Supplementary information to: Do authors comply with mandates for open access?

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SUPPLEMENTARY MATERIAL

Policies analysed

We analyse compliance rates for a sample of public and private research funders from the United States (National Institutes of Health [NIH], National Science Foundation [NSF], Bill and Melinda Gates Foundation), Canada (Canadian Institutes of Health Research [CIHR], National Science and Engineering Research Council [NSERC], Social Sciences and Humanities Research Council [SSHRC]), the United Kingdom (Biotechnology and Biological Sciences Research Council [BBSRC], Engineering and Physical Sciences Research Council [EPSRC], Economic and Social Research Council [ESRC], Medical Research Council [MRC], and Wellcome Trust), and Europe (European Research Council [ERC]).

The ten national research councils represent the main funders of basic research in their respective countries. The Bill and Gates Foundation and the ERC provide cases of multinational mandates and private foundation mandates. The funders' mandates differ in their characteristics as well as of their time since implementation, and cover a large spectrum of disciplines (Table S1)[1]. For the case of NSERC and SSHRC, implementation started in 2015—following an endorsement of open access principles in 2010—and is effective on grants awarded from May 2015 onwards. Therefore, most of the results for these two funders need to be interpreted not as compliance with mandates but, rather, as compliance with the principles of OA.

We drew our data for Table S1 from the Registry of Open Access Repository Mandates and Policies (ROARMAP). A few notes on the terminology here. First, it is important to clarify the distinction between the date of deposit and the embargo period. The former refers to the point at which the document is provided to the repository; the latter specifies the point at which the document becomes accessible on the repository. The locus of deposit also requires clarification: the listing "subject repository" typically refers to a specific platform (e.g., NIH mandates papers are deposited on PubMed Central) whereas "any suitable repository" allows the researcher to select from among compliant repositories.

[1] Aggregate data are available in an accompanying file (see https://www.nature.com/articles/d41586-018-07101-w).

Table S1. Characteristics of open access policies analysed

Agency	Country	Year of first iteration	Deposit of item	Locus of deposit	Date of deposit	Open Access	Evaluation	Embargo length permitted	Gold OA option	Funding for APCs
BBSRC	UK	2006	Required	Europe PMC	Embargo	Required	No	6 months for STEM; 12 months for HSS	Gold recommended	Specific funds
CIHR	CA	2008	Required	None	Embargo	Required	Yes	12 months for STEM	Green	Allowed
EPSRC	UK	2011	Required	None	Embargo	Required	No	6 months for STEM; 12 months for HSS	Gold recommended	Specific funds
ERC	Europe	2014	Recomm	Europe PMC and arXiv recommended	Embargo	Recommended	n/s	6 months for STEM; 12 months for HSS	Green	Allowed
ESRC	UK	2006	Required	None	Embargo	Required	No	6 months for STEM; 12 months for HSS	Gold recommended	Specific funds
Gates	US	2015	Required	PubMed Central	Publication	Required	n/s	none	Green	Allowed
MRC	UK	2006	Required	Europe PMC	Embargo	Required	No	6 months for STEM; 12 months for HSS	Gold recommended	Specific funds
NIH	US	2008	Required	PubMed Central	Publication	Required	Yes	12 months for STEM	Green	Allowed
NSERC	CA	2015	Required	None	Embargo	Required	Yes	12 months for STEM	Green	Allowed
NSF	US	2013	Required	NSF Public Access Repository	Embargo	n/s	n/s	12 months for STEM and HSS	n/s	n/s
SSHRC	CA	2015	Required	None	Embargo	Required	Yes	12 months for STEM	Green	Allowed
Wellcome Trust	UK	2005	Required	Europe PMC	Other	Required	n/s	6 months for STEM; 6 months for HSS	Gold recommended	Specific funds

Used data provided by the Registry of Open Access Repository Mandates and Policies (ROARMAP)
n/s=not specified

Table S2 complements Table S1 with details on the percentage of OA papers per funder, along with financial support for OA, and sanctions and infrastructures associated with the OA policies.

Table S2. Percentage of OA papers, financial support, sanctions and infrastructures associated with the OA policies analysed

