. Drawing on group discussions and interviews ($n = 42$), this study explores the perceptions, attitudes and behaviours of researchers towards OA publishing. We focus on researchers in the field of biomedical and health informatics located in different global regions and from different seniority levels. Overall, the results show that whilst most researchers support the idea of making scientific knowledge freely accessible to everyone, they are hesitant about actually living this practice by choosing OA journals to publish their own work. Article processing charges and quality issues are perceived as the main obstacles in this respect, revealing a two-sided evaluation of OA models, reflecting the different viewpoints of researchers as authors or readers. The results further highlight hitherto underexplored influencing factors regarding institutional frame conditions, located on the level of the scientific system, the publication service providers or the national/international OA policies.

Keywords: open access, science communication, attitudes, qualitative interviews, academic publishing

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INTRODUCTION

The dissemination of findings and ideas is an integral part of scientific research. Academic journals are important venues in this respect, as they not only create a public record of knowledge that shapes the development of disciplines, but also form a core component of scholarly communication—within and beyond the scientific community (Hyland, 2016). Over the years, publication processes have significantly changed. This is most evident in the development of Open Access (OA) models. Initially founded in niche areas by small initiatives embracing the idea of sharing knowledge freely on the web (Dalton et al., 2020), the notion that (publicly funded) research should be publicly available to all interested parties has now become a global movement. OA publishing is seen as a possibility for the democratization and broader communication of science, blurring the line between internal and external science communication (Bonfadelli et al., 2017).

In this vein, reputable journals are offering new options for publishing research papers (Kuballa, 2017) and are evaluating ways of spreading OA by implementing and testing new business models (Haux et al., 2016; Spann et al., 2017). The rise of OA on the publication market is stimulated by politics and science organizations. The European Union stated in a press release in May 2016 that all scientific output of publicly funded projects has to be freely accessible to everyone and thus published in OA until 2020 (Politico, 2016). Even 1 year earlier the Max Planck Society started a global Open Access initiative, which is endorsed by research councils, funding agencies, academic institutions, and publishers committed to speeding up the transition to OA by transforming existing subscription-based journals into OA journals [for a comprehensive overview of the OA movement and its implications for scientific research see Kuballa (2017), Max Planck Digital Library (2019)]. These attempts correlate with the requirements of societal impact and public engagement of science through science communication activities (Bonfadelli et al., 2017): researchers are increasingly called out to communicate their knowledge not just within their field but also to general audiences. Open access availability fits into this paradigm (Leßmöllmann, 2020), although simply providing access to information about a (highly specialized) topic does not compensate for an actual barrier-free dialogue between scientists and the public.

With the growing relevance of OA models, the determinants of scientists' publishing attitudes and behaviours have received considerable scholarly interest (Rowley et al., 2017; Severin et al., 2020). Overall, however, the research field presents itself as rather scattered and a comprehensive understanding of why scientists decide (not) to publish in an Open Access journal is still lacking. Given the centrality of scientific knowledge for contemporary societies (Weingart, 2001), it is nevertheless crucial to understand the drivers and obstacles for OA publishing to discuss the future development of scholarly communication and to decide on appropriate strategies. Moreover, with some notable exceptions [e.g., Sheikh (2019), Joung et al. (2019)], prior studies have mainly focused on the publishing behavior of scientific communities in Europe and the US [e.g., Zhu (2017)]. Research on a global movement such as OA, however, calls for an international perspective that takes into account the varying individual and institutional conditions that influence the production, dissemination, and reception of scientific knowledge.

Building on previous research in this area (Kuballa et al., 2019), the present study aims to address these gaps by providing an in-depth investigation of an exemplary research discipline that is particularly affected by transitions to OA (Severin et al., 2020). We conducted group discussions and interviews with medical informatics researchers located in all parts of the world and with different levels of seniority in order to obtain a comprehensive picture of their perceptions, motivations and behaviours regarding OA publishing. Besides providing an international and generational overview, we deepen prior examinations of individual and institutional contexts. As the OA movement ultimately depends on the authors' decision where to publish their work (Heaton et al., 2019), our findings offer important insights into a current trend that might significantly shape the internal and external communication of science (Lüthje, 2017; Leßmöllmann, 2020), and serve as building blocks helping relevant stakeholders in advancing a barrier-free development and communication of science.

BACKGROUND AND CONTEXT: PERCEPTIONS OF AND ATTITUDES TOWARDS OA PUBLISHING

OA has a longer history of development (Suber, 2009), key steps being the Budapest Open Access Initiative in 2002 and the Berlin Declaration on Open Access in 2001, both asking for a liberal copyright policy for facilitating the access to scientific literature (Budapest Open Access Initiative, 2002; Max-Planck-Gesellschaft, 2003). The share of OA articles has grown steadily since then: while it was only 2.9% in 2003, it was already 27.9% in 2017 (Laakso et al., 2011; Piwowar et al., 2018). Over the years, complementary but parallel strategies to OA have been advocated. The most important ones are the gold road and the green road to OA. The gold road (also known as gold OA) refers to the primary publication of scientific work either in a genuine OA journal or by choosing the OA option offered by a subscription-based journal. Importantly, the content is freely available from the moment it is published, whereby the rights of use granted to the publisher and the conditions of use applying to the openly accessible content are clearly specified. Gold OA models are typically funded by publication fees (so-called Article Processing Charges) payed by the author of the accepted and published article. The green road (also known as self-archiving or green OA), by contrast, refers to depositing a preprint or defined postprint version of the scientific work in institutional or disciplinary repositories or on personal websites. In this study, we focus on the perceived drivers and obstacles of publishing in gold OA models.

Open Access can only contribute to the democratization and broader communication of science (Bonfadelli et al., 2017) if scientists themselves regard it as a real alternative to the traditional publishing model. Over the years, survey and interview studies have consistently shown that across all disciplines, the majority of researchers is in favor of Open Access (Dallmeier-Tiessen et al., 2011; Tenopir et al., 2017). The ability to reach wider, also non-academic audiences and to increase the visibility and impact of one's own work are the key benefits associated with this publishing model (Heaton et al., 2019; Joung et al., 2019; Dalton et al., 2020).

