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Transition to the open access model of academic publishing: a psychological perspective

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Abstract

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1 Introduction

Since the turn of the century we have witnessed the open access (OA) movement urging for providing the public with unrestricted, free access to scholarly literature – much of which results from publically funded research. The movement promotes the OA model of academic publishing in place of the traditional model where readers have to pay for accessing literature and where reuse and sharing of the scholarly works are constrained by restrictive copyright and licencing terms. The defining characteristics of OA to scholarly literature are free availability on the public internet and permitting any users to read, use, reproduce and distribute published work without any financial, legal, or technical barriers as long as the authors of the published work are properly acknowledged (Budapest Open Access Initiative, 2002). The potential benefits of OA academic publishing include wider dissemination of scholarly knowledge and mobilisation of knowledge for social and economic benefits. The benefits of OA publishing have been examined extensively and while there are growing numbers of studies showing positive impact of OA, the existing evidence remains inconclusive. To realise the potential benefits of OA to scholarly literature it is crucial to achieve a successful transition from the traditional model of academic publishing to the OA model of academic publishing. However, it remains unclear how such a transition can be managed – what kind of policies and other interventions are needed to be taken by, for example, governments, research funders, universities and researchers in order to accomplish it.

One of the key challenges in the transition to the OA model of academic publishing is to change the publishing habits of scholars. While publishing scientific discoveries has long been a part of an academic job, the significance of the behavioural change is considerable and shouldn't be taken for granted. Researchers had traditionally little control over readers'

ability to access or reuse their work. Now academic authors can ensure readers have free access to their work and unrestricted rights to reuse and distribute, if they select and arrange payments for an appropriate OA copyright licence from options offered by a publisher or archive an appropriate version of the paper into a free online repository without violating the publisher's copyrights. Bernius et al (2009, p.108) note that "despite the high number of scholars who support the new paradigm when asked, the realization of OA in most disciplines is rather low" and "little is known about the reason of this discrepancy". We argue that in order to manage the transition to the OA model we need to understand better what enables, encourages and inhibits adoption of OA publishing among academic researchers.

So far OA policies of research funders were the main instruments for stimulating adoption of OA publishing in academia but it is unclear whether on their own they will be able to stimulate the transition to the OA model of academic publishing. The reasons are twofold. Not all published research articles come from externally funded research and thus the OA mandates of research funders do not apply always and to everyone. Second, the enforcement of funders' OA policies may be quite difficult. Therefore researchers' adoption of OA publishing is likely to depend to some extent on their willingness to do so. We argue that a psychological perspective will enable to understand better what drives, enables and inhibits OA publishing among academic researchers and will enhance our understanding of what, if any, targeted interventions are needed to encourage the adoption of academic publishing and manage a transition to the OA model of academic publishing. Our study adopts a recently developed COM-B model of behaviour (Michie et al., 2011) to examine researchers' motivations, capabilities and opportunities to provide OA to their research articles.

It is plausible that not all academics will embrace OA publishing in the same way. Not only researchers' willingness but also their ability to provide OA to outputs of their research as well as the opportunities to do so may vary across and within disciplines. While studies show that adoption of OA publishing is higher in sciences than in arts and humanities, the differences within disciplines and the reasons for them are comparably less understood (Park, 2009). Given that our past behaviours shapes how we behave in the presence, we argue that researchers who have provided OA to their research materials or outputs (e.g. open datasets or open source biological materials or software) may have different motivations, capabilities and opportunities for OA publishing than researchers who have contributed to the wider community through more restrictive channels, such as exclusive/for-profit licensing of intellectual property, contract research or sharing data within multilateral collaborations. We argue that scholars with a track record of open-source approaches to intellectual property (IP) are more likely to embrace OA publishing than those with a track record of proprietary approaches to IP.

Our study is based on 22 in-depth interviews with scientists working in the fields of bioscience in the United Kingdom (UK) after the launch of RCUK's OA policy (RCUK, 2012b). Bioscience is an intriguing case to investigate the aforementioned within-discipline differences as the open science ethos coexists with more proprietary approaches to

intellectual property. Guided by the COM-B model, we conduct qualitative content analysis to gain rich insights into psychological and environmental factors that affect adoption of OA publishing among bio-scientists with a track record of open-source and proprietary approaches to IP and answer the following questions: (1) What (if anything) motivates each group of scientists to provide OA to their publications? (2) What (if any) capabilities do scientists in each group lack to do so? (3) What (if any) external factors provide and restrict opportunities of each group of researchers for providing OA to their publications?

The study contributes to the academic literature in two ways. First, we enrich our understanding of researcher's predispositions for OA publishing and within-discipline differences. Our findings show a wide range of individual motivations and capabilities and environmental factors that scientists perceive to affect their OA publishing. Our analysis reveals that scientists a track record of open source approaches to IP are strongly motivated to provide OA to their publications while scientists with a track record of proprietary approaches to IP tend to lack motivation but feel under the pressure of research funders to adopt OA publishing. Second, we make a conceptual contribution to the field of science, technology and innovation studies by introducing the COM-B model of behaviour. We show that this conceptual framework can usefully guide analysis of researchers' behaviour and help to generate findings that can inform the design of science and innovation policy interventions. In the final section we discuss the implication for policy and practice as well as the compatibility of policies on OA publishing with policies on research commercialisation. We argue that one size fits all policies and other interventions are unlikely to be sufficient to stimulate adoption of OA publishing among researchers and there is a need for more targeted approaches.

2 Transition to OA publishing – insights from STI studies

Scholarly publishing plays a key role in disseminating scientific and technical knowledge (Houghton and Oppenheim, 2010). As scientific and technical progress is cumulative in a sense that researchers evaluate, replicate, and build upon knowledge produced by others, access to the works of others is necessary to advance science and technology. Given the potential effects of the OA model of academic publishing on science, technology and innovation, it is unsurprising that STI scholars have started inquiry in this area; however the volume of work is still quite small and the findings shed little light into how the transition from the traditional to OA model of academic publishing can be managed. To identify studies about OA in the STI field we have searched key STI journals, listed in Table 1, using Bolean search terms: 'open access' AND publishing. We have carefully reviewed abstracts of all identified articles and excluded unrelated studies (e.g. about other aspects of openness such as open data or open peer-review). The search strategy allowed us to identify 21 relevant original articles and 10 commentaries which were carefully read and analysed.

Table 1. Studies of OA in STI journals

Journal	**#Articles**
Scientometrics	16
Prometheus	3 + 10 commentaries

Research Policy	2
R&D Management, Technovation, Industry and Innovation, Industrial and Corporate Change, Technological Forecasting and Social Change	0

Note. All journal but Prometheus were searched through Web of Science.