Agency	Number of funded papers	% OA papers 2009-2016	Financial support	Sanctions	Infrastructure	Repository
Wellcome trust[1]	46,592	87.3%	Addional funding for APCs	Withholds 10% of the total grant budget until all outputs comply	Support for authors in their negociations with publishers Led alliance of 27 funders supporting Europe PMC	Europe PMC
NIH[2]	704,313	86.8%	APCs are eligible expenses	Suspension of award processing	PubMed Central (Naitonal Library of Medicine); Creation of a Public Access Compliance Monitor	PubMed Central
MRC[3]	52,086	79.2%	Block funding to institutions rather than individual researchers	Suspended payments for individuals and instiutions; OA papers are the only ones eligible for 2021 REF	Repository managemend by EMBL-EBI with joint funding from 27 institutions	Europe PMC
Gates[4]	12,475	78.9%	Fees covered directly by the foundation	Non-negotiable term included in all grant agreements	Creation of a system dedicated to the OA publishing process	PubMed Central
BBSRC[5]	30,173	74.1%	Block funding to institutions rather than individual researchers	Suspended payments for individuals and instiutions; OA papers are the only ones eligible for 2021 REF	Repository managemend by EMBL-EBI with joint funding from 27 institutions	Europe PMC
ESRC[6]	10,522	69.3%	Block funding to institutions rather than individual researchers	Suspended payments for individuals and instiutions; OA papers are the only ones eligible for 2021 REF	None	None
ERC[7]	85,620	66.5%	APCs considered as indirect costs	FP7: None (researchers to show they have made their 'best effort'); H2020 (article 29): grant reduction	Repository managemend by EMBL-EBI with joint funding from 27 institutions	None, but Europe PMC and arXiv are recommended
CIHR[8]	66,754	55.8%	APCs are eligible expenses	Breach of the Tri-Agency Framework: Responsible Conduct of Research	Integration of reporting in the Research Reporting System (RRS)	None
EPSRC[9]	73,033	54.7%	Block funding to institutions rather than individual researchers	Suspended payments for individuals and instiutions; OA papers are the only ones eligible for 2021 REF	None	None
NSF[9]	450,608	46.7%	APCs are eligible expenses	Must submit to PAR in order to be included in annual or final report; voluntary compliance until 2018	Department of Energy infrastructure	NSF Public Access Repository
NSERC[10]	139,924	30.2%	APCs are eligible expenses	Breach of the Tri-Agency Framework: Responsible Conduct of Research	None	None
SSHRC[11]	7,917	23.1%	APCs are eligible expenses	Breach of the Tri-Agency Framework: Responsible Conduct of Research	None	None

1. https://wellcome.ac.uk/funding/guidance/complying-our-open-access-policy
2. https://www.ncbi.nlm.nih.gov/pmc/utils/pacm/; https://publicaccess.nih.gov/FAQ.htm#762; https://grants.nih.gov/grants/guide/notice-files/NOT-OD-12-160.html; https://grants.nih.gov/grants/guide/notice-files/NOT-OD-13-042.html
3. https://www.ukri.org/files/legacy/news/grant-fec-tcs-january-2018-v1-pdf/; https://mrc.ukri.org/research/policies-and-guidance-for-researchers/open-access-policy/
4. https://www.gatesfoundation.org/How-We-Work/General-Information/Open-Access-Policy; https://www.gatesfoundation.org/How-We-Work/General-Information/Open-Access-Policy/Page-2; https://chronos.gatesfoundation.org/
5. https://bbsrc.ukri.org/about/policies-standards/access-research-outputs/; https://www.ukri.org/funding/information-for-award-holders/open-access/
6. https://esrc.ukri.org/funding/guidance-for-grant-holders/open-access-to-research-outputs/; https://www.ukri.org/funding/information-for-award-holders/open-access/
7. https://erc.europa.eu/sites/default/files/document/file/ERC_Open_Access_Guidelines-revised_feb_2016.pdf; http://ec.europa.eu/research/participants/data/ref/fp7/92570/fp7-lga-clauses_en.pdf;
http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/amga/h2020-amga_en.pdf; https://erc.europa.eu/funding/frequently-asked-questions/results?search_api_aggregation_1=&page=12; http://ec.europa.eu/research/participants/data/ref/fp7/89593/ipr_en.pdf
8. http://www.science.gc.ca/eic/site/063.nsf/eng/h_42701EA6.html?OpenDocument#24; http://www.rcr.ethics.gc.ca/eng/policy-politique/framework-cadre/#a6-1
9. https://epsrc.ukri.org/about/access/roaccess/; https://www.ukri.org/funding/information-for-award-holders/open-access/
10. https://www.nsf.gov/pubs/2018/nsf18041/nsf18041.jsp
11. http://www.science.gc.ca/eic/site/063.nsf/eng/h_42701EA6.html?OpenDocument#24; http://www.rcr.ethics.gc.ca/eng/policy-politique/framework-cadre/#a6-1
12. http://www.science.gc.ca/eic/site/063.nsf/eng/h_42701EA6.html?OpenDocument#24; http://www.rcr.ethics.gc.ca/eng/policy-politique/framework-cadre/#a6-1

Data sources

Two data sources are used in the analysis: Unpaywall, a dataset with metadata detailing the open access versions of scholarly papers, and Clarivate Analytics Web of Science (WoS), a well-established citation index. Created by Heather Piwowar and Jason Priem, Unpaywall[2] is primarily a browser extension that allows researchers to find an OA version of scholarly papers. Based on paper information obtained from Crossref, it aggregates links to OA papers from several data sources, such as the Directory of Open Access Journals (DOAJ)[3], PubMed Central[4], as well as 50,000 journal websites and repositories[5]; excluding versions of papers available through Sci-Hub or on social networking websites, such as Academia or ResearchGate. All articles classified as OA must be on a webpage where there is no registration, login, fee, or IP range requirement. (Our classification could not accurately assess whether papers were immediately available or licensed for reuse.) As of April 18th 2018, Unpaywall contained OA status for 95,842,233 DOIs from scholarly documents; making this information available through an API as well as a raw data file[6]. Unpaywall records from the raw data file were matched with WoS papers published between 2008 and 2017, for a total number of journals articles analysed of 12,495,074. In addition to providing the OA status of papers, the Unpaywall datafile also provides whether scholarly papers are available on a publishers' website (gold OA) or in a repository (green OA), as well as the multiple instances of those. In both cases, open access may have been preceded by an embargo period—generally of 12 months. A paper for which a version was found on both a publisher website and a repository would be considered as both gold and green–although, following Harnad[7], the browser plugin would point to the publishers' version.

