Discipline-specific Guidelines on Responsible Open Science

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List of Abbreviations

AI	Artificial Intelligence
CARE	Collective Benefit, Authority to Control, Responsibility and Ethics
CS	Citizen Science
CRediT	Contributor Roles Taxonomy
DMP	Data Management Plan
DPO	Data Protection Officer
ECoC	European Code of Conduct for Research Integrity
EU	European Union
FAIR	Findability, Accessibility, Interoperability and Reusability
GDPR	General Data Protection Regulation
LMIC	Low-and middle-income countries
OA	Open Access
OS	Open Science
RE	Research Ethics
RFO	Research Funding Organisation
RI	Research Integrity
RPO	Research Performing Organisation
UNESCO	United Nations Educational, Scientific and Cultural Organization
WP	Work Package

I. Discipline-related Guidelines: Health and Life Sciences

1. Research Environment and Infrastructures

1.1. When designing OS infrastructure, transparency versus confidentiality, protection of personal data, legal and ethical questions linked to auditability, accountability, and responsibility, degree of decentralisation and distribution, among others, should be considered. This is especially important in the health and life sciences, where vulnerable persons and sensitive personal information need special consideration and protection.

1.2. RPOs should provide and invest in good data management schemes that ascertain secure storage and use of research data and metadata. For reasons of accountability and verification of health and life sciences-related datasets, the long-term sustainability of the infrastructure required for OS is particularly important. If opting for cloud infrastructure, the choice of cloud provider including the country in which the cloud provider company is registered, should be considered from a legal perspective.

1.3. When considering technologies in OS infrastructures, such as artificial intelligence (AI) and blockchain, it is important to continuously explore their usefulness, limitations, and risks to ensure they safeguard ethics and fundamental rights appropriately.

2. Protection of Research Participants, the Environment, Ecosystems, and Cultural Heritage

2.1. Research participants' autonomy, dignity, integrity, protection of personal data, and other rights should always be respected. Research participants should not be exposed to exploitation or unnecessary harm. In health research, some research participants may also be patients, or otherwise vulnerable, and in such cases, particular attention must be paid to potential power imbalance and exacerbation of vulnerability. In an OS environment, alternative modes of engagement and consent might have to be considered and ethically reflected on by researchers and research ethics committees.

2.2. In health, genetic and life sciences research, it is especially important for researchers to consider the protection of human beings from potential physical, psychological, social and other harms of participating in new scientific research and/or in research that is similar to what has already been conducted. Likewise, the potential for informational harm from reusing and/or misusing personal data from previously conducted scientific research must be considered.

2.3. Protecting the privacy and control interests of research participants and their communities is essential in an open data environment. Researchers, research ethics committees, RPOs, and policymakers should analyse the risks of reidentification and dual use in different fields and develop governance mechanisms and technical solutions to address these risks. In health and life sciences, it is increasingly rare for data to be considered anonymous/anonymised. In instances when data is reidentifiable due to the inclusion of uniquely identifiable data, many and/or specific variables, or possibilities to link the data with other datasets, the dataset must be processed in compliance with the data protection legislation. Exploring other approaches to protect privacy than anonymisation is increasingly important and is thus recommended.

2.4. When publishing research results, the data should be published in the least identifiable manner possible, and that research participants are made aware and have consented to the risk of reidentification, if any.

2.5. Prior to making personal data available for OS purposes, researchers should ensure that procedures in accordance with the law are in place for the new data user to report back findings of

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relevance to a research participant's current or future health or quality of life. The research participants' right to know and right not to know must be respected.

2.6. Researchers, RPOs, RFOs, research ethics committees, policymakers, and other animal-welfare related committees should ensure that OS and reuse of already obtained scientific data are in alignment with the principles of animal research (such as the principle of the 3Rs in animal research, i.e., replacement, reduction, and refinement).

2.7. It should be recognised that respect for ecosystems and cultural heritage may limit openness in research. The principle of openness according to the nuances of different research fields and methods should be explored. Special consideration should be placed on cultural data and the necessity of restrictive access in some instances. In health and life sciences research, collective consent may be required to protect indigenous rights.

3. Open and Reproducible Research Practices

3.1. Open research practices

3.1.1. Considering the guidelines of the International Committee of Journal Medical Editors, researchers are encouraged to adopt the use of contributor roles taxonomy (CRediT) that describes the specific role of each contributor in a scientific output from conceptualisation, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, software, supervision, validation, visualisation, writing original draft, to review and editing.