Most studies of OA published in STI journals have used bibliometric methods and can be divided into three distinguishable categories. The first stream of work includes descriptive studies, focused on one or more scientific disciples, characterising the uptake of publishing in fully OA journals (Cheng et al., 2012; Mukherjee, 2009), the characteristics of these journals (Graziotin et al., 2014; Gumpenberger et al., 2012) and academics publishing in them (Mukherjee, 2009). The second stream of work examines whether existing metrics for evaluating journals accurately characterise OA journals with a two-stage publication process (Bornmann et al., 2010). The third and largest stream of work examines advantages of OA (Davis and Fromerth, 2007; Dong et al., 2006; Gaulé and Maystre, 2011; Gentil-Beccot et al., 2010; Koler-Povh et al., 2014; Sotudeh and Horri, 2008, 2009; Wang et al., 2015), with most focus on scientific impacts of OA publishing. Articles deposited to open repositories were found to receive more citations (Davis and Fromerth, 2007; Gentil-Beccot et al., 2010; Koler-Povh et al., 2014) but it is disputed whether this effect is attributable to the open and early accessibility of deposited articles (Gentil-Beccot et al., 2010) or to their quality (Davis and Fromerth, 2007; Koler-Povh et al., 2014). Articles published under OA licences in hybrid journals (i.e. journal making income from reader-subscriptions and APC fees for OA) were also shown to have a citation advantage (Gaulé and Maystre, 2011; Wang et al., 2015) as well as more page views (Wang et al., 2014), downloads and mentions on social media (Wang et al., 2015) but it is also debated wheatear the citation advantage is attributable to articles' OAibility or rather their quality (Gaulé and Maystre, 2011). While the third steam of bibliometric studies enhances our understanding of the benefits of the OA model of academic publishing and in some cases strengthens and in some weakens the rationale for the transition to the new model of publishing, it tells us nothing about how to manage such transition.

Another stream of work in the STI filed focuses on the economics of OA publishing and examines whether new models for scholarly publishing constitute more cost effective ways for communication and dissemination of research findings than subscription-based models. A study of Houghton and Oppenheim (2010) has shown that benefits and cost saving related to the journal-mediated and repository-mediated OA models exceed their costs and that the repository-mediated model is far more cost-effective than the journal-mediated OA model. The cost-benefit analysis of Houghton and Oppenheim has been highly controversial (see Prometheus Vol. 28 issue 1). Some considered their assumptions and figures as "for the most part reasonable and even conservative" (Harnad, 2010) while others criticised their work for underestimating true cost of publishing, overestimating cost savings, and unreasonable assumptions, for example, about worldwide uptake of OA (Hall, 2010). This stream of work assessing cost effectiveness of different publishing models can inform the

focus of policy instruments, e.g. on the repository-mediated OA, but tells us relatively little about the range of interventions needed to stimulate the adoption of the specific model of OA publishing.

A transition to OA publishing has also been analysed from a socio-political angle. The works point to the ethical and political unacceptability of the traditional academic publishing system and consider the role of OA model in bringing about a change to the system (Beverungen et al., 2013; Harvie et al., 2013). Scholars examine the socio-political dynamics of change, focusing on the bottom-up strategies taken by academics to resist what they see as profiteering practices of commercial academic publishers (Harvie et al., 2013) as well as top-down policies of national governments and research funders aimed at improved dissemination and utilisation of scholarly knowledge (Beverungen et al., 2013; Harvie et al., 2013). The funders' policies promoting journal-mediated OA model have been closely scrutinised and their potential consequences were discussed, including the possibility of intensifying financial pressures on universities (Harvie et al., 2013, p.234), putting decisions on what publications are openly accessible into the hands of university committees responsible for allocating funds for APCs (Beverungen et al., 2013) but also their potential to empower editorial boards to leave a publisher and set up a replacement journal in order to bring down charges (ibid). With regard to managing the transition towards OA publishing, studies taking a socio-political perspective highlight a wide range of consequences of promoting journal-mediated or repository-mediated route to OA, but, similarly to the previous streams of work, tell us little on the range of interventions that could stimulate the adoption of a specific model of OA publishing.

In conclusion, our understanding of how to manage the transition to OA academic publishing remains limited. The transition rests to large extent upon the adoption of the new publishing model by researchers but the analytical perspectives taken by the past studies in the STI field are not well suited to reveal what drives and inhibits adoption of OA publishing among academic researchers. We argue that a study taking a psychological perspective is needed to understand better the dynamics of researchers' publishing behaviour and generate useful implications for managing the transition to OA academic publishing. In the next section we introduce a psychological framework that we will use to guide our empirical analysis and we review a few studies outside of STI filed which provide some insights into psychological and environmental factors affecting adoption of OA publishing among academics.

3 Psychological framework for analysing changes in researchers' publishing behaviour

We argue that the COM-B model (Michie et al., 2011) explicating why individuals behave the way they do will allow to generate new insights into drivers, enablers and inhibitors of researcher's publishing behaviour. The COM-B model is a framework proposed by Michie et al (2011) as a comprehensive and parsimonious model applicable to all volitional and non-volitional behaviours. The COM-B model draws on insights from past theories and empirical studies of behaviour and suggests that capability, opportunity, and motivation interact to generate behaviour that in turn influences these components (Michie et al., 2011). In other words, for any behaviour to occur, an individual has to be motivated, capable and have an

opportunity (i.e. conducive social and physical environment) to perform the behaviour. The model hypothesises that each component affects the behaviour directly and in addition, changes in opportunities and capabilities can alter the levels of motivation and thus have additionally an indirect effect on behaviour (Michie et al., 2011).

The COM-B framework has significant analytical strengths allowing a more comprehensive and fine-grained analysis of behaviours in comparison to older psychological frameworks, such as Theory of Planned Behaviour (Ajzen, 1985) and Social Cognitive Theory (Bandura, 1977, 1986). First, unlike these past models, the conceptualisation of motivational forces in the COM-B framework includes both reflective (e.g. evaluations, plans) and automatic (e.g. habits, emotions) sources of motivation. Second, the COM-B model endogenises the environmental factors that lie outside the individual (i.e. opportunities) and explicates their relation to internal factors (i.e. motivations, capabilities) in generating behaviour. Third, unlike its predecessors the COM-B model is dynamic in a sense that it recognises that engagement in a behaviour alters the factors pre-disposing the said behaviour.

Last but not least, the past frameworks explain factors affecting behaviour but do not readily suggest how to change it. In the COM-B framework a change in behaviour is thought to involve changing one or more components of the 'behavioural system' in order to put the behavioural system into a new configuration. The COM-B model is integrated into the Behaviour Change Wheel (Michie et al., 2011) – a novel and conceptually-sound framework for behaviour change interventions which identifies nine intervention functions that can be deployed to address deficits in one or more of the three components of the 'behavioural system' and seven policy categories that can be used to enable relevant interventions to occur. The COM-B model is therefore well-placed to inform policy and practice outside academia. It has been used in the design of interventions in areas as diverse as eating (Robinson et al., 2013; Watt et al., 2013), risk of Alzheimer's disease (Anstey, Bahar-Fuchs, Herath, Rebok, & Cherbuin, 2013), and condom use (Newby, French, Brown, & Lecky, 2013). We believe that the framework could be fruitfully used in science, technology and innovation policy studies to gain in-depth understanding of drivers of a wide range of individual behaviours, including OA publishing, sharing of research data, commercialisation of research outputs, among others. Studies guided by the COM-B model could generate evidence for design and implementation of more effective science and innovation policies. Our study is the first attempt to examine the usefulness of the COM-B model for the science, technology and innovation studies. Specifically, we use the COM-B model to identify researchers' predispositions for OA publishing behaviour. In the following sections we discuss the insights from past studies into motivations, capabilities and opportunities for OA publishing.