We use an in-house version of the WoS—rather than the web interface—hosted at the Observatoire des sciences et des technologies, based on the XML files of the Science Citation Index Expanded (SCIE), the Social Science Citation Index (SSCI) and the Arts and Humanities Citation Index (AHCI). The Web of Science indexes several metadata associated to each scholarly paper, such as the authors' names, their institutional affiliations, publication venue and discipline, as well as citation rates. Field and subfield classifications used here are those developed for the National Science Foundation, which classifies each journal into one discipline and one specialty. Although the WoS has its own internal unique identifier for papers, Digital Object Identifiers (DOIs) are also included in the database for more recent years. As this identifier is used to match Web of Science records with the OA status of paper from Unpaywall, we restricted the analysis to journal articles that have unique DOIs between 2009 and 2017 (N= 12,683,296 papers). Since mid-2008, records of articles indexed in the WoS also include funding acknowledgements for the SCIE (these were added in 2015 for the SSCI). Therefore, for funders focusing on the social sciences and humanities (such as SSHRC in Canada and ESRC in the UK), the recall of funded papers is much lower pre-2015. However, as the focus of the paper is the compliance rate of funded papers—rather than the proportion of funded papers—this should not affect the results[8]. Funding

[2] https://unpaywall.org/
[3] https://doaj.org/
[4] https://www.ncbi.nlm.nih.gov/pmc/
[5] Piwowar H, Priem J, Larivière V, Alperin JP, Matthias L, Norlander B, Farley A, West J, Haustein S. (2018) The state of OA: a large-scale analysis of the prevalence and impact of Open Access articles. PeerJ 6:e4375 https://doi.org/10.7717/peerj.4375
[6] https://unpaywall.org/products/snapshot
[7] Harnad S, Brody S, Vallières F, Carr L, Hitchcock S, Gingras Y, Oppenheim C, Stamerjohanns, H, Hilf E R (2004). The access/impact problem and the green and gold roads to open access. Serials Review 30 (4): 310-314.
[8] For instance, we tested whether focusing exclusively on papers indexed in the SCIE would change the results for SSHRC. While it does increase overall OA rates—as OA is higher in fields of science and medicine and social sciences and humanities—the trends remain the same and overall OA rates plummet 2013 onwards.

acknowledgements (funding agency field) are a proxy for funded articles: they rely on both the funded research to report funding and on the indexer to add this to the paper metadata. Unfortunately, there are no global list that match publications with funded projects; therefore, there exists no full sampling frame upon which a validation can be done to assess the degree to which funded researchers are compliant in reporting.

Funding acknowledgements

For each of the 12 funders analysed, we searched in the funding field for various ways under which the funders' names (i.e., NSF, National Science Foundation, US NSF, etc.) could be written. Table S3 presents the numbers of papers retrieved from each funder, broken down by whether the corresponding author is associated with the same country or group of countries (in the case of ERC) of the funder. As the corresponding author is likely to bear the responsibility for the work and also to provide funding, we considered a paper subject to mandates only when the corresponding author was from the same country or region as the funding agency (see Figure S2 for difference in compliance between papers with and without corresponding authors from the funders' country). For instance, analysis of papers funded by the NSF and NIH were limited to those having a corresponding author from the United States; papers funded by CIHR, NSERC, and SSHRC were limited to those with a corresponding author from Canada, papers funded from BBSRC, EPSRC, ESRC, MRC, and Wellcome Trust were limited to those from the United Kingdom. Papers funded from ERC and the Gates Foundation had no geographic restriction, as these funders' mandates go beyond a single country. For all funders but those from Canada, the proportion of OA papers was higher when the corresponding author was from that country than when it was from a foreign country (Figure S1). We suspect the inversion for Canada is due to the strong collaboration ties with the United States—when the corresponding author is not from Canada, it is in most cases from the United States—and mandates from that country are generally more efficient than those from Canada. For ERC, funded papers are compared with other papers from corresponding authors from countries that have received funding from the council. While most of these are in Europe, notable exceptions are the Israel, Turkey, and the United Kingdom, which are included in the comparison group.

Table S3. Number of papers containing a funding acknowledgement to one of the funders analysed, by corresponding author address, 2009-2017

Funder	Number of papers with corresponding author in country	% of papers with corresponding author in country	All funded papers
NIH	604,432	85.8%	704,313
NSF	319,946	71.0%	450,608
NSERC	109,712	78.4%	139,924
ERC*	85,620	-	85,620
EPSRC	59,439	81.4%	73,033
CIHR	54,965	82.3%	66,754
MRC	35,094	67.4%	52,086
Wellcome trust	31,563	67.7%	46,592
BBSRC	24,878	82.5%	30,173
Gates*	12,469	-	12,475
ESRC	8,680	82.5%	10,522
SSHRC	6,120	77.3%	7,917