3.1.2. RPOs should have policies, procedures, and support services in place for researchers to preregister their protocols on OS platforms/openly available sources to avoid unnecessary replication and wasting of resources, particularly in health and life sciences research.

3.1.3. Researchers should include a data management and sharing plan in manuscripts and publications in health and life sciences research.

3.2. Open data

3.2.1. Researchers and RPOs should ensure transparency in animal research by submitting a protocol to the relevant body in accordance with applicable legislation, informing the public about the ongoing research, the number of animals, species, methodological details, the risks, and any failed experiments of kind to promote integrity, accountability, advance public awareness, ensure public trust, encourage data reuse, and encourage collaborative research.

3.2.2. Health and life sciences journals should explicitly state their publication policies, and such include on how to handle complaints and appeals, allegations of research misconduct, data sharing, reproducibility, and conflict of interests.

3.2.3. Public-funded health research should be openly available and accessible by the public, and disseminated in a manner that is transparent, timely, and easily understood.

3.2.4. Scientists should openly and freely communicate their research tools and methods to other scientists in the health and life sciences field across the world, to the extent compliant with intellectual property and other relevant legislations.

3.2.5. RFOs should:

- within the limits of data protection legislation, incentivise data sharing through, for example, the inclusion of open data requirements in data management plans.
- revise or provide new measures for data quality assurance.

3.2.6. RPOs should

- invest in scientific health databases that are interoperable with other scientific repositories.

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- provide assistance to researchers in determining the legal compliance of relevant research repositories.

3.2.7. Researchers should:

- in publications, ensure that it is clearly described how/where data, software codes, and research materials can be accessed and/or obtained in publications. This includes, for instance, documentation on animal subjects and their environment and the type of drugs used. This documentation should ideally be in an open format.
- ensure that data sharing in the health and life sciences take into consideration not only legal and ethical but also jurisdictional considerations.
- deposit data sets in health and life sciences in data repositories that assign a Digital Object Identifier (DOI) under an open license or other persistent identifiers.
- continuously reassess the identifiability of the anonymised human data deposited in a repository.
- use ORCID or other persistent digital identifier.
- give a clear explanation on why some if not all aspects of their health, genomic, animal research, and clinical trials cannot be publicly shared at a specific time.

3.3. Open Methods and Tools

3.3.1. Publishers and repositories should facilitate the publication and exchange of health and life sciences protocols. In addition, they should provide clear and detailed instructions for code and software sharing.

3.3.2. Researchers should make software open source and available in open/community software repositories, to the extent compliant with intellectual property and other relevant legislations. If new software or a new algorithm is central to the research output, researchers should deposit also the associated source code, documentation for running and installing software, and a test dataset with control parameter settings.

3.4. Open Access Publication

3.4.1. Whenever possible, researchers should publish open-access or deposit their full research in available open-access repositories to the extent permitted by the law to avoid unnecessary experiments involving animals and humans. The ethical aspect of urgently needed transparency is another argument in favour of open-access publication, as studies should be findable and internationally readable.

3.4.2. All contributors in health and life sciences research making substantial intellectual contributions to research outputs should be appropriately acknowledged. Research teams should discuss authorship matters as early as possible in the course of their work together.

3.4.3. Policymakers, RFOs, and RPOs should encourage the publication of negative and null results. Negative and null results are the product of good research practices and, thus, ought to occupy the same status as positive results, including being recognised as research products. Reporting of negative results is important also to prevent exposing humans and animals to unnecessary harm due to unnecessary repetition of research. In addition, adverse events and critical incidences should be shared in addition to being reported to appropriate agencies.

3.4.4. RPOs should promote the priorities of OS and seek to secure financially sustainable OA to journal articles. Universal access to publicly funded research, including research data within the limits of the law, is fundamental to tackling public health challenges.

3.4.5. To avoid unnecessary human and animal experiments, researchers, policymakers, RFOs, and RPOs should promote the linking of all relevant research outputs. At the end of a research process, researchers might have a preregistration, a preprint, a publication in a journal, a dataset, and a

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protocol. Connecting these outcomes in a way that enables other scientists to better assess the results is essential.

3.4.6. Health and life sciences publishers should clearly state their licensing policies about the sharing of author manuscripts and published articles in third-party repositories.