3.1 Motivation for OA publishing

People have capabilities and opportunities to do many things and it is often their motivation that determines what they actually do. Our understanding of researchers' motivations for OA publishing is still quite limited. We have searched SCOPUS database for articles that mention 'motivation AND "OA" and publishing' in their title or abstract or keywords. The

search yielded 23 results but only three studies examined researchers' motivations (Bernius et al., 2009; Collins and Milloy, 2012; Park, 2009).

Specifically, Collins and Milloy (2012) studied perceptions of and attitudes towards OA monographs through a survey of 31 scholars in humanities and social sciences and found that scholars expect OA monographs to have higher citations and usage but lower print sales - a belief that arguably motivates adoption of OA publishing. Their examination of motivations is focused however on motives for publishing in general and provides limited insights into motivations for OA publishing. Bernius et al. (2009) discusses implications and incentives for all market players in the publishing system. They present a computational simulation of the scientific publishing market showing that early adopters of OA publishing will benefit from increased citations but their advantage disappears when all authors adopt the new publishing model. The study does not examine motivations of scholars in an empirical way. Finally a study by Park (2009) significantly advances our knowledge of motivations for OA publishing. His analysis of the reasons for publishing in fully-OA journals through the lens of theory of planned behaviour (Ajzen, 1985) and innovation diffusion theory (Rogers, 2003) reveals five significant attitudinal factors including behavioural experience, perceived knowledge, perceived career benefit, perceived visibility advantage, perceived authoritative advantage, and perceived technological advantage. Park shows also that motivations differ depending on the tenure status but his study ignores non-rational motivational forces such as habits and emotions and the focus on publishing in fully OA journals limits the generalisability of the findings. All three above studies have been undertaken before major shift in policies of research funders, are limited in scope (e.g. to OA journals or monographs) and neither have examined whether motivation for OA publishing vary among researchers with different experiences of contributing to wider community.

Adopting a COM-B framework will enable us to gain more fine-grained insights into the motivations for OA publishing. In the COM-B framework, motivation is defined broadly as "brain processes that energize and direct behaviour" (Michie et al., 2011, p.4) and is divided into automatic and reflective motivation. The former comprises of factors that drive behaviour without involving intentional decision making such as emotions, impulses, desires, inhibitions, reflexes, habits. Given that many new fully OA publishers have operated since early 2000s (e.g. in 2000 the Public Library of Science (PLoS) in US and BioMedCentral in the UK, PeerJ in 2012), habits and other automatic motivations may have formed but our understanding of these motives remains limited. Reflective motivation is associated with analytical intentional decision-making and includes evaluations and plans (i.e. conscious intentions) (Michie and West, 2013; West and Michie, 2010). These could be, for example, so far poorly understood evaluations of benefits of OA publishing, funder's OA policies, quality of OA journals, or costs of APCs.

We expect that researchers with different experiences of contributing to wider community will not be equally motivated to adopt OA publishing. While perceived benefits of OA publishing are known to motivate researchers' behaviour (Park ,2009), it is plausible that the researchers with a track record of open-source approaches to IP will make more positive

evaluations of OA publishing than researchers with a track record of proprietary approaches to IP. The latter group has first-hand experience of difficulties associated with bringing scientific knowledge into practice to generate economic and societal benefits and may be more sceptical of effectiveness of increased knowledge accessibility without interaction between knowledge producers and users. Furthermore, those trying to make impact through open channels may have stronger positive emotions towards OA publishing as they have already invested time and energy in making their data or research materials available, often with the hope to advance science and innovation. Using the COM-B framework as conceptual lens our study will provide in-depth understanding of reflective and automatic motivations energising researchers to make their publications OA and reveal differences in motivations of researchers with different experiences of contributing to wider community.

3.2 Capabilities for OA publishing

Individuals are more likely to do things they are capable of doing. So far capabilities of researchers related to OA have not been studied systematically. We may expect that most researchers have the computer skills needed to submit a paper to a repository or a journal. However, it is less likely that researchers have got the knowledge of different copyright licences offered by publishers that is needed to take an informed decision to make a publication OA. The Creative Commons copyright licenses slowly emerge as a standard in OA academic publications and an alternative to 'all rights reserved' copyright licences. The most liberal and typically most expensive Creative Commons licence is CC-BY which gives anyone the right to access, distribute and use the content of a publication as long as the user gives credit to the authors. Various combinations of additional terms may be added to a CC-BY licence to create further restrictions on reuse and/or distribution of published work. For example an addition of a 'non-commercial' clause (NC) prohibits commercial reuse of published content, the 'share alike' clause (SA) requires users to share the whole work/any derivative works on the same terms and the 'non-derivative' clause (ND) prohibits creative derivative works using excerpts from a publication. The most restrictive but often the cheapest for the author is CC-BY-NC-ND licence where a publisher allows users to access and share the publication but not to use it commercially and/or create derivative works (ND: 'no derivative works'). As researchers' decisions on copyright licence for their publication affect the extent of publication's accessibility and re-usability, their capability to make informed choices is important.

There is a possibility that researchers with a track record of open-source approaches to IP are more familiar with OA copyright licences that those with a track record of proprietary approaches to IP. For example, those who produce open-source software or open-source databases are likely to have some understanding of how copyrights affect accessibility and reusability of published materials. We will investigate researchers capabilities for OA publishing and differences among researchers using the COM-B framework which defines a capability as the 'individual's psychological and physical capacity to engage in the activity concerned' (Michie et al., 2011, p. 4). To capture important distinctions within the research literature, capability is subdivided into 'psychological capability' (i.e. having the knowledge, psychological skills, strength and stamina to engage in the necessary mental processes) and

'physical capability' (i.e. having the physical skills, strength, and stamina) (Michie et al., 2011).

3.3 Opportunities for OA publishing

The environmental enablers, facilitators and barriers experienced by researchers in relation to making their publication OA are also not well studied. Opportunities for provision of OA to one's papers will be reduced if OA fees are unaffordable. So far a dominant model is to charge authors a fee per article (e.g. OA publishers like BMC and PLoS and eLife, and all hybrid journals) and the costs of these fees are met in most cases by authors' institutions or research funders. The cost barriers have received attention of research funders and policy makers (see section 5). A study of 1,370 fee-charging open-access journals active in 2010 found that charges range from $8 to $3,900 (Solomon and Björk, 2012) however fees in hybrid journals tend to be higher (Van Noorden, 2013).