* No country restriction

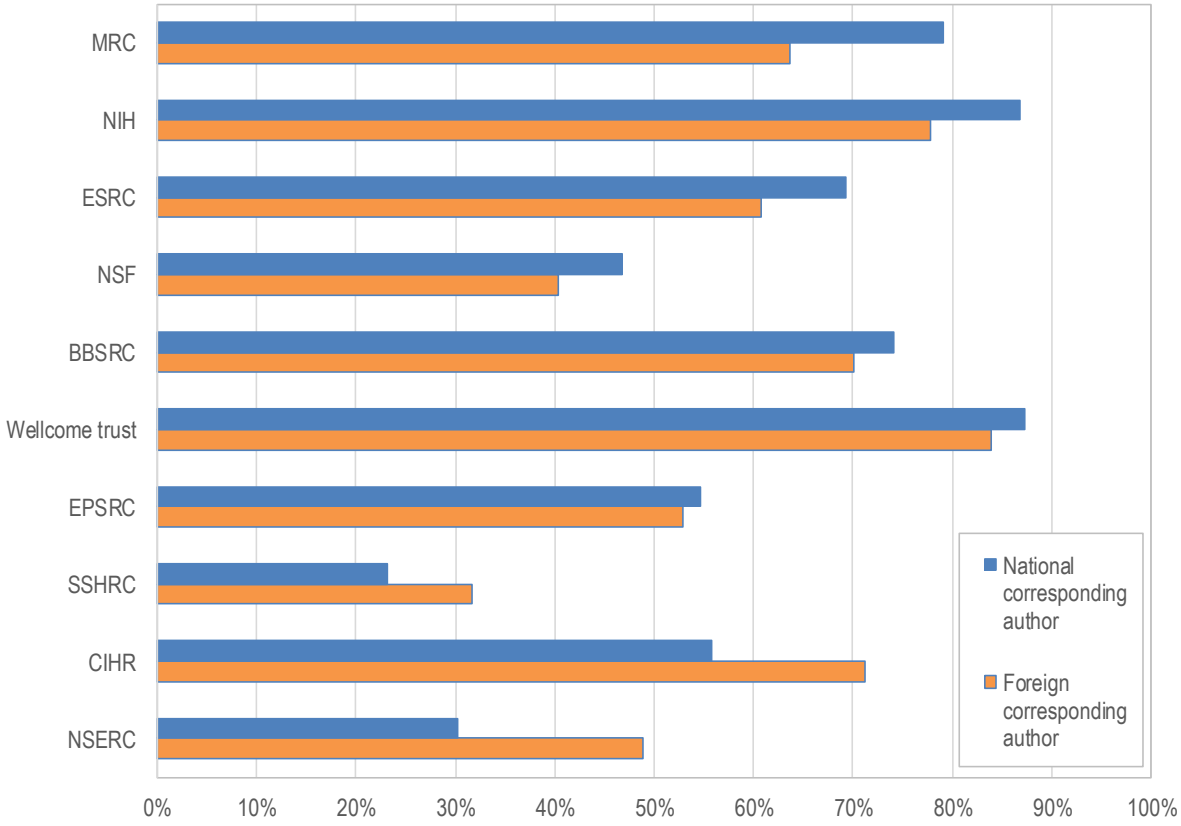

Figure S1. Proportion of funded papers that are freely available to read, by country of the corresponding author, 2009-2017

To provide validation of the indexation of funding acknowledgements, we took all papers published in 2015 (n=708,063) that were indexed in both WoS and PubMed (a bibliographic database for medical research created by the NIH National Library of Medicine). The PubMed database was retrieved from the NLM website[9], and transformed into a SQL relational database for bibliometric analysis. Given that the funding information it contains are standardized, we simply use the string "*NIH*" in the funding agency field, which allowed for the retrieval of papers funded by NIH and its various institutes. Of these papers found in both databases, WoS indexed 11.3% as NIH-funded papers; whereas PubMed identified 12.7% as NIH-funded papers. Nearly 80% of these funded papers (n=75,199) were indexed by both WoS and PubMed as NIH-funded. PubMed was more likely to identify NIH-funding than WoS: 2% (14,565) of the full sample of 2015 papers was only identified by PubMed as NIH-funded, whereas less than 1% (n=5,154) were uniquely indexed by WoS as NIH-funded. Across the entire time period (2009-2017) these database differences lead to some differences in compliance rates (Figure S2): PubMed both associates more articles with NIH and reports higher rates of NIH compliance (at 92%, compared to 88% in WoS). The set of papers PubMed is also more likely to favor green-only OA than WoS (47.50% vs 41.91%, arguably due to the direct link with PubMed Central). Despite these small differences, these results suggest that the two funding acknowledgements sources yield very similar results. Furthermore, studies evaluating the degree to which indexing is done accurately have demonstrated that WoS is the more robust catalog to

[9] https://www.nlm.nih.gov/databases/download/pubmed_medline.html

date which matches publication and funding data[1011]. Therefore, the WoS database—as well as its indexation of funding acknowledgements—is used for the present analysis. Future analyses could compare these results with propriety datasets (e.g., Dimensions) or with other emerging sources (e.g., Crossref funder ID).