Despite the positive stance towards open access, researchers appear to be reluctant to fully embrace it (Rowley et al., 2017). This is particularly evident regarding their experience with OA models, and according to what criteria they choose a publication outlet for their own scholarly work. Recent studies show that a considerable share of the scientific community is not sufficiently aware of OA-related initiatives and resources, especially when being located in lower income countries (Sheikh, 2019). Moreover, OA availability is a rather low-ranked factor when deciding where to publish (Blankstein and Wolff-Eisenberg, 2019), even among scholars who have already

authored an OA publication (Solomon and Björk, 2012). Similar to other disciplines (Eger et al., 2015; Zhu, 2017), for researchers in medical and health science, the main criteria for choosing a journal are its perceived reputation and impact factor as well as the rigor and speed of peer review services (Schroter et al., 2005; Joung et al., 2019; O'Hanlon et al., 2020). According to Peekhaus (2020), these criteria reflect traditional values grounded in the academic tenure and promotion system, where OA is not of major importance yet. Scholars' hesitations towards publishing in OA journals echo these considerations, together with uncertainties about plagiarism and copyright (Lwoga and Questier, 2015), in particular regarding commercial reuse (Joung et al., 2019).

One problem associated with OA alternatives is the high prevalence of predatory journals, which pledge small publishing fees and fast turnout but do not publish the paper or provide no proper quality control. Swanberg et al. (2020), for example, found that only 60% of the surveyed university and medical school faculty members could correctly identify a journal as predatory. Young and inexperienced researchers, as well as researchers from resource-limited settings are most likely to be trapped by fraudulent publishers (Kurt, 2018).

This finding is closely linked to a second common barrier of OA, namely the funding of article processing charges (APCs) (Dallmeier-Tiessen et al., 2011; O'Hanlon et al., 2020). Discipline-based studies, however, provide mixed evidence on charging policies as a barrier to OA. While for some researchers in STEM fields, factors as higher quality and greater likely citation might outweigh cost, others perceive APCs as a key challenge for authors without institutional support and research funding (Schroter et al., 2005). Studies conducted among medicine and health researchers in India (Singh, 2015), Pakistan (Sheikh, 2019), or Spain (Hernández-Borges et al., 2006) confirm this view, raising concerns that APCs can reinforce existing hierarchies, as they might exclude authors from publishing in specific (prestigious) outlets. In the literature, attitudes towards OA publishing are mainly assessed from the perspective of researchers as authors. However, the OA movement also refers strongly to researchers as readers of scholarly work. Moreover, especially when it comes to costs, the impact of resources—of countries and institutions—becomes apparent (Sheikh, 2019).

Besides the professional affiliation and related geographic location of researchers, their seniority level has been found to explain attitudes and behaviors towards OA publishing—even though prior studies yield inconclusive results (Rodriguez, 2014): while some studies found that younger and less experienced researchers are more open to OA, others found they rather shy away from new publishing models as they are concerned about negative impacts on tenure (Rowlands et al., 2004; Harley et al., 2010). As young scientists are generally in need of guidance and support to successfully manage a publication process (Merga et al., 2018), this might be probably even more true for a publication outside the traditional, subscription-based routines, while facing the pressure of career and research quality assessment requirements (Wakeling et al., 2019).

Overall, the findings reviewed in this chapter demonstrate the strong interdependence of individual and institutional decision-making mechanisms, which nevertheless needs further analysis. In this paper we focus on three main analytical dimensions to address this research gap, namely institutional frame conditions, researchers' current career stage (i.e., level of seniority) and researchers' geographical location, classified in six world regions (i.e., regionality). Institutional frame conditions here refer to the potential requirements or facilities on part of at least three players that are vital for the generation and publication of scientific knowledge, namely the universities, the publication service providers, and the national and international OA policies that are developed for example by funding bodies. They are external factors, which cannot (or only with difficulty and in the long term) be altered by the scientists themselves but which might significantly shape their attitudes and behaviours towards Open Access. Together, the level of seniority, regionality, and institutional frame conditions provide a comprehensive framework that allows us to view the topic of OA from different angles and thus to better understand its practice in an exemplary research field such as biomedical and health informatics.

OBJECTIVES AND RESEARCH QUESTIONS

In order to shed light on current developments in scholarly communication, the overall aim of this study is to explore the relevant individual and institutional factors that speak both in favour and against OA publishing from a researcher's perspective[1]. Since prior research has hinted to a discrepancy between awareness and experiences (Rowley et al., 2017), we first investigate researchers' familiarity with Open Access:

RQ1: How experienced are the researchers with OA?

Overall, we are interested in researchers' perceptions of and attitudes towards Open Access on the individual level. Our second research question therefore asks:

RQ2: What do researchers perceive as the drivers and obstacles of OA publishing?

The perception of OA may vary depending on the role researchers play in the process of sharing knowledge. Focusing on the author's perspective, we ask about researchers' publication habits:

RQ3: What criteria are most important when choosing a publication medium and model?

Researchers are not only authors but also readers of scientific publications. In order to gain insights from both perspectives, we further ask:

RQ4: How does the reception behaviour of OA articles compare to subscription-based articles?

RQ5: Do researchers differ between a reader's and an author's perspective regarding OA?

As stated above, there are several efforts in politics and science to enhance OA. Therefore, our sixth research question asks

[1]The order of the research questions has changed slightly from the original study plan. The study plan can be obtained on request from the first author.

about aspects on the institutional level that might affect the publication process:

RQ6: What influence do frame conditions have on the decision for a publication?

As we have no prior research on that, we are interested in how researchers imagine the future of OA publishing:

RQ7: How do researchers appraise the development of the publication landscape in the near future and what are their wishes in this regard?

Finally, in order to provide a comprehensive picture on OA publishing, the differences between regionality and seniority levels are considered:

RQ8: Are there country differences and differences between seniority levels in the state and standing of OA?