While it is clear that cost barriers can affect the uptake of OA publishing our understanding of other environmental factors influencing researchers' publishing behaviour, such as time and peer pressure, remains limited. It is unclear whether researchers who work closely with commercial partners face more or different barriers to OA publishing than those who work predominantly with other academics. If commercial organisations see wider dissemination of collaborative research outputs as threatening their competitive position they may put pressure on academics to publish under the old model of subscription-based access. Moreover, it is possible that, when institutional funds are limited, researchers funded by public funders with OA mandates are prioritised over researchers funded by commercial organisations by university committees allocating funds for APC in the attempt to increase compliance with funders' OA requirements.

Our study aims to enhance our understanding of environmental forces that affect OA publishing. In the COM-B framework external environment is captured by the concepts of 'opportunity' that refers to all 'factors that lie outside the individual that make the behaviour possible or prompt it' (Michie et al., 2011). The opportunity is divided into two types: (a) 'physical opportunity' referring to environmental factors that allow and facilitate behaviour such as time, physical clues, resources, locations, physical barriers and (b) 'social opportunity' defined as interpersonal influences, social clues and cultural norms that influence our thinking and doing. We will investigate whether physical and social opportunities experienced by researchers with a track record of proprietary and open-source approaches to IP differ.

4 Methodology

As this is one of the first studies exploring psychological and environmental factors that affect adoption of OA publishing we have employed a qualitative methodology, specifically semi-structured interviews. This approach allowed us to be open to all factors that academic researchers consider relevant to their publishing behaviour and to avoid limiting the scope of our study to a few factors decided in an ad-hoc manner.

We have chosen to examine motivations, capabilities and opportunities for adoption of OA publishing by researchers based in the UK a year after the major UK research councils

introduced OA mandates favouring journal-mediated OA. The interviews with researchers were conducted between September 2013 and January 2014. The timing of our study allowed us to capture how researchers respond to OA mandates, identify psychological and environmental factors that enable, stimulate and inhibit adoption of OA publishing after the introduction of OA mandates and make recommendations for further interventions needed to increase OA publishing.

The study is focused on bioscience as this is a discipline where the open science ethos, exemplified by the open data and open-source movements (e.g. BioBricks), coexists with more proprietary approaches to intellectual property and closed channels of knowledge transfer. In order to gain some insights into the differences in bioscientists' predispositions for OA publishing within a discipline we aimed to identify scientists with different past experiences of 'openness' using information on internet and prior knowledge of the authors. We approached a number of principal investigators based in the UK and working in biosciences (including systems biology, metabolomics, synthetic biology, biological engineering, and bioinformatics) of which 22 agreed to be interviewed. The information gathered during interviews confirmed that scientists can be classified into two distinct groups. The first group includes 12 bioscientists who in the past shared knowledge with wider academic and non-academic community predominantly through open channels for example through publishing in academic journals, creating open datasets or open-source technologies. Their experience of working with industry was limited and consisted mainly of having an arms-length relation with industrial partner on publically-funded projects. The second group includes 10 bioscientists who in the past shared knowledge with wider community through publishing in academic journals as well as through somewhat restrictive channels, exemplified by industry-sponsored collaborative research, contract research (i.e. fee for service), exclusive/for-profit licensing of patented (and some non-patented) technologies developed by the scientists and owned by a university.

During the semi-structure interviews the scientists were asked about their awareness of OA polices and their impact on them, whether they provide gold and green OA to their papers and if so, since when, reasons for making papers openly accessible, and perceived benefits and challenges related to OA publishing. Issues of open data and open source technologies were also discussed but are not presented here. Interviews took 1.5 to 2 hours and verbatim transcriptions were completed. The transcripts were anonymised and their accuracy was verified by the interviewees.

We performed content analysis of interview transcripts in order to identify motivations, capabilities and opportunities experienced by each group of scientists. The analysis was assisted by NVivo software. It started with a deductive coding scheme corresponding to the components of the conceptual framework. The initial nodes included: 'OA Publishing Behaviour', 'Automatic Motivations', 'Reflective Motivations', 'Psychological Capabilities', 'Social Opportunities' and 'Physical Opportunities'. Next the coding system was developed in an inductive manner as specific predispositions for OA publishing were identified in the transcripts. For example, when a passage expressing the idea that OA publishing is morally right was identified, a new node 'OA is a right thing to do' was created under the node

'Reflective Motivations' and all text passages with the same meaning were coded into this node. After the initial coding of all transcripts a number of steps were taken to ensure coding consistency. First all text passages that had been coded into a specific node were read carefully. This led to exclusions of passages allocated to a node when differences of meaning were found, merges of nodes when meaning was the same and revisions of nodes' names. Next the transcripts were re-read in search for passages which were accidently omitted during the initial analysis. The inductively developed set of nodes covers a wide range of motivations, capabilities and opportunities and is presented in Tables 1-4. The last step of the analysis involved cross-group comparisons. To this end, the transcripts of interviews with scientists in Group 1 and Group 2 were clustered and NVivo query functions were used to identify how many references were made to a specific predisposition by each group and how many scientists in each group made these references. We consider the predispositions of two groups to be different if respondents in one group make at least twice as many references to a certain motivating factor, capability or an opportunity as the other group. The predispositions for OA publishing and differences between groups will be discussed in the next chapter.

5 Empirical context: OA policies in the UK

Research Councils in the UK introduced mandates for OA in the first decade of 2000s (MRC, BBSRC, NERC, ESRC, STFC in 2006, AHRC in 2007 and EPSRC in 2011). They encouraged deposition of articles in open repositories and publishing in quality OA journals and allowed researchers to include the predicted costs of APCs in OA journals in the costing of their research projects (RCUK, 2005). However, the policies were not evenly enforced (BIS, 2011). In its 2011 white paper, the UK Government expressed commitment to OA to published outputs of publicly-funded research and a conviction that "free and OA to taxpayer-funded research offers significant social and economic benefits by spreading knowledge, raising the prestige of UK research and encouraging technology transfer." (BIS, 2011, p.76). The government helped to set up an independent working group chaired by Dame Janet Finch that examined how to expand access to published research findings. Finch Group's report endorses OA and makes 10 recommendations including that "a clear policy direction should be set towards support for publication in OA or hybrid journals, funded by APCs, as the main vehicle for the publication of research, especially when it is publicly funded" and "more effective and flexible arrangements to meet the costs of publishing in OA or hybrid journals" should be established (Finch, 2012, p.7).The report clearly favours the journal-mediated over repository-mediated OA model and for that it has received substantial criticism and has been referred to as 'a Trojan horse' serving publishing industry interests instead of UK research interests (Harnad, 2012).