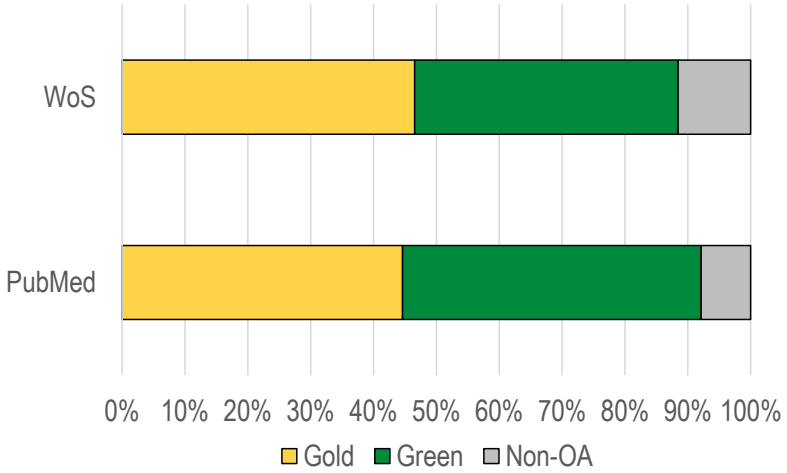

Figure S2. Proportion of NIH-funded papers that are freely available to read, WoS and PubMed, 2009-2017

Limitations

Our analysis does have limitations. Given the diversity of sources on which OA version of papers can be found (both legally and illegally), the Unpaywall algorithm's accuracy errs more on the precision side (i.e. false positives) than recall (i.e. false negatives). Manual analysis of a sample of papers in Piwowar et al.[12] has shown that an actual OA version could be found for 96.6% of papers which were considered and for 12.3% of papers which were labeled as closed. Hence, results presented here can be considered as a *minimum* proportion of papers available in OA. Most of the missing papers are green OA papers. Therefore, if the algorithm does not find those green versions, they might be equally difficult for researchers to find them. This suggests that centralized repositories—such as arXiv, etc.—might be more efficient than decentralized deposit (i.e., on researchers' websites, etc.). Along these lines, the analysis here is limited to Web of Science publications—papers published in journals not indexed by this database might exhibit different OA patterns (especially in the social sciences and humanities). The research cycle—i.e., time between funding, research, and publication—might also affect compliance rates, as there are likely some papers that fall outside the time coverage of some of the most recent OA mandates. Moreover, the fact that funding acknowledgements for the SSCI are being indexed 2015 onwards (and that the AHCI is not indexing them) leads to an underestimation of funded papers for funders focusing on the social sciences and humanities. There is, also, a limitation with any temporal analysis of access.

[10] Kokol, P., & Blazun Vosner, H. (2018). Discrepancies among Scopus, Web of Science, and PubMed coverage of funding information in medical journal articles. Journal of the Medical Library Association, 106(1), 81-86.
[11] Grassano, N., Rotolo, D., Hutton, J., Lang, F., & Hopkins, M.M. (2016). Funding data from publication acknowledgements: Coverage, uses, and limitations. Arxiv. https://arxiv.org/abs/1604.04896
[12] Piwowar H, Priem J, Larivière V, Alperin JP, Matthias L, Norlander B, Farley A, West J, Haustein S. (2018) The state of OA: a large-scale analysis of the prevalence and impact of Open Access articles. PeerJ 6:e4375 https://doi.org/10.7717/peerj.4375

Bibliometric data can only capture the time of publication. We do not have the date of award of the funding. Therefore, it is expected that there is a time lag between the implementation of a policy and adoption (as measured through publications). Furthermore, there are often time delays in access as a result of embargos and bronze OA. Therefore, it is recommended that compliance is measured within a timeframe that accounts for these limitations.

Additional figures

Figure S3. Proportion of papers available in freely available to read, by funder and type of accessibility, 2009-2017

Funder	Biomedical Research	Clinical Medicine	Health	Mathematics	Earth and Space	Psychology	Physics	Biology	Professional Fields	Social Sciences	Chemistry	Engineering and Technology	All Disciplines
Wellcome trust	92%	84%	87%	96%	71%	80%	73%	88%	93%	74%	73%	79%	87%
NIH	93%	86%	79%	87%	73%	75%	84%	76%	74%	59%	81%	71%	87%
MRC	88%	75%	79%	87%	62%	62%	47%	83%	77%	73%	59%	50%	79%
Gates	89%	81%	83%	95%	50%	47%	51%	57%	28%	44%	52%	46%	79%
BBSRC	83%	71%	77%	90%	57%	44%	58%	68%	92%	52%	49%	52%	74%
ESRC	92%	76%	72%	70%	66%	60%	69%	60%	59%	63%	60%	56%	69%
ERC	80%	64%	59%	75%	82%	50%	75%	66%	46%	46%	36%	46%	67%
CIHR	71%	51%	52%	73%	43%	22%	36%	57%	47%	26%	25%	22%	56%
EPSRC	76%	64%	70%	78%	59%	54%	60%	68%	58%	62%	39%	49%	55%
NSF	76%	70%	52%	69%	54%	34%	48%	46%	35%	26%	24%	23%	47%
NSERC	57%	38%	42%	55%	31%	18%	40%	28%	14%	8%	10%	12%	30%
SSHRC	78%	35%	25%	40%	33%	17%	27%	36%	14%	16%	0%	17%	23%
All funded papers	85%	79%	73%	67%	57%	56%	56%	51%	42%	39%	35%	29%	66%

Figure S4. Proportion of funded papers that are freely available to read, by discipline and funder, 2009-2017