In order to substantiate these research questions, the present study explores the researchers' perspectives in the field of biomedical and health informatics. Research and publication practices are shaped by disciplinary traditions (Harley et al., 2010). In the field of medical and health sciences, peer-reviewed journal articles reporting on empirical findings play a major role (Fry et al., 2009), with scholars in this field spending a great amount of time reading them (Tenopir et al., 2011). Moreover, in medical and health sciences, the development of OA models is already well-advanced (Severin et al., 2020), making them a nice testing ground for potential variations between regions and seniority levels that can be transferred to research fields with similar traditions. As this interview study on OA represents an empirical module of a project in the field of biomedical and health informatics, we also had the unique opportunity to compile a broad international sample and thus to provide in-depth insights into the scholarly communication practices of one specific discipline [see also Kuballa et al. (2020[2])]. Being more specific, this study is part of the "Trans-O-MIM" project, conducted by the Peter L. Reichertz Institute for Medical Informatics (PLRI) in cooperation with Schattauer Publishers in Stuttgart, Germany, and is funded by the German Research Foundation (DFG). The abbreviated title means the development of "[s]trategies, models and evaluation metrics for the goal-oriented, stepwise, sustainable and fair transformation of established subscription-based scientific journals into open-access-based journals with Methods of Information in Medicine as example" (Haux et al., 2016). A concrete attempt for journal transformation in this project is *Methods Open*, a newly created OA-track of *Methods of Information in Medicine*.

METHODS

This study relies on guide-based group discussions and individual interviews with researchers in the field of biomedical and health informatics. The open approach allows us to reveal new and hitherto disregarded aspects pertaining to the perceptions, attitudes, and behaviours of this research community regarding OA publishing as the respondents have the opportunity to talk about their own experiences in detail, especially with regard to institutional frame conditions, level of seniority, and geographic region. Moreover, it allows us to review and deepen extant findings obtained in quantitative surveys (Rowley et al., 2017). In preparation for this study, we conducted a short survey at an international meeting of biomedical and health informaticians (Kuballa et al., 2017).

TABLE 1 | Composition of the sample.

	Level of seniority		
	Junior	**Middle**	**Senior**
Africa	2 (GD, GD)	3 (GD, I, I)	2 (I, I)
Asia and the Pacific	2 (I, I)	2 (GD, I)	3 (GD, GD, GD)
Europe	2 (GD, I)	3 (GD, GD, I)	4 (GD, GD, I, I)
Latin America	3 (I, I, I)	2 (I, I)	2 (GD, I)
Middle East	2 (I, I)	2 (GD, I)	2 (GD, I)
North America	2 (GD, I)	2 (GD, I)	2 (GD, I)

Number of participants per category. Type of interview: GD, group discussion; I, individual interview.

Sample

In this study, we focus on the perceptions, attitudes, and behaviours of persons doing research in the field of biomedical and health informatics worldwide. Our sampling frame therefore comprised all persons who are organized in the International Medical Informatics Association (IMIA[3], which is the global umbrella organization of biomedical and health informatics with ∼70,000 members. The sample itself consisted of single IMIA members who were suggested to us by the organization as potential participants. As we are interested in differences between regionality and seniority levels, the process for recruiting included a focus on these two characteristics. In total, we interviewed 42 participants from all over the world (divided into six regions) and varying academic experience (divided into three levels), either in group discussions or individual interviews. The three seniority levels are junior (i.e., researchers at the beginning of their careers such as Ph.D. students), middle (i.e., researchers with intermediate experience such as postdoctoral researchers) and senior (i.e., researchers with long experience such as professors or department chairs). The six world regions are Africa, Asia and the Pacific, Europe, Latin America, Middle East, und North America. Thirty-three percent of our participants were female. The exact composition of the sample is displayed in **Table 1** (see **Appendix A** for more information on the sample).

Overall, we conducted six group discussions with two to four participants each (i.e., 18 persons in total). This data base is enriched with individual interviews with another 24 researchers who participated in discipline-specific national or international conferences or authored a paper published in *Methods of Information in Medicine*'s OA track *Methods Open*. Initially, we intended to study a sample of 36 persons in the discussion sessions. However, due to differing time zones, we faced difficulties in recruiting larger international groups, which

[2]Unpublished technical report.

[3]For more information on IMIA visit https://imia-medinfo.org/wp/.

is why we decided to rely on individual interviews. The interviews followed the same guidelines as the group discussions.

Procedure

The group discussions and interviews were conducted from July 2017 to February 2018. Each group discussion lasted for about 1 h, the individual interviews lasted for about 30 min. The majority of them was conducted virtually, using a video conferencing tool[4], only six individual interviews were conducted face-to-face. All conversations were recorded using at least audio for further transcription and analysis in MAXQDA software. All group discussions and interviews were done in English. Transcription was based on a set of rules established by Kuckartz (2018) and Dresing and Pehl (2015), which focus on the content.

Overall, our methodological design ensured that participants could respond spontaneously and unconfined, with as little intervention as possibly needed. In the group settings, the interviewer paid attention to establish an open culture of discussion, encouraging participants to freely narrate and to engage with arguments raised by fellow participants. The topics covered in the group discussions and interviews were based on a guideline representing the research questions of this study[5]. The interviewer did not follow this guideline rigidly, but rather used it as vehicle to structure and animate the conversations. If the situation demanded it, more specific follow-up questions on aspects brought up by the participants were asked.

Analytical Approach

In order to identify patterns in the data and to answer our research questions, the transcripts of the group discussions and interviews were systematically annotated and condensed following the qualitative structuring content analysis approach by Mayring (2014). Three authors of this paper were directly involved into the analytical processes, in constant exchange with the entire team of authors. They developed a coding scheme containing central dimensions based on the research questions investigated in this study[6]. Two authors immersed themselves in the data by reading and rereading the transcripts carefully and conscientiously, in search for deeper understanding (Moser and Korstjens, 2018). They applied the coding scheme using MAXQDA following an iterative procedure based on a mutual understanding agreement: First, one author selected and reduced the material so that the essential content remained. She prepared a coding scheme (containing variables and dimensions) and a coding guideline (containing coding rules and a collection of anchor examples for orientation) that was used to mark discovery points. Then, a second author reproduced the procedure and further structured the material, leading to the final annotated material in accordance to the previously defined coding scheme. A third author has supervised all steps, ensuring a satisfactory reliability of the subsequent coding of the two authors. Coding scheme and findings were intensively discussed among all authors to ensure intersubjective understanding.