The UK Government accepted all but one[1] of the Finch Group's proposals and shortly afterwards allocated £10m to help universities move to OA, with the view that most money would be spend on publishers' APCs in order to provide journal-mediated OA (BIS, 2012). Around the same time Research Councils UK (RCUK) - the strategic partnership of the United Kingdom's seven research councils - published an OA policy (RCUK, 2012b) that supersedes

[1] The recommendation that e-journals move to a reduced or zero VAT rating was not accepted

the existing policies of the individual councils and states a clear preference for journal-mediated route, immediate OA to papers from the publication date, and copyright licences that require attribution of content to the authors but allow unrestricted reuse and distribution for commercial and non-commercial purposes (namely CC-BY licence). Repository-mediated option is allowed by the RCUK policy when funds for APCs are not available. RCUK awarded block grants to help some UK universities cover the costs of OA publishing and prohibited costing APCs into research grants (RCUK, 2012a). The policy has been prised in the media for promoting not only free access to scholarly literature but also maximizing its reusability (Neylon, 2012). It has also been heavily criticised for a lack of clarity, inadequate consideration of policy implementation costs (House of Lords Science Technology Select Committee, 2013) and promoting 'a model which will paradoxically intensify financial pressures on British universities – and thus is likely to make the environment for researchers even harsher'. (Harvie et al., 2013, p.234). Harnad (2013) drew even darker picture predicting that the likely effects of the endorsement for journal-mediated OA will be 'researcher resistance, very little OA and a waste of research funds'.

Two years later Higher Education Agency for England (HEFCE) announced an OA requirement for the Research Excellence Framework (REF) – a system for assessing quality and impact of research in the UK which require every full-time scholar to submit four publications for expert review. The assessment is carried every 6-7 years and its results inform the distribution of research funds by the four UK higher education funding bodies which allocate about £2 billion per year. To make their publications eligible for submission to REF after 1 April 2016, authors must deposit a final peer-reviewed manuscripts of their journal articles and conference proceedings with an International Standard Serial Number in an institutional or subject repository on the date of acceptance for publication (HEFCE, 2014). HEFCE's preference for a repository-mediated OA is at contrast with RCUK's prioritisation of journal-mediated OA.

We argue here that the effectiveness of OA policies is dependent on their ability to change researchers' behaviour. A policy may be designed to effect behavioural change by educating, persuading, incentivising, coercing, training, restricting or restructuring external environment (Michie et al., 2011). Both RCUK and HECFE policies arguably aim to coerce researchers' into OA publishing. In case of RCUK the *coercion* is achieved by making OA publishing a condition of awards of research grants and creating expectation or even fear of punishment. The researchers who do not fulfil the conditions of award would be in breach of the contract with the funder, which is punishable. However, RCUK does not specify the punishment for non-compliance. In case of HEFCE policy, the funders aim to coerce researchers into making their publications OA by making OA an eligibility criterion for REF. Moreover, RCUK tries to effect change by restructuring the external environment. In order to *remove financial barriers*, the aforementioned funds for OA publishing are provided to UK universities. The policy also indirectly targets the *copyright barriers* created by publishers. Specifically RCUK requires that "results arising from their funding are published only in journals that are compliant with Research Council policy on Open Access" (RCUK, 2012). To publish research outputs from UK researchers, publishers have to offer OA copyright licences for journal-mediated and/or repository-mediated OA. Although the policy is

targeted at researchers we may expect a spill-over change in publishers' practices which in turn will increase researchers' opportunities for OA publishing. In conclusion, the RCUK OA policy seems to assume that when the financial and copyright barriers are removed, the proverbial 'stick' will be sufficient to motivate researchers to provide OA to the published outputs of their research. RCUK believes that "the wider dissemination and accessibility (…) serves the interest of researchers both as creators and as users of published research outputs" (RCUK, 2005) and perhaps for this reason further incentives are not provided. There is no consideration for researchers' capabilities to adopt OA publishing and an assumption is made that the one-size-fits-all policy can be effective.

6 Researchers' predispositions for making their publications OA

6.1 Motivation for OA publishing

A wide range of motivations for OA publishing and differences between two groups are revealed by the content analysis of interview transcripts. Table 1 illustrates the reflective and automatic motivations referred to by scientists in the order of decreasing frequency of references. References to reflective motivations were more prevalent than to automatic motivations. The latter included references to having a habit or a routine of publishing in OA journals while the reflective motivational factors consisted of evaluations of the need for OA, moral judgments of OA publishing and business models in the academic publishing industry, evaluations of the costs of OA publishing and evaluations of the impacts of OA publishing on oneself, readership, innovation, science, publishing system and universities and evaluations of funders' OA policies.

The differences between scientists with a track record of open-source approaches to IP (group 1) and scientists with a track record of proprietary approaches to IP (group 2) are clearly visible. Group 1 made 57 positive evaluations that motivate OA publishing (see evaluations with (+) sign in Table 1) and 20 negative evaluations that demotivate OA publishing (see evaluations with (-) sign in Table 1). The responses of Group 2 were more balanced with 32 motivating evaluations and 37 demotivating evaluations. To gain more insights into the differences between groups we identified motivating/demotivating factors that were referred to by one group at least twice as many times as by the other group – they are highlighted in green and red respectively in Tables 2-6. This comparisons show that Group 1 had stronger moral convictions about the righteousness or goodness of OA publishing. For example one respondent noted that OA 'is just the right way, fundamentally personally I feel it's the right thing' (13091902) while another opined 'it's a good thing to do' (13092701). Group 1 expressed more beliefs that OA publishing will increase readership of scholarly literature and will bring personal benefits to those who adopt it, in the form of better access to literature, more citations, or new contacts and collaborations. One scientist explained: 'Obviously if the paper is OA there is going to be more people reading it and it's going to be easier to cite, and it's going to get more citations, there's a very clear relationship that has been shown forever. So it's better for me, if I make them OA I get much better, much quicker response to my papers.' (13092502). It's interesting to note that citations are seen mainly as personal benefit rather than a sign of scientific progress.

Moreover, Group 1 had slightly stronger convictions about the immorality of the traditional business model in the publishing industry, exemplified by the following passage: 'We do all the work; they [publishers] take all the money and the government pays for everything. It is a totally broken business model that only still exists because they are tenaciously clinging onto it.' (13100201). The belief that OA publishing 'is a way to break that stranglehold' (13100201) of publishers, although not frequent, was also more prevalent in Group 1. This group included also comparably more individuals who have already developed a habit of OA publishing. Group 2, on the contrary, expressed stronger negative beliefs demotivating OA publishing, such as negative evaluations of the need for OA and its potential to stimulate innovation. A response of one scientist captures well both points: 'If you think where most of innovation is going to happen, it's going to be in your leading research universities or the companies, both of whom would have access to all the information anyway prior to OA.' (14011601). Group 2 made also more negative evaluations of the cost of APCs. While many found APCs expensive, some said even that these 'fees are just ridiculous' (140123). In conclusion, the analysis reveals that Group 1 is more strongly motivated to adopt OA publishing than Group 2.