Discipline and specialty		Wellcome Trust	NIH	MRC	Gates	BBSRC	ESRC	ERC	CIHR	EPSRC	NSF	NSERC	SSHRC	All Funded Papers
Biology	Agricult & Food Science	50%	45%	39%	50%	42%	50%	31%	9%	47%	19%	8%	13%	24%
	Botany	85%	73%	73%	60%	79%	53%	69%	36%	72%	59%	38%	29%	58%
	Dairy & Animal Science	78%	41%	33%	50%	33%	0%	53%	47%	67%	30%	16%	0%	26%
	Ecology	77%	61%	91%	74%	70%	63%	62%	69%	68%	40%	32%	61%	44%
	Entomology	79%	63%	43%	49%	37%	0%	41%	14%	50%	23%	11%		34%
	General Biology	94%	96%	87%	95%	92%	100%	91%	75%	98%	81%	82%	56%	88%
	General Zoology	89%	70%	25%	67%	38%	38%	59%	36%	83%	41%	19%	17%	41%
	Marine Biology & Hydrobiology	67%	58%	0%	0%	54%	67%	66%	0%	59%	34%	18%	12%	31%
	Miscellaneous Biology	93%	89%	88%	79%	80%	83%	70%	66%	74%	55%	48%	19%	70%
	Miscellaneous Zoology	33%	46%			48%	33%	45%	0%	0%	31%	20%	0%	29%
Biomedical Research	Anatomy & Morphology	87%	93%	91%	100%	96%		74%	76%	80%	60%	56%	100%	78%
	Biochemistry & Molecular Biology	86%	91%	80%	78%	76%	88%	69%	57%	65%	69%	39%	38%	81%
	Biomedical Engineering	67%	71%	43%	54%	37%	100%	43%	15%	44%	35%	9%		45%
	Biophysics	94%	90%	79%	75%	80%		75%	46%	78%	71%	31%		77%
	Cellular Biology Cytology & Histology	92%	93%	89%	92%	85%	67%	85%	73%	71%	81%	62%		88%
	Embryology	98%	94%	96%	100%	96%		93%	79%	100%	91%	75%		93%
	General Biomedical Research	97%	97%	96%	97%	95%	99%	89%	92%	93%	90%	90%	94%	95%
	Genetics & Heredity	93%	92%	88%	80%	86%	67%	83%	70%	86%	73%	59%	65%	85%
	Microbiology	91%	94%	87%	82%	82%	79%	72%	82%	79%	75%	65%	50%	85%
	Microscopy	91%	81%	64%	33%	61%		41%	15%	47%	44%	27%		51%
	Miscellaneous Biomedical Research	84%	86%	81%	60%	49%	63%	42%	36%	40%	55%	11%	16%	69%
	Nutrition & Dietetic	87%	90%	90%	91%	83%	82%	63%	56%	50%	66%	54%	35%	82%
	Parasitology	89%	95%	89%	86%	74%	67%	92%	76%	67%	50%	29%		82%
	Physiology	93%	92%	89%	94%	83%	70%	82%	81%	89%	62%	59%	50%	87%
	Virology	97%	95%	94%	90%	90%	100%	80%	80%	100%	84%	73%		91%
Chemistry	Analytical Chemistry	79%	79%	55%	58%	44%	100%	30%	18%	35%	32%	11%		45%
	Applied Chemistry		61%	50%	0%	43%		28%	33%	27%	19%	2%		19%
	General Chemistry	73%	84%	61%	54%	52%	67%	38%	31%	44%	31%	14%		42%
	Inorganic & Nuclear Chemistry	45%	73%	35%	50%	38%		33%	7%	30%	12%	6%		21%
	Organic Chemistry	59%	81%	48%	41%	37%	50%	31%	16%	29%	29%	8%		42%
	Physical Chemistry	83%	80%	78%	55%	56%	0%	36%	32%	40%	19%	10%	0%	28%
	Polymers	64%	68%	48%	33%	41%		34%	21%	39%	14%	8%		23%