[4]We used the video conference software of DFN, the German National Research and Education Network, based on Adobe Connect.

[5]The exact wording of the guidelines can be found in **Appendix B**.

[6]The coding scheme can be found in **Appendix C**.

RESULTS

Experience With OA Publishing (RQ1)

The majority of the 42 medical informatics researchers that participated in this study has already published in an OA journal. However, while researchers with long or intermediate experience are mostly familiar with Open Access, especially researchers on a junior level from Latin America and from Africa seem to have a lack of experience with this publishing model. This might also be explained by the fact that young researchers in our sample tend to face more difficulties with allocating funding to pay publication fees or have not much publication experience in general. Two interviewees indicated to be editors in chief of OA journals. Besides actual experience with OA publishing, the knowledge about this model is also quite divers. While some interviewees are very well-versed with the discussions and developments surrounding OA, others have never encountered this model before. Accordingly, their definition of OA ranges from detailed information about its functionality, implications, and challenges to the rather simple notion of *"If I can download the PDF." (Europe, junior).*

The presentation of the results continues with the drivers and obstacles of OA publishing identified on an individual level (RQ2), including a differentiated view on participants' attitudes and behaviors as authors and readers (RQ3, RQ4, RQ5). It then moves on to influences on an institutional level (i.e., frame conditions related to the scientific system, the publishing system, and national/international OA policies), RQ6) and participants' estimations of the future of OA publishing (RQ7). The chapter closes with a summary of the regional differences as well as of differences between seniority levels observed in the data (RQ8).

Individual-Level Drivers of OA Publishing (RQ2)

Across all regions and seniority levels, for the majority of interviewees the increased and easier accessibility of articles is the main driver of Open Access publishing. From an authors' perspective, the enhanced accessibility of scientific knowledge is closely related to intrinsic motives regarding science's contribution to society. Scholarly resources are perceived as a public good that should not be hidden behind a paywall:

> *"Well, I think Open Access is absolutely necessary, it's, ahm, it is part of the development in our society regarding transparency, accessibility of information, democratization of information and, ahm, rate to distribute scientific knowledge in a just bigger and larger way than through the subscription journal." (Europe, senior).*

Moreover, about half of the interviewees point out that scientific findings should be accessible for everyone and everyone should have the chance to learn from them. Here, a global perspective is adopted and across all regions, respondents point out the need of developing countries to have free access to scientific knowledge.

This argument applies also to non-academic audiences, as non-academics are usually not able to inform themselves about recent research published in subscription-based journals. One interviewee for example said:

> *"I spend a lot of time talking to cancer patients and support groups and explaining the research I do and they're always stunned that a lot of it is behind paywalls and I mean I share it, but (...) I find it frustrating that, you know, it's just not, especially things that are grant fund by government or you know, a charity and it's like, yes but it's not there for them to see, just seems them disconnect (...)." (Asia and the Pacific, junior).*

For respondents arguing from this perspective, Open Access does not end with free access to publications but is expanded in terms of providing easier-to-comprehend information for laypersons or the possibility to promote multilingualism in scientific resources. This can yet also result in an overflow of information that requires critical management—also in connection with unreliable content:

> *"Ahm, the pro is definitely we can get a lot of information from this kind of resource. Ahm, but it could also be a con there are too many information and, ahm, how could we find what we need in a short time? And maybe if the information could be organized better, so the users could find what they need quickly." (Asia and the Pacific, junior).*
> *"These predatory journals where we need to spend a lot of time to choosing between, this also could be a problem." (Latin America, junior).*

Greater accessibility also implies greater visibility and impact of one's own work. Since it is of utmost importance for the respondents that their ideas and findings are encountered by as many people as possible, expecting a wider reach is another reason for advocating OA strategies. Correspondingly, a faster publication process and better copyright for authors are considered additional advantages of OA, as they allow researchers to access and distribute their own work in a timely manner, and thus give others the chance to build on it. This is problematic with subscription-based articles, as pointed out by one participant:

> *"(…) this year I received an e-mail from a library in Argentina from Buenos Aires and they were asking me to send my work for them, because they would like to have access and didn't have the money to buy it. So I sent it to them, through a mail. I don't even know if this is okay, ahm, to do." (North America, junior).*

Accessibility is further discussed from the perspective of a reader. Many interviewees stress the relevance of being connected to a (well-equipped) institution that provides them with subscriptions to domain-specific journals. In this vein, especially researchers from economically weaker regions report to be excluded from information published in subscription-based journals, which leads to difficulties in building on relevant literature:

> *"I was planning to do a systematic review but systematic review I have to access like many papers so I stopped that idea of doing a systematic review being from Ethiopia. But just for to cite for my work articles I'm just using, requesting my friends to send me and, yeah that's how I'm working." (Africa, middle)*

Individual-Level Obstacles of OA Publishing (RQ2)

Across all regions and seniority levels, the by far most mentioned obstacles in OA publishing are the related costs. Especially interviewees from economically weaker regions reported to not have funding to pay the charges for an OA publication, which drives them away from this publishing model:

> *"We are not all American funded. We are not all funded in a way that we can even ask to that money and (...) especially in the IT, e-health sector which there isn't any funding and so every time we publish we have got zero income and we're expected to spend. And that's, ahm, that's what hurts the most." (Africa, senior).*

Even if the charging policy does not completely exclude researchers from OA, it significantly limits their choice of OA journals:

> *"my first criteria will be, ahm, will they ask me that payment. So because I cannot pay I will just like check at BMC even though it's a low impact or it's not the right journal I will submit to BMC because they will automatically waive article[s] from developing countries." (Africa, middle).*

Most researchers addressing APCs as a criterion for choosing a journal for publication are on a junior or middle level and no mention of this obstacle came from European interviewees. Overall, the interviewees do not understand how the amount of money comes about and believe the high amount is not justified.