Table 2. Motivations for OA publishing

AUTOMATIC AND REFECTIVE MOTIVATIONS FOR OA PUBLISHING	**(Respondents No) Coding References**	
	GR 1	**GR 2**
32 evaluations of the need for OA	**9 (7)**	**23(10)**
(+) Need for OA	8 (6)	9 (7)
(-) No need for OA	1 (1)	14 (6)
26 moral judgment of OA	**18 (9)**	**8 (4)**
(+) OA is the good/right thing to do	17 (8)	8 (4)
(-) Doubts about OA being the right thing	1 (1)	0 (0)
18 evaluations of APCs	**6 (4)**	**12 (7)**
(-) APCs are expensive	5 (3)	10 (7)
(-) APCs not proportional to value added by publishers	1(1)	2(2)
14 evaluations of OA's impact on readership	**11 (6)**	**3 (3)**
(+) OA will increase readership	10 (6)	3 (3)
(-) Doubts about the public's abilities to comprehend scientific papers	1 (1)	0 (0)
14 evaluations of personal benefits from OA	**10(6)**	**4 (3)**
(+) OA will generate more citations	4 (4)	2 (1)
(+) OA makes it easier for me to create databases	2 (2)	0 (0)
(+) OA gives me access to wider range of journals	1 (1)	1 (1)
(+) OA helps to establish contacts abroad	1 (1)	0 (0)
(+) OA preprint protects the claim to priority over an idea	1 (1)	0 (0)
(+) OA will give me quicker response to my papers	1 (1)	0 (0)
(+) OA will help to create new collaborations	0 (0)	1 (1)
13 evaluations of OA's impact on innovation	**3 (2)**	**10 (7)**
(+) OA stimulates innovation (SMEs, academia/industry outside UK)	2 (1)	2 (2)
(-) Doubts about OA's positive impact on innovation	1 (1)	6 (5)
(-) OA info can be put to ill-use	0 (0)	2 (2)
11 evaluations of OA policies	**8(4)**	**3 (3)**

(-) Policy requirements of different funders are conflicting	4 (2)	0 (0)
(-) Policy requirements are unclear (when green OA is legitimate)	2 (1)	0 (0)
(-) Requiring a small commentary to be OA is unreasonable	1 (1)	0 (0)
(-) It's hard know when the policy applies (attributing outputs to particular source of funding)	1 (1)	0 (0)
(-) It was wrong that authors covered APCs from research grants	0 (0)	1 (1)
(-) It's wrong that public money is spent on OA	0 (0)	1 (1)
(+) If OA is required for some publications, it's required for all	0 (0)	1 (1)
10 references to automatic motivation		
(+) Habit of OA publishing	**8 (5)**	**2 (2)**
7 moral judgements on publishing industry	**5 (2)**	**2 (2)**
(+) Old business model of publishing industry is wrong	5 (2)	2 (2)
5 evaluations of OA's impact on transformation of publishing system	**4 (3)**	**1 (1)**
(-) People may be priced out of being able to publish	1 (1)	0 (0)
(+) Authors, not libraries, will be the gatekeepers of what is accessible	1 (1)	0 (0)
(+) OA may lead to fewer but better publications	1 (1)	0 (0)
(+) Subscription-based publishers will become more open	0 (0)	1 (1)
(+) The stranglehold of publishers will be broken	1 (1)	0 (0)
4 evaluations of OA's impact on science	**1(1)**	**3(1)**
(-) Doubting that OA will advance science	0(0)	1(1)
(+) OA will advance science	1(1)	2(1)
2 evaluations of OA's impact on university	**2 (2)**	**0 (0)**
(-) OA does not help universities to increase competitiveness	1 (1)	0 (0)
(+) University libraries will save money	1 (1)	0 (0)

Note. The motivational factors are presented according to the decreasing number of references.

6.2 Physical opportunities for OA publishing

We find a range of environmental factors can enable, facilitate and constrain OA publishing. Table 2 illustrates the factors in the physical environment referred to by scientists in the order of decreasing frequency of references. Group 1 made 36 positive references and 46 negative references to environmental factors while Group 2 made 26 and 44 respectively, suggesting the perceptions of their physical environments are fairly similar. There were no significant difference in the number of references made to each factor with one exception - group 2 complained about time constraints that prevent them from archiving publications into institutional repositories while Group 1 did not mention time to be a factor restricting OA publishing.

Both groups of scientists referred to the availability of suitable journals with OA policies and funds for a publisher's APCs as the key environmental factors affecting OA publishing. Although none was denied funds for APCs, scientists expressed many worries about a university's funds drying out, a university adopting quality/impact factor-based fund allocation criteria and sharing costs of APCs in collaborative research. Most respondents experienced that suitable journals with OA policies are available in their fields but it was noted that some fully OA journals 'are really not reputable' (13092502) and "not so highly rated in their impact factor" (131212). There were no concerns about the quality of established journals that enable authors to choose an OA licence (i.e. hybrid journals) but as their APCs tend to be more expensive scientists face a dilemma whether to publish cheaply

or in what they consider a reputable journal: 'Shall I pay a smaller amount and go for a lower impact or should I pay a larger amount and go for a higher impact.' (13092602).

University systems and processes were also identified as factors affecting OA publishing. Specifically, scientists made references to university processes for allocations of funds for APCs which they found either clear, or easy or cumbersome. They also referred to institutional repositories that enable provision of OA but may be off putting if a system is user-unfriendly. Access to administrative support for archiving papers into repositories was seen to facilitate OA publishing.

Table 3. Physical factors enabling or constraining opportunities for OA publishing

PHYSICAL OPPORTUNITIES FOR OA PUBLISHING	Coding References (Respondents No)	
	GR 1	GR 2
62 references to the availability of funds for APCs	**41 (12)**	**21 (5)**
(-) worries about availability of institutional funds for APCs	24 (8)	15 (5)
(-) difficulties in sharing OA cost in collaborative projects	6 (4)	1 (1)
(-) researchers no longer have control over funds for APCs within research project budget	4 (4)	2 (1)
(+) availability of institutional-grant funds for APCs	7 (5)	3 (2)
61 references to the availability of suitable journals with OA policy	**30 (11)**	**31 (8)**
(+) availability of suitable journals (relevant or good quality or high impact factor journals)	22 (10)	18 (7)
(-) unavailability of suitable journals	8 (7)	13 (5)
15 references to university process for allocation of funds for APCs	**7 (5)**	**8 (4)**
(+) university fund allocation process is clear or easy	4 (3)	4 (3)
(-) university funds allocation process is unclear	2 (2)	3 (2)
(-) university does not have a system for allocation of OA funds	1 (1)	1 (1)
7 references to the availability of university administrative support for archiving	**4 (3)**	**3 (3)**
(-) no university admin support for archiving papers into repositories	1 (1)	3 (3)
(+) university has admin support for archiving papers into repositories	3 (3)	0 (0)
5 references to the availability of time for archiving	**0 (0)**	**5 (3)**
(-) no time for self-archiving	0 (0)	5 (3)
3 references to the availability of institutional repository	**1 (1)**	**2 (2)**
(+) user-friendly institutional repository	0 (0)	1 (1)
(-) user-unfriendly institutional repository	1 (1)	0 (0)
(-) repositories owned by multiple institutions disappear	0 (0)	1 (1)
2 references to technical barriers created by publishers	**2 (1)**	**0 (0)**
(-) Publisher fails to give access to a paper after APC is paid	2 (1)	0 (0)

6.3 Social opportunities for OA publishing

Social environment is also found to affect OA publishing and some differences between two groups are identified. Table 4 portrays the social influences and social norms referred to by scientists in the order of decreasing frequency of references. The content analysis revealed three sources of social influence – research funders, employing universities and peer academics. Research funders are seen as sending a clear message that OA matters, although

as shown earlier their policies receive both positive and negative evaluations. The influence of universities varies. Some scientists thought that OA is important to their university while others provided examples showing that a university does not actively encourage OA publishing. Moreover, scientists experienced both encouragement and resistance from their peers. Beside direct social pressures, scientists made a few references to the norm of pro-openness in biosciences that facilitates the adoption of OA publishing; for example: 'As far as I can tell, everybody I know is supportive of those ideas and would naturally go for that' (13100101).