Clinical Medicine	Addictive Diseases	84%	84%	66%	56%	50%	59%	62%	45%	67%	66%	17%	9%	80%
	Allergy	77%	78%	59%	73%	44%		31%	16%	40%	67%	21%	67%	67%
	Anesthesiology	84%	81%	65%	100%	100%		50%	64%	88%	94%	68%	100%	77%
	Arthritis & Rheumatology	85%	86%	79%	41%	88%	100%	58%	61%	91%	91%	85%	67%	81%
	Cancer	87%	89%	81%	79%	82%	73%	79%	67%	76%	84%	64%	15%	86%
	Cardiovascular System	83%	87%	79%	62%	71%	74%	67%	51%	73%	81%	47%	0%	81%
	Dentistry	45%	82%	54%	80%	50%	40%	25%	28%	35%	67%	15%	100%	72%
	Dermatology & Venerial Disease	85%	85%	70%	69%	85%	80%	62%	45%	50%	85%	27%		79%
	Endocrinology	88%	89%	85%	81%	76%	81%	63%	59%	53%	52%	37%	22%	82%
	Environmental & Occupational Health	94%	88%	89%	95%	67%	86%	72%	67%	78%	50%	27%	61%	83%
	Fertility	83%	87%	74%	58%	92%	61%	68%	75%	100%	86%	79%	100%	84%
	Gastroenterology	75%	84%	56%	66%	43%	60%	52%	38%	48%	84%	41%	50%	76%
	General & Internal Medicine	89%	87%	87%	78%	86%	93%	80%	66%	83%	75%	61%	55%	82%
	Geriatrics	89%	86%	71%	0%	68%	78%	38%	41%	62%	69%	44%	0%	80%
	Hematology	90%	90%	86%	87%	79%	100%	78%	63%	73%	78%	60%	0%	86%
	Immunology	87%	90%	81%	80%	73%	85%	69%	63%	76%	75%	45%	33%	84%
	Miscellaneous Clinical Medicine	68%	80%	59%	44%	25%	62%	42%	31%	45%	54%	12%	25%	63%
	Nephrology	86%	86%	77%	100%	88%	100%	64%	50%	80%	80%	58%		81%
	Neurology & Neurosurgery	85%	88%	73%	74%	72%	72%	67%	52%	70%	75%	42%	38%	78%
	Obstetrics & Gynecology	59%	79%	58%	63%	39%	50%	31%	24%	20%	48%	16%	20%	68%
	Ophthalmology	87%	87%	76%	35%	87%	96%	89%	72%	89%	95%	79%	80%	84%
	Orthopedics	70%	75%	62%		62%	50%	60%	35%	65%	59%	25%	50%	63%
	Otorhinolaryngology	57%	78%	58%	33%	58%	100%	17%	17%	52%	58%	22%	17%	70%
	Pathology	91%	91%	83%	61%	91%	100%	64%	55%	54%	85%	55%	0%	85%
	Pediatrics	68%	80%	53%	72%	60%	54%	60%	39%	40%	60%	35%	34%	72%
	Pharmacology	75%	84%	62%	78%	66%	56%	41%	40%	53%	60%	27%	45%	73%
	Pharmacy	80%	73%	57%	33%	63%		22%	16%	29%	26%	3%		46%
	Psychiatry	75%	77%	65%	55%	70%	64%	50%	30%	60%	65%	28%	24%	68%
	Radiology & Nuclear Medicine	85%	84%	63%	73%	49%	67%	45%	30%	58%	67%	21%	50%	73%
	Respiratory System	83%	81%	78%	51%	69%	88%	53%	43%	55%	33%	44%	44%	76%
	Surgery	70%	74%	58%	92%	44%	61%	31%	42%	42%	52%	18%	50%	68%
	Tropical Medicine	97%	96%	96%	96%	97%	96%	91%	95%	80%	93%	97%	100%	96%
	Urology	58%	80%	59%	83%	29%	100%	25%	44%	58%	64%	31%	17%	74%
	Veterinary Medicine	73%	74%	71%	50%	56%	44%	67%	35%	33%	43%	40%	0%	61%