Besides APCs, from an author's perspective, a second obstacle relates to the perceived quality and reputation of OA journals. Within the last years, the number of predatory journals grew steadily, and many interviewees reported to regularly receive fraudulent e-mails inviting them to submit or review a paper:

> *"(…) they are not reputable and then unfortunately Open Access has turned to a scam of academics, ahm, it also allows people to publish, ahm, without proper peer-review." (North America, senior).*

Some researchers in our sample—in particular from Africa, Latin America, and Asia and the Pacific—further perceive OA journals to be less reputable than their subscription-based counterparts. These concerns correspond to the criteria for choosing a publication outlet and model, which are further explored in our third research question.

Choosing a Publication Outlet (RQ3)

More than half of the interviewees mentioned the Impact Factor as primary criterion for choosing a publication outlet or model, although many of them question its role in academia:

> *"(…) I think we all hate that part of science that we have to think about that [publishing in an as high impact journal as possible]*

but it is a necessary evil for having a job in this field." (North America, junior).

A suitable scope of the journal (i.e., a good fit) was mentioned with nearly the same frequency, followed by the quality of the editorial and peer review services. However, in many cases researchers report having problems identifying journals of high quality or doubt that just because a journal is well-known it is automatically of high quality. In regard of the quality factor we found that this seems most important for researchers with an advanced career. Another criterion that is important for some of the interviewed persons is a fast processing time. Open Access availability is only for a few respondents the primary factor for choosing a publication outlet, and mostly applies only when sufficient funding is provided to cover the APCs.

Reception Behaviour (RQ4)

Our fourth research question turns to researchers as readers of OA publications. While the perceived quality and reputation of a journal was regarded as an obstacle for publishing in an OA journal, interestingly, these concerns are not mentioned regarding reading an OA publication. In fact, in most cases, the reception behavior at OA articles appears to be the same compared to subscription-based articles. One interviewee stated, for example:

"I don't really check for if it is open or if it's subscription. I go more, okay, is this an interesting journal for my view, then I check if it's open or if it's, ahm, it needs a subscription, of course I'm happier when I know it's open and it's easier." (Latin America, junior).

Interviewees outlined that they usually inform themselves about new articles *via* search engines such as PubMed or Google Scholar. While this applies to both, OA and subscription-based articles, many also use electronic table of content alerts, which rather stem from subscription-based journals than from OA journals. A slightly more positive reception behavior of OA articles could be observed at researchers from Middle East and from Asia and the pacific.

Differences Between Authors and Readers (RQ5)

In the statements presented in the context of the first three research questions, we have already seen different perceptions inherent in the role of an author of scientific publications, which are met by OA models. On the one hand, publishing implies to communicate findings to diverse, also non-academic audiences, and to provide them with relevant and timely information. On the other hand, it enables researchers to gain reputation in the scientific community and to become visible in the respective field. Moreover, nearly half of the researchers in our sample actively differ between a readers' and an authors' perspective in regard to OA. Here, the dividing line between the two roles becomes most apparent in terms of costs, as summarized by one interviewee from North America:

"If you make it a pay to read model it disadvantages the readers in poor areas, if you make it an Open Access journal you disadvantage the authors of, ahm, papers in resource poor areas." (North America, senior).

That is, in the position of a reader, the vast majority welcomes OA publications due to their accessibility, while in the position of an author, the opinion on OA is more difficult, as especially APCs are regarded as a limiting factor. Most researchers who actively differentiated between these positions are located in Europe and Northern America and are advanced in career.

Institutional Influences: Frame Conditions (RQ6)

The previous sections have pointed to individual-level attitudes and behaviour, providing insights into the perception of OA publishing from the perspective of scientists as authors and readers. However, as anticipated by our sixth research question, the decision (not) to publish in an OA journal might also be affected by institutional frame conditions, located on the level of the scientific system, the publication service providers or the national/international OA policies. Overall, the influence of frame conditions on the decision for a publication was difficult to define for many respondents.

The interviews reveal that funding is identified as a central influencing frame condition that is discussed in terms of changes pertaining to the scientific system, to publication providers, and to OA policies in order to promote a barrier-free communication of scientific knowledge. Regarding the scientific system, researchers from all around the world, but predominantly on a middle or senior level of seniority, argue that their decision on a publication model oftentimes builds on the demands of funding organizations. Hence, in their view, funding bodies could support the OA movement by providing additional money that enables researchers to cover the APCs of (required) OA publications, so they do not need to decide between spending money on another study or on publication fees. Besides the funding bodies, researchers are demanding for policies on different levels of the system and other specifications in order to support OA publishing. Where such policies exist, interviewees think they are a good method and do not feel constricted by them in terms of their publication freedom. Especially researchers from Asia and the Pacific, Middle East, and Latin America desire having such policies, as one interviewee states:

"I guess if more grant bodies really insist on it and the other thing is if more universities insisted on it for their students, like that would make a massive change, you know, because if like, if our university would say student work has to be in Open Access, students are doing so many projects (...)." (Asia and the Pacific, junior).

Resonating with the individual-level obstacles identified in this study, a reduction of the costs was also the most popular request to publication service providers, as especially researchers from low- or middle-income countries do not have money to afford an OA publication:

"Ahm, if we have different discounts or agreements as you mentioned with our institute to waive our, ahm, the cost for our authors it would be great opportunity and this would promote Open Access in Egypt so well." (Middle East, middle).

In this context it needs to be mentioned that many researchers did not use or even know about waiver systems of publishers so far. However, international cooperation might make the system even more difficult, as one participant outlined:

"So the publisher tell us that, ahm, because there are two authors from Germany and from the US we are not going to make it free. Ahm, but I was saying they are not funded, they were just giving a scientific support (. . .) and they do not have specific funding for that research work. (. . .) Because the student cannot pay, the accepted paper must have been withdrawn." (Africa, middle)

Besides funding, the quality of the journal is an important issue for the interviewees. Many argue that the quality of OA journals is regarded as lower compared to subscription-based journals, which makes it hard to publish in them due to reputation reasons. The career-related impact of the decision where to publish one's work is thereby considered very high. Hence, they demand publishers to increase the quality of OA journals to the common standard of subscription-based journals.