There are some differences between scientists with a track record of open-source and proprietary approaches to IP. The latter – Group 2 - cited more often the pressure from research funders as the reason from adopting OA publishing. For instance one of them said: 'It was a reaction rather than something that was thought about beforehand' (131204). Group 1 made references to peer pressure while Group 2 made none. Scientists in Group 1 had both positive and negative experiences with their peers. The resistance from international co-authors who are not subjected to the same OA polices was noted as one of the problems: 'certainly on a number of occasions we've ended up just shouldering the whole lot, just because we have to get it out at a certain time but they don't.' (13092602). Overall, Group 1 made 10 references to social factors encouraging OA publishing and 8 references to factors discouraging it. Group 2 made 16 and 2 respectively. This shows that on balance the OA publishing behaviour of Group 2 is influenced more by social pressure, predominantly from research funders, than the behaviour of Group 1.

Table 4. Social factors enabling or constraining opportunities for OA publishing

SOCIAL OPPORTUNITIES FOR OA PUBLISHING	**Coding References (Respondents No)**	
	GR 1	**GR 2**
14 references to social pressure from research funders	**3 (3)**	**11 (6)**
(+) research funders require OA publishing	3 (3)	11 (6)
9 references to social clue/pressure from employing universities	**4 (4)**	**5 (2)**
(-) universities do not brief staff on OA requirements of funding bodies	1 (1)	0 (0)
(-) university PG education does not include OA agenda	0 (0)	1 (1)
(-) university promotion policies - high impact journals matter regardless of their OA status	1 (1)	1 (1)
(+) university encourages staff to adopt OA publishing	2 (2)	2 (1)
(+) university strategy includes OA agenda	0 (0)	1 (1)
8 references to social pressure from peers	**8 (5)**	**0 (0)**
(-) co-authors decide to publish without providing OA	3 (3)	0 (0)
(-) international collaborators do not understand the need for gold OA	3 (3)	0 (0)
(+) my co-authors want to have OA publications	2 (1)	0 (0)
3 references to social norm of pro-openness in the discipline	**3 (2)**	**2 (1)**

Given that industrial partners may have influence on publications we have inquired about their impact on uptake of OA publishing. According to the interviewed scientists, engagement with industry does not restrict opportunities to provide OA to published work.

Commercial partners do not object to publishing under OA licences in OA journals or in hybrid journal and patenting is also compatible with OA (or non-OA) publishing as long as a patent application is filed before a publication in a journal (e.g. in Europe) or within a grace period allowed by Intellectual Property Laws of some countries (e.g. in USA). Although engagement with industry and commercialisation of research outputs do not create a barrier to publishing under OA licences, they can constrain scientists' ability to 'openly' write about their scientific work (see Table 3). Scientists in Group 2 who unlike Group 1 have significant engagement with industry and in commercialisation reported they are restricted in what they can write in their papers and that publications are delayed and occasionally halted by industrial partners. Some of them have also taken strategic decisions not to publish their work in order to facilitate commercial exploitation of their research outputs. Numerous examples of content restrictions were provided such as this one: '… if you're working on a compound called "blah, blah, blah" you have to take that out, for example. Or if you're working on a specific strain, species name, you have to take that out' (140120). These restrictions are not trivial as they make impossible for the reader to replicate and use what is described in a publication. In summary, although industrial partners do not oppose OA publishing, scientists working with industry and engaged in commercialisation are well aware that commercially valuable information is not always published in academic journals. This may explain partly why group 2 expressed many doubts about the OA publishing's potential to stimulate innovation.

Table 5. Social factors constraining publishing (OA or non-OA)

OPPORTUNITIES FOR PUBLISHING	**Coding References (Respondents No)**	
	GR 1	**GR 2**
21 references to barriers related to collaborative research with industrial partners	**3 (2)**	**18 (7)**
(-) commercial partner restricts the content of a publication	2 (2)	10 (6)
(-) commercial partner delays a publication	1 (1)	5 (4)
(-) commercial research partner prohibits a publication	0 (0)	3 (2)
11 references to barriers related to patenting and commercialisation of university IP	**n/a**	**11 (6)**
(-) publication is not undertaken for strategic reasons (weak patent, plans for more patents, lack of IPR protection)	0 (0)	8 (5)
(-) commercial partner restricts the content of a publication	0 (0)	1 (1)
(-) patenting process delays a publication	0 (0)	1 (1)
(-) commercial partner prohibits a publication	0 (0)	1 (1)
5 references to barriers related to contract research	**n/a**	**5 (1)**
(-) commercial partner's restrictions on the content of publications	0 (0)	2 (1)
(-) research material is not scientifically interesting	0 (0)	1 (1)
(-) research material not methodologically robust for a publication	0 (0)	1 (1)
(-) publication is not undertaken for strategic reasons (secrecy enables future contract research)	0 (0)	1 (1)

6.4 Psychological capabilities for OA publishing

The capabilities were rarely mentioned as a factor affecting OA publishing and there were no stark differences between two groups (see Table 3). Unsurprisingly no references were made to physical capabilities for OA publishing. There were 5 negative comments about psychological capabilities for provision of repository-mediated OA and only 2 negative comments related to journal-mediated OA. Scientists talked about their limited understanding of copyright laws for self-archiving and computer skills needed to provide links to papers on a website without violating copyrights. One person commented: "we don't quite understand what you are allowed to do and what you are not allowed to do, by law, and in practice those are different things." (13100101). Some were simply not aware of the possibilities of self-archiving. With regard to journal-mediated OA, one scientist who wanted to publish under an OA licence admitted to give it up because the publisher's system was too difficult to understand. He said: 'I think I did let one of those [articles] go. I must say and I just thought "We'll forget that one and I won't report it [to the funder]". I just looked at it and thought "You know…". It was looking so complicated. It was a while ago actually, it was so complicated with the particular journal; I just looked at it and thought "You know this isn't worth it". (13092501). While the few comments about capabilities provide valuable insights, overall capabilities were not recognised by most interviewees as an important factor affecting their publishing behaviour and there were no differences between groups.