3.4.7. Publishers, RPOs, and RFOs who encourage, or demand preprinting should acknowledge reasons that can prevent or limit preprint publishing. These include, for example, security and biosecurity issues, a business case, or legacy code.

4. Citizen Science

4.1. Citizen science offers a potential for socially relevant research and innovation, however, the involvement of citizen scientists without proper support can potentially be an ethical and legal challenge. In the case of health and life sciences, researchers and citizen scientists should take into account that some restrictions may apply, such the need of a recognised RPO, qualified researchers, and biosecurity considerations.

4.2. Researchers working with citizen scientists should ensure transparency and open communication to diminish unavoidable power imbalance. While integrating individuals with vulnerabilities as citizen scientists into research initiatives is commendable, researchers, RPOs, and policymakers should ensure the rights, safety, and well-being of these individuals.

5. Training and Education

5.1. Open Education

5.1.1. Open education is especially important in the context of informal learning, such as in contexts where there is a lack of formal education. Researchers, RPOs, and other relevant stakeholders and institutions are encouraged to actively produce and promote open educational resources.

5.1.2. Policymakers and RPOs should promote the development and use of open educational resources and ensure that the principles of OS are integrated into research education in health and life sciences professions curricula.

5.1.3. Health and life sciences faculties should actively support the use of open resources, technology, and teaching practices in education through free and open-source software and promote capacity building.

5.2. OS Training

5.2.1. RPOs should implement training programs for all organisational levels including researchers, clinicians, animal research personnel, citizen scientists involved in institutional projects, and other relevant staff, establishing programs focused on both OS principles and training methodologies for train-the-trainer initiatives.

5.2.2. OS training should be structured to align with specific methodologies and research practices, providing guidance on handling ethical dilemmas and integrity issues specific to health and life sciences.

5.2.3. Health and life sciences students should advocate for peer-education events and awareness campaigns for OS.

6. Inclusivity

6.1. Researchers should be aware of potential biases in research related to gender, ethnicity, age, disability, epistemological frameworks, and other factors and act to ensure that responsible OS practices promote equity, inclusiveness, and diversity. For example, gender balance may be particularly important in clinical trials and other health-related research.

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6.2. To support research dissemination, results of research in local languages are encouraged to consider appropriate high-quality translation in English or vice-versa. This is particularly important in health and life sciences research where research results about health ought to be locally accessible and widely disseminated. Additionally, researchers should maintain transparent documentation of the translation processes, including details of linguistic choices, cultural considerations, and community engagement for accountability and quality control. RPOs, RFOs, and other relevant stakeholders should provide the necessary resources to achieve this goal.
6.3. Students in the health and life sciences fields are encouraged to participate in various alliances and organisations, with the aim of ensuring that they maintain uninterrupted access to research.
6.4. RFOs and publishers should promote collaborations that benefit health and life sciences researchers in LMICs within the OS framework by advocating for inclusive policies that ensure equity in collaborations and fair representations and opportunities for the researchers. In all cases, adequate and appropriate data governance and respect for research participants and their rights should be ensured.
6.5. Policymakers should develop OS policies that prioritize inclusivity and implement measures that enhance the accessibility of OS practices for all health and life sciences researchers. Equal opportunities for participation in OS activities should be promoted through conducting regular assessments to identify gaps in inclusivity within OS initiatives.

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II. Discipline-related Guidelines: Humanities[1]

1. Research Environment and Infrastructure

1.1 Researchers should reach out to experts in data management and curation, research ethics and integrity, as well as to colleagues from relevant fields to learn about best practices, the most fitting resources, templates, and infrastructure to implement Open Science in a responsible manner.

1.2 Researchers should preferably use infrastructure adapted to their discipline's needs and specific format[2]. This includes specialised and well-indexed preprints servers or open data repositories adapted to long-form publications such as monographs.

1.3 Researchers should include co-authors and other relevant contributors in the data repositing process.

2. Open and Reproducible Research Practices

2.1. Open research practices

2.1.1 Researchers should engage in Open Science practices only when possible and relevant for the sake of transparency, quality, and greater discoverability. It should be also recognised, that some disciplines in the Humanities are based on highly subjective and personal discourse, perspectives, and artistic actions, therefore, not all open research practices are recommendable.

2.2. Open data

2.2.1. Researchers should explicitly present the metadata and data used under more specific terms (e.g., primary sources, secondary sources, theoretical documents, bibliographies, critical editions, codes, images, teaching materials, videos, annotations, notes).