"Research is very expensive and, ahm, what you publish becomes your reputation and so, if that [Open Access publication] is not [as] well-handled as a good reviewed publication, it can really, really ruin you and at a very high cost. So that's a risk that I see." (Africa, middle)

Moreover, the respondents would welcome OA journals that are not run by profit-oriented publishing houses but for example by scientific organizations. One part of good quality is a thorough and fast review process. Some respondents therefore suggest incentivizing the reviewers, for example by paying them or proving them with a free submission in the respective journal, in order to speed up the reviewing process. Moreover, a smooth publication process that uses up-to-date workflows (e.g., in terms of data security or communication) appears to be important to increase the attractiveness of OA options.

Another point regarding the scientific system is the demand for a change of the scientific evaluation/reward system, mostly in regard to the high importance of the Impact Factor. In this respect, the increased availability of OA papers also raises concerns, as one researcher argues:

"that makes you do that [publishing OA] out of this like set reasons of you need to compare each other. So, like the idea of sharing knowledge—great thing. But having this metric to, well like have more citations because it's Open Access, like gambling on that, so I have to pay more money, but my visibility is better so I get better metric, that's kind of a, yeah, struggling idea." (Europe, junior).

Ethical considerations are also pointed out by other participants, who report that co-authors were not willing to pay for the publication after the paper was accepted.

At the same time, the publication strategy of junior scientists in particular follows the expectations and requirements of their university, which means that factors located on the individual level (such as intrinsic motivations for turning to OA options) take a back seat:

"I would like to publish in something well-known, at least in the beginning. And maybe that then I have more flexibility where to publish, I mean, I still, I only have one article published, still now, ahm, in a refereed journal and, ahm, something in a conference, which wasn't reviewed and yeah, so I need to fast publish and something which is acceptable to people here." (Middle East, junior).

Overall, the topic marketing and information on OA was often addressed and more action demanded. The interviewees, without any differences in their geographic location or career level, outlined that there is not enough information available on OA publishing and they desire better information about the differences and advantages of it compared to subscription-based publications. In this regard they think publishers should make the workflows of an OA publication more transparent (e.g., where does the publication fee go?), and more actively promote their OA options. More guidance on OA was also desired for example for the identification of predatory journals, which is often seen as difficult, especially from researchers at the beginning of their career.

Future of OA Publishing (RQ7)

Enriching perceptions of the current status, our seventh research question asks for a look into the future. Despite the partly controversial attitudes towards OA models, including the concerns from an author perspective, the huge majority of researchers in our study predict a bright future for the OA movement, with a rise of the OA proportion within the next 5 years. Here, no differences across regions or seniority levels have been observed. A majority of the respondents would also desire a change of the whole publication system to OA in the future, although most of these comments were from young, junior-level scientists. It appears that OA publication is strongly associated with modern, digital communication, which stands out from old-fashioned, paper-based systems:

"People are using the internet for free (. . .) and when you go through Pubmed or any other portals, (. . .) if you can read the abstract and do not get access through the full article it's so, ahm, weird, in our times." (Europe, senior).

Many who are also in favor of OA demanded though to retain a choice between the publication models in future. Especially researchers in the middle and in their late career have a more differentiated view on the future of OA:

"It depends on what the big publishing houses are tending to do. Are they going to stand up as a group or are they going to come one publishing house after the other and it isn't just the publishing houses, the societies (. . .) own some of the journals." (Africa, senior).

Those interviewees mostly also prefer OA but mention problems associated with the future of this publication model. So, in their opinion it will depend from the journal and the publisher development regarding this topic, but they see also a dependency from external influencing factors such as politics and policies and mention the further existing financial problem associated with OA.

Differences Regarding Regionality and Seniority (RQ8)

Taken together, in line with the final research question, our data points to some differences due to the geographical location and the seniority level of the respondents. First, it becomes clear that OA is closely linked to the question of resources. Researchers from economically weaker regions (e.g., Africa, Middle East, or Latin America) report far more often to be unable to go for OA alternatives at all or only from certain journals due to financial reasons, which in turn are closely tied to a country's political and economic situation:

> *"It depends on the economic scenario of the country. So, a few years ago we had a better condition in Brazil, I'm talking about Brazil. Ahm, now we are in a political and economic crisis. So, it affects directly the funding." (Latin America, middle).*

In addition, the question is raised, off when a country should get the publication costs waived, highlighting the fine differences also within regions:

> "*I'm very opposed to the extreme costs that some journals are charging now, one. Two, they say they will reduce the fee, or waive the fees to the least developed countries. But it is for a state in the middle, as we are in South Africa, I think it's very expensive" (Africa, senior).*

This ultimately reveals the many different levels the decision to publish in an OA journal is located at: for it is not only the respective region or country (and the associated economic situation) that is decisive whether one can afford to choose this publication model, but also the size or type of the institution within that country:

> *"The problem is when you are in a developing country and you are in smaller institutions. So, if you could help these smaller institutions [with waivers], then I think this would be very nice" (Latin America, junior).*

At the same time, in our sample, the reception of OA journals is slightly more positive among researchers located in the Middle East and Africa. In addition to researchers from Asia and the Pacific, they also strongly emphasize the adoption of OA policies as an important mechanism to advance the OA movement in the future.