Table 6. Capabilities for OA publishing

PSYCHOLOGICAL CAPABILITIES	**Coding References (Respondents No)**	
	GR 1	**GR 2**
5 references to psychological capabilities related to repository-mediated OA	**2 (2)**	**3 (2)**
(-) not understanding the legal rules on self-archiving (copyrights)	1 (1)	1 (1)
(-) lack of awareness of the possibility of self-archiving pre-prints	0 (0)	1 (1)
(-) lack of awareness of institutional OA repository	0 (0)	1 (1)
(-) lack of computer skills for self-archiving	1 (1)	0 (0)
2 references to psychological capabilities related to journal-mediated OA	**1 (1)**	**1 (1)**
(-) not understanding systems provided by publishers	1 (1)	0 (0)
(-) lack of awareness that paying an APC makes a paper OA	0 (0)	1 (1)

7 Discussion and conclusions

This study adopts a psychological perspective, namely the COM-B conceptual framework that has not been used previously in STI studies, to analyse drivers, enablers and inhibitors of OA publishing. Our approach generates new empirical insights into why OA publishing is adopted by academic researchers and implications for managing transitions to OA model of academic publishing.

The comprehensive conceptualisation of motivations in the COM-B framework combined with the qualitative exploratory methods enabled us to generate new empirical insights into motivations for OA publishing. Looking at publishing under OA licences in general rather than only in specific publication outlets, such as OA monographs (Collins and Milloy, 2012) and fully-OA journals (Park, 2009), we corroborate the past findings showing the significance of the researchers' expectations of personal benefits, including increased citations to their work and career development (Bernius et al., 2009; Collins and Milloy, 2012; Park, 2009). Additionally, our study reveals importance of automatic motivational forces, namely past experience of OA publishing as well as other reflective motivations, including evaluations of the need for OA, moral judgments on OA publishing model and the traditional business model of publishing industry, evaluations of costs of OA and evaluations of OA's impact on innovation and on transformations in the publishing system. While Park (2009) showed that motivations vary depending on the tenure status of a researcher, we find that scientists with a track record of open-source and proprietary approaches to IP are not equally driven towards adopting OA publishing. The first group is motivated by past habits, a belief in a need for OA, a perception that OA publishing is morally right while traditional publishing system is morally wrong, and expectations of positive impacts of OA model on oneself, readership and a publishing system. These motivations are absent among scientists with strong track record of commercialising their research outputs and using other proprietary approaches to knowledge transfer. Instead, we find they are demotivated by negative evaluations of a need for OA, costs of OA and the potential of OA academic publishing to stimulate innovation.

The COM-B framework directed our analysis towards the physical and social environments as well as individual capabilities that shape scientists' behaviour. By broadening analytical focus, our study goes beyond the focus on motivations for OA publishing (Collins and Milloy, 2012; Park, 2009). We find both scientists with a track record of open-source and proprietary approaches to IP perceive the availability of funds for OA and suitable journals with OA policies as key enablers of OA publishing. We do not find evidence that scientists whose research is partially or wholly funded by industry have more difficulties securing funds for publishers' OA fees. They do however report having less time for archiving papers in OA repositories. This does not mean that scientists not involved in commercialisation of research output are less busy but rather that they are more likely to 'find time' for provision of OA to their work as they are highly motivated to do so. It's also important to note that the social pressure created by research funders' OA mandates is the main driver of OA publishing among scientists with a track record of proprietary approaches to IP. Finally, our study finds that the lack of psychological capabilities, such as understanding of copyrights or computer skills, is rarely mentioned as reasons for not adopting OA behaviour. Although we expected that the adoption of OA publishing among the researchers who don't use open source licences may be impeded by a limited understanding of OA licences, we do not find evidence for that. This however could be a finding specific to biosciences as even those who do not use OA or open source licences to distribute their research data or materials may be familiar with them as users.

Due to its exploratory aims and qualitative methodology, our study is based on a small sample of scientists in one discipline - biosciences. The findings are not generalizable to a larger population. However, the rich qualitative insights from our work pave the way for more extensive analyses of drivers, enablers and inhibitors of the adoption of OA publishing. Future studies employing surveys or mixed-methods could build on our work in order to examine larger populations across different disciplines and countries and enhance understanding of the publishing behaviour of academic researchers in different contextual settings. The small sample size also does not allow us to make definite recommendations for policy and practice but it can be used to discuss the practical implications and to illustrate how psychological assessments of scientists' behaviour could inform science policy and organisational interventions targeted at changing their behaviour.

Specifically, our study shows that the reasons for OA publishing vary among academics what implies that transition towards OA model of academic publishing cannot be achieved through one-size-fits-all interventions by policy-makers, research funders and universities. The insights from our study suggest that research commercialisation and OA publishing are compatible per se but different interventions may be needed to encourage adoption of OA publishing among those who commercialise their research and those who don't. The scientists with a track record of open-source approaches to IP hold many beliefs that motivate them to adopt OA publishing and have the capabilities needed to perform the behaviour. To maximise the uptake of OA publishing among this group of scientists, there is a need for intervention such as 'environmental restructuring' and 'enablement' (Michie et al. 2011) that increase means for and reduce barriers to OA publishing and thus increase opportunities for the target behaviour. For example, these could be interventions ensuring that publishers' OA fees are affordable or that clear rules for OA publishing of co-authored work exist to avoid negative peer pressure. This type of interventions are unlikely to be effective on their own in case of scientists who are not strongly motivated to adopt OA publishing – characteristic to those who engage in commercialisation of their research outputs. As adoption of OA publishing among this group is driven mainly by social pressure created by research funders, it is reasonable to expect a change in their behaviour only if this social pressure is sustained or their motivations for OA publishing are enhanced. Given that enforcement of OA mandates and monitoring of compliance is very resource-intensive, it is not guaranteed that the scientists will feel the same social pressure to adopt OA publishing in the future as they did when the mandates were introduced. Interventions such as 'incentivisation', 'coercion' or 'persuassion' (Michie et al. 2011) may be needed to enhance their motivations and increase uptake of OA publishing.

Therefore, the transition to the OA model of academic publishing needs to be managed with the recognition of differences in motivations, capabilities and opportunities for OA publishing among academic researchers. For example, universities should understand the behavioural systems of their employees in order to design targeted interventions. Educational events, such as OA days often seen in the UK universities, aim to raise awareness of OA publishing, OA mandates and university procedures for allocation of OA funds. This type of intervention targets the psychological capability of researchers but if researchers don't adopt OA publishing because of low motivations or environmental

barriers, the educational interventions are done in vain. Universities should identify the deficits in motivations, capabilities and opportunities associated with their employees' non-compliance with OA mandates and design interventions that are likely to address the deficits in the specific component, using, for example, behavioural change techniques described by Michie et al (2011, 2013, 2014-book).

In conclusion, the psychological perspective adopted in this study generates new empirical insights that enhance our understanding of drivers, enablers and inhibitors of the adoption of OA publishing among academic researchers. We show that such insights can be used by universities, funders and policy-makers to manage the transition towards OA model of academic publishing with more targeted interventions aiming to change researchers' publishing behaviour. The study opens the way towards more psychological assessment for science policy purposes.

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