Figure S5 (continues on page 14).

Discipline and specialty		Wellcome trust	NIH	MRC	Gates	BBSRC	ESRC	ERC	CIHR	EPSRC	NSF	NSERC	SSHRC	All Funded Papers
Earth and Space	Astronomy & Astrophysics		85%	100%		100%		97%		87%	96%	95%		96%
	Earth & planetary Science	75%	64%	100%	100%	86%	64%	53%	8%	63%	49%	26%	32%	46%
	Environmental Science	75%	73%	59%	48%	56%	67%	44%	45%	54%	29%	14%	33%	34%
	Geology	58%	46%	0%	33%	39%	67%	49%	20%	44%	25%	18%	29%	26%
	Meteorology & Atmospheric Science	100%	84%	100%	86%	88%	66%	81%	50%	74%	45%	51%	40%	51%
	Oceanography & Limnology		72%	80%	67%	63%	64%	62%	86%	46%	44%	37%	33%	44%
Engineering and Technology	Aerospace Technology		75%	100%		100%		35%		41%	12%	10%	0%	20%
	Chemical Engineering	0%	56%	25%	38%	50%	50%	28%	0%	44%	12%	5%	17%	16%
	Civil Engineering	0%	67%	17%	33%		53%	32%	0%	47%	4%	3%	0%	13%
	Computers	83%	75%	60%	29%	51%	62%	58%	46%	62%	41%	29%	16%	44%
	Electrical Engineering & Electronics	81%	61%	57%	54%	59%	50%	52%	22%	49%	26%	17%	26%	29%
	General Engineering		89%					60%	0%	37%	14%	7%		21%
	Industrial Engineering	0%	61%	29%	0%		50%	36%	22%	49%	10%	7%	27%	16%
	Materials Science	78%	73%	55%	52%	47%	33%	43%	18%	48%	21%	11%	33%	30%
	Mechanical Engineering	100%	67%	23%	0%	36%	20%	42%	4%	41%	14%	6%	60%	20%
	Metals & Metallurgy	100%	45%	40%		33%	33%	33%	0%	43%	8%	8%	0%	16%
	Miscellaneous Engineering & Technology	60%	66%	50%	43%	83%	64%	45%	17%	50%	19%	10%	0%	25%
	Nuclear Technology	67%	74%	25%				62%	25%	45%	16%	7%	0%	36%
	Operations Research		42%		0%		75%	43%		55%	29%	15%	13%	28%
Health	Geriatrics & Gerontology	84%	83%	83%		82%	87%	65%	50%	100%	73%	67%	26%	76%
	Health Policy & Services	91%	83%	88%	79%	82%	80%	73%	64%	71%	57%	61%	41%	80%
	Nursing	63%	69%	50%	38%		41%	0%	14%	33%	31%	0%	7%	58%
	Public Health	87%	81%	80%	85%	69%	78%	74%	63%	71%	61%	34%	41%	78%
	Rehabilitation	77%	70%	45%	20%	50%	37%	37%	37%	57%	54%	42%	13%	56%
	Social Sciences, Biomedical	89%	79%	75%	85%	80%	69%	48%	34%	67%	31%	0%	26%	67%
	Speech-Language Pathology and Audiology	71%	80%	88%			44%	33%	45%	68%	44%	26%	8%	66%
Math	Applied Mathematics	98%	94%	94%	100%	96%	91%	67%	96%	72%	59%	50%	67%	62%
	General Mathematics	100%	69%	100%	0%	57%	50%	79%	100%	84%	76%	68%	0%	71%
	Miscellaneous Mathematics		75%	100%				80%	100%	84%	72%	65%		70%
	Probability & Statistics	86%	83%	81%	89%	62%	69%	85%	50%	78%	68%	34%	41%	68%
Physics	Acoustics	64%	90%	34%	100%	58%	48%	44%	17%	59%	45%	23%	25%	57%
	Applied Physics	67%	75%	50%	29%	57%	0%	49%	30%	44%	23%	16%	0%	29%
	Chemical Physics	73%	88%	48%	67%	53%		45%	26%	45%	25%	14%		35%
	Fluids & Plasmas	100%	74%	80%	40%	81%		59%	60%	49%	28%	17%		36%
	General Physics	78%	78%	76%	71%	59%	96%	82%	50%	76%	65%	61%	43%	68%
	Miscellaneous Physics	50%	82%	0%	0%			61%	33%	63%	39%	32%		45%
	Nuclear & Particle Physics		74%		100%			97%	40%	80%	87%	83%	0%	90%
	Optics	73%	87%	48%	64%	60%	50%	48%	46%	55%	31%	19%	0%	43%
	Solid State Physics	83%	72%	14%	20%	50%		71%	18%	62%	55%	55%		58%
Professional Fields	Communication	0%	66%	100%	0%		53%	60%	0%	25%	9%	0%	3%	41%
	Education	100%	69%	100%	25%		66%	46%	52%	47%	43%	28%	12%	47%
	Information Science & Library Science	100%	92%	83%	83%	100%	52%	50%	82%	84%	60%	39%	22%	76%
	Law	80%	49%	100%		0%	74%	45%	0%	55%	11%	17%	21%	33%
	Management	100%	46%	59%	18%	67%	59%	50%	28%	54%	25%	12%	15%	26%
	Miscellaneous Professional Field	100%	75%	100%	0%		60%	17%	50%	64%	9%	14%	4%	22%
	Social Work	88%	57%	60%	50%		41%	33%	40%		7%		12%	48%
Psychology	Behavioral Science & Complementary Psychology	79%	81%	62%	33%	37%	51%	39%	13%	28%	26%	5%	15%	50%
	Clinical Psychology	84%	69%	57%	25%	65%	65%	39%	17%	53%	44%	0%	10%	58%
	Developmental & Child Psychology	80%	71%	68%	45%	100%	64%	41%	26%	75%	33%	18%	19%	60%
	Experimental Psychology	75%	82%	62%	100%	61%	56%	48%	45%	61%	44%	27%	25%	58%
	General Psychology	97%	78%	68%	100%	70%	84%	91%	50%	81%	70%	77%	39%	74%
	Human Factors	100%	71%	25%	100%	100%	68%	25%	10%	54%	13%	7%	7%	32%
	Miscellaneous Psychology	79%	74%	55%	0%	39%	52%	46%	18%	45%	33%	15%	12%	58%
	Social Psychology	75%	64%	81%	67%	67%	72%	35%	10%	100%	23%	18%	9%	41%
Social Sciences	Anthropology and Archaeology	52%	62%	67%	50%	50%	44%	25%	14%	60%	12%	0%	8%	20%
	Area Studies	100%	29%				52%	33%	0%	100%	6%	0%	10%	29%
	Criminology	50%	41%	100%			61%	57%	17%	75%	17%	0%	3%	35%
	Demography	100%	66%	0%	71%	0%	78%	64%	50%	50%	46%	0%	32%	63%
	Economics	100%	58%	100%	42%	47%	70%	56%	8%	62%	43%	10%	30%	47%
	General Social Sciences	86%	53%	78%	20%	100%	73%	46%	45%	80%	24%		16%	46%
	Geography	67%	52%	50%	75%	100%	62%	52%	10%	61%	15%	3%	11%	33%
	International Relations		0%				54%	39%			21%		6%	31%
	Miscellaneous Social Sciences	77%	71%	75%	30%	55%	57%	56%	14%	42%	18%	10%	11%	39%
	Planning & Urban Studies	0%	59%	50%	60%	100%	59%	47%	42%	75%	13%	0%	2%	28%
	Political Science and Public Administration		59%	50%	0%	50%	58%	34%	21%	53%	15%	7%	11%	30%
	Science studies	78%	63%	0%		0%	47%	34%	42%	73%	23%	17%	23%	37%
	Sociology	86%	58%	60%	44%	100%	59%	40%	22%	67%	22%	0%	13%	42%

Figure S5. Proportion of funded papers that are available in open access, specialty and funder, 2009-2017