Regarding seniority levels, some of our interviewees assume a generation gap, with younger researchers being already more into OA than their more experienced colleagues. Senior scientists are therefore regarded as central gatekeepers for the OA movement:

> *"I think if, you know I like the idea of Open Access, but I think it will take the senior level scientist to persuading that more or promoting it more. I think if journals are wanting to move this way then it may take some marketing and messaging to senior scientists to demonstrate the value of this." (North America, junior)*

In our sample, however, especially junior-level scientists have published very little in OA journals, which nevertheless might be due to the fact that they often lack the funding to make unrestricted journal choices and are dependent on the requirements and expectations of their university or mentors. Moreover, they feel most insecure about the identification of predatory journals:

> *"I just would like to know if they have some, ahm, criterias to go to, because I just don't want to have my work in some, ahm, portal that isn't so, ahm, trusted." (North America, junior).*
> *"Because the Open Access journals they tend to be confusing predatory journals. The same issue in my university also, if it is an Open Access journal they always evaluate if it's not a predatory journal, they tend to confuse it too." (Africa, junior).*

Interviewees with a more advanced career have a more differentiated opinion of OA, which also takes into account implications for the science or publication system in general, such as the informative value of evaluation metrics that are based on downloads, the increasing speed and amount of publications and the related challenges for thorough quality management, or the dominance of big publishing houses. Interestingly, it is also the senior researchers (located in Europe and Northern America) who explicitly distinguish between an author's and a reader's perspective when talking about the OA movement.

DISCUSSION

Fuelled by growing initiatives in politics and science, Open Access may significantly alter the internal and external communication of science (Leßmöllmann, 2020). Since the potential of this movement relies on the underlying motivations and needs of individual researchers, this study set out to comprehensively explore the perceptions, attitudes and behaviours of biomedical and health informaticians towards OA publishing. As early adopter of OA strategies, this discipline is a valuable case in this respect. Overall, the findings of our group discussions and interviews support previous research in this area, but also point to hitherto underestimated aspects, in particular regarding institutional frame conditions, regionality and seniority.

Individual-Level Factors

First, corroborating extant interview and survey studies across various disciplines including medicine and health (Tenopir et al., 2017; Heaton et al., 2019), accessibility appears to be the most important driver of the OA movement. Accessibility is thereby understood in multifaceted ways. From the authors' point of view, it enables comprehensive communication of one's own ideas and findings. In line with findings by Dalton et al. (2020), this is not only regarded as a matter of reputation and

visibility in the field, but also as part of an intrinsic motivation and perceived responsibility to provide broad (non-academic) audiences with scientific knowledge. Our data further supports the well-documented discrepancy between a general support for Open Access and the actual use of OA alternatives (Rowley et al., 2017). As recently indicated by O'Hanlon et al. (2020) or Joung et al. (2019), for those who decide to publish in OA, the most important criteria for choosing a journal are its reputation (e.g., Impact Factor) and quality (e.g., thorough peer review and editorial services). OA accessibility itself, however, is only for a few respondents a primary factor for choosing a publication outlet, and mostly applies only when sufficient funding is provided to cover the APCs (Tenopir et al., 2016).

Overall, our data support prior studies demonstrating that costs are the most prevalent obstacle of OA publishing (O'Hanlon et al., 2020), as researchers with no or only limited funding report to be excluded from this publication model. Importantly, this aspect is also considered by researchers affiliated with well-funded institutions. In this context, however, several of our interviewees have hitherto not known about or used the free waivers offered by OA journals to authors (located in low- or middle-income countries) who cannot afford to pay the APCs. Here, the need for comprehensive information about the OA model becomes evident. While country-specific studies have already pointed to an information deficit (Sheikh, 2019), it is noteworthy that in our study, many interviewees actively desire more information on OA and also think that publishers should better advertise this model. In addition to questions about the financing model and the lack of transparency regarding high APCs, uncertainty revolves around predatory journals, as especially respondents with less experience face difficulties in distinguishing them from an authentic OA journal. Besides the concrete—and widely examined (Kurt, 2018; Swanberg et al., 2020)—danger of predatory journals, some of our respondents also referred to the quality of OA publications as potential obstacle. Hence, although in their quantitative survey, Rowley et al. (2017, p. 1,206) have already identified "positive progress" regarding the perceived quality and production standards of OA journals, there is still distrust in this publication model, even in a research field such as biomedical and health informatics that has joined the OA movement early on [see Joung et al. (2019) for similar results; Severin et al. (2020)].

While from the author's point of view, a distinction between OA and traditional, subscription-based journal is certainly being drawn, from a reader's point of view, we could not identify such differences. This may reveal an important difference between green and gold OA that warrants further investigation: a cross-disciplinary study on researchers' use of OA repositories reports that readers have difficulties identifying the version of an archived manuscript (i.e., whether it is a pre-print or a final publication), with potential negative implications for the perceived quality of the content found (Spezi et al., 2013). The focus on the different roles that researchers play in the publication process—as authors and as readers—payed off in our study. Several study participants who are located in North America and Europe and are already advanced in their career made this analytical distinction even themselves when talking about OA. One explanation for this pattern might be that these researchers are faced with distinct strategies and objectives from political and scientific institutions. Specifically, in North America and Europe OA strategies are promoted by third-party funding providers and scientific associations, but also by political actors, which draws attention to this publication model and its advantages and disadvantages for various stakeholders. Moreover, due to their function in the acquisition and realization of third-party funded projects, scientists that are more advanced in their career come into closer contact with OA publishing as authors, while at the same time, the accessibility of journals at universities in North America and Europe is usually relatively good, making OA less important from a reader's point of view.

Despite the obstacles outlined above, most interviewees predict a future growth of OA models in the coming years. Most of them declared to be ready for Open Access, but they see challenges that need to be worked on in order to establish an equitable global development and communication of science. Closely related to this is the link between OA and the availability of resources (for instance to pay for APCs), which comes to the fore by the international focus taken in our study. Although our respondents are clearly more optimistic, this result resonates with Dalton et al. (2020), who show that scientists are uncertain where the OA movement is heading in the future, as it can have significant negative implications for poorly funded institutions, especially in developing countries.

Institutional Frame Conditions

Besides individual-level factors that shape the perceptions, attitudes, and behaviour of researchers in terms of OA models, our study explored whether institutional-level factors such as demands of funding bodies, the scientific system or the publication service providers might determine where a publication ultimately finds a home. Notably, our respondents had difficulties to freely expand on the influence of institutional frame conditions, but when being asked more explicitly, their considerable impact became apparent. Overall, the researchers in our sample do not feel restricted in their freedom of publication by policies stipulating that results must be made openly available. By contrast, many would even like to see more such policies (established by grant bodies or academic institutions) in order to further advance the transformation of the traditional publishing system. That is, the results indicate that the respondents would like the obstacles perceived at the individual level (e.g., costs or perceived quality deficits) to be solved on an institutional level: either by improving the peer review system on part of the publication service providers or by adapting the academic reward system on part of the scientific system.