2.2.2. Researchers should share relevant data and metadata as much as possible to increase transparency.

2.2.3. Data are often not "owned" or "created" in the Humanities but rather based on historical, cultural, and creative practices laid out by others. Researchers should, therefore, clearly and comprehensively communicate the origin of their personal knowledge.

2.2.4. When researchers use materials held by other institutions (e.g., museums, libraries, archives) they need to coordinate their activities for opening data with the existing legal framework, institutional requirements and guidelines, and established best practices in the field.[2]

2.2.5. A diversity of disciplines in the Humanities are re-using resources from the public domain, that contain expressions of traditional culture, knowledge, and artifacts that are not protected by copyright. These are very often highly sensitive expressions, such as sacred objects, rituals, traditional beliefs, and ceremonies. Moreover, they might be under custodianship of local communities and indigenous peoples. To re-use them responsibly, researchers should analyse how their use will affect the original form and purpose of these expressions, and whether it is respectful towards the rights of the relevant communities. It is also advisable, to inform the communities and

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[1] The Humanities are diverse and multi-faceted. For this guideline, we are defining the Humanities as including (but not limited to): history and archaeology; languages and literature; philosophy, ethics and religion; and the arts.

[2] For text and data mining exception see: Directive (EU) 2019/790 on Copyright and Related Rights in the Digital Single Market; for data models and standards: the Europeana Data Model (EDM), for open access practices for humanities and arts: Open Access guidelines for the arts and humanities: Recommendations by the DARIAH European research infrastructure consortium (Laurent Romary, Erzsébet Tóth-Czifra. 2019. ⟨halshs-02106332⟩).

indigenous groups, and – if needed – ask for their permission to re-use their traditional cultural expressions.[3]

2.2.6. There are also issues of privacy, security and other culturally and morally sensitive matters, to be considered while using works form the public domain. As they are not protected by copyright, they also fall outside the scope of the so-called open licenses. It is recommendable to use ethics statements to protect legitimate interests of others.

2.2.7. Practices and recommendations for open data sharing in the Humanities must consider the existence of global research resource inequalities: accessing and sharing data requires resources.

2.3. Open Access Publication

2.3.1. Open Access practices increase findability, impact, and visibility of research. They facilitate citation and secure greater discoverability. Using Open Access models can be especially beneficial to smaller research and artistic communities, and those fields of research based on national languages.

2.3.2. Researchers should consider using preprints to increase the circulation of new ideas and facilitate wider, community-driven feedback. Preprints may also strengthen accessibility to research for non-academic audiences.

3. Citizen Science

3.1. Aligning with both personal privacy requirements and open science principles, researchers should offer clear terms and conditions to participants of CS projects, and to be involved in decision-making processes where suitable.

3.2. Research ethics committees should adapt their practices to encompass not only Citizen Science research with traditional human subjects but also CS projects, where citizen scientists actively contribute personally identifiable information,

including observations, photos, sensor data, and geolocation data. By adhering to the FAIR principles, which are aligned with the transparency and reproducibility goals of open science, the ethical reviews must include a detailed data management plan, to minimise the risks associated with such highly sensitive data.

4. Inclusivity

4.1. Some disciplines in the Humanities are language-dependent, often regionally rooted and based highly on personal discourse. Researchers should, therefore, to the best of their capabilities, provide their research in as many languages as possible (including regionally relevant and international languages), in translations of the highest possible quality.

4.2. RPOs, RFOs, and other relevant stakeholders should support the creation of translations financially, infrastructurally and in other appropriate ways.

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[3] See: Ethical Principles for Safeguarding Intangible Cultural Heritage, UNESCO 2015, https://ich.unesco.org/en/ethics-and-ich-00866.

III. Discipline-related Guidelines: Natural Sciences

1. Protection of Research Participants, the Environment, Ecosystems, and Cultural Heritage

1.1. Researchers should acknowledge and anticipate the harm their research might cause (in particular to communities to which the researchers do not belong and for which they lack cultural understanding).

1.2. Researchers should identify potential risks to individuals and communities, assess whether the same populations benefit from the research in some ways, provide the opportunity to the potentially affected parties to contribute to the project, and share responsibility for the project with those communities.

1.3. Researchers should identify potential risks to the environment and ecosystems. This concerns especially natural scientists conducting field studies or collecting observations in the wild. The risks to identify include those to, e.g., natural heritage sites and populations of endangered or otherwise fragile species.[4]

1.4. Researchers should