Regionality

Given its close ties to the science-society interface, more research is needed to trace the global development of Open Access, accounting for the perspective of individual researchers. A shift in focus away from well-studied (Western) countries will thereby be essential. Our data supports previous single-country studies regarding costs as main barrier to choose an OA publication outlet (Singh, 2015; Sheikh, 2019). Apparently, actors at the

institutional level are regarded as having a duty in this respect: particularly researchers from Asia and the Pacific, Middle East and Latin America argue in favour of funding policies that advance OA strategies in their regions. However, while an international sample allows to transfer and extrapolate the development of this publishing model (at least to a certain extent) on a global level, the present study also indicates that broad regions might need to be further differentiated to gain even more analytical depth by taking into account the conditions of sub-regions or particular institutions.

Level of Seniority

Besides regionality, a closer look at the seniority level might be an issue for future research. Contrary to prior notions that seniority is no strong predictor for perceptions of or experiences with OA publishing (Rodriguez, 2014), our data indicate that junior-level researchers have greatest interest in OA, but often lack the financial and institutional opportunity to actually choose this publication model. The power of norms and scientific cultures with regard to the establishment of an alternative publication model has already been discussed (Harley et al., 2010). In our study, aligning with findings by Wakeling et al. (2019), junior- and middle-level respondents place a strong emphasis on requirements of their scientific institution when choosing a publication outlet. That is, for researchers not holding a professorship yet, considerations regarding their lab culture, academic positions or promotion appear to play a major role. Interestingly, and in contrast to a study by Heaton et al. (2019), the influence of peers is not considered relevant by our respondents. Nor does there appear to be any specific guidance on how to navigate an OA publication, although this kind of support—from mentors and editors alike—could be crucial for researchers at the beginning of their career (Merga et al., 2018). At the same time, senior researchers—who are the mentors of younger colleagues—appear to have a less optimistic view on OA, taking into account the associated controversial discussions within the political and scientific system.

While enriching the scholarly debate about perceptions, attitudes and behaviours of researchers towards OA publishing, our findings have limitations that need to be considered. First and foremost, due to the small number of participants in the group discussions and interviews, the study is limited in its representativeness. Biomedical and health informatics shares important features of its scholarly practices with other disciplines such as the social sciences; most importantly the relevance of empirical work published in peer-reviewed journal articles (Fry et al., 2009). However, due to the wide spread of OA within the discipline (Severin et al., 2020), it is possible that some challenges are no longer relevant and thus underestimated in our study. Moreover, we studied members of one particular association, and it cannot be ruled out that there is a bias towards pro OA as the broader project context of the study was known to our participants. Hence, our findings need to be replicated with larger samples and contrasted with other disciplines before being generalized within and across research fields. We therefore encourage future research to use the manifold aspects documented in this study as the basis for a standardised representative survey to test their explanatory power and to further advance our knowledge about current trends in scholarly communication within and beyond the scientific community.

CONCLUSION

Taken together, the main findings of our study support previous research exploring the drivers and obstacles of Open Access publications, while fostering institutional frame conditions, the level of seniority and the geographical location of researchers as important analytical dimensions.

First of all, our study has reflected on the idea of science as a public good that should be open for everyone is at the core of science communication efforts (Leßmöllmann, 2020). However, openness through free online access of scientific journal articles is more of an organisational or technical accessibility as the provided information is tailored for a highly specialized audience. It is therefore questionable whether OA publishing is really to discuss as science communication activities. In our study, this has been reflected as the concern about an information overload that could result from a strong promotion of Open Access initiatives in the future. It is to clearly state that without curation, explanation, and a translation into everyday language or contexts, OA availability remains rather an instrument of internal science communication—or even "only" as part of iterative knowledge generation processes. This is nevertheless of high importance, as OA creates an opportunity to keep up to date with all developments in the field, particularly for researchers from resource-limited regions and institutions.

Resources (or the lack thereof) are a second major issue raised by our participants. Scholars have already raised the question of whether OA is really the democratic medium it is supposed to be (Dalton et al., 2020). Our study goes one step further by discussing OA in the light of science communication, where the ability for everyone's participation is a central objective (Humm and Schrögel, 2020). In this sense, the question also arises whether a similar development of the OA movement can be assumed globally. According to our data, institutional frame conditions on the level of science policy actors are assigned a key role in this respect: they appear to be central drivers of OA, with individual researchers adapting to their overarching strategies while to some extent still being rooted in the traditional (subscription-based) publishing system.

Finally, our results indicate that researchers at early stages of their career (i.e., pre- and postdocs) could be the pioneering generation establishing OA models as respected alternatives besides subscription-based models. However, in order to advance in the scientific system, they must adhere strongly to the norms and guidelines of the respective institution (Wakeling et al., 2019; Dalton et al., 2020). Our study thus reveals a gap for the development of strategies to balance intrinsic motivation in favour of OA and actual publication behaviour.

So, overall, our study speaks to the field of Open Access research as well as to the science of science communication by revealing a gap between science and practice, between normative perspectives and actual behaviours, between freedom of choices and path dependencies within scientific institutions. It demonstrates that the debate surrounding Open Access (and

related concepts such as Open Science) must free itself from a simplistic, normatively loaden view that instantly connects the opening of scientific knowledge to preconceived benefits. Instead, it requires an analytical and theoretical differentiation of the drivers and obstacles of OA publishing and their implications for different stakeholders—across generations and regions.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

SK, MT, and RH conceived the initial idea and designed the study. EG developed the theoretical framework with input from SK and wrote the paper with input from SK, MT, and RH. SK, MS, and CM developed and conducted the interviews and group discussions, with support from MT. EG and SK analyzed the data. RH supervised the project. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcomm.2020.587465/full#supplementary-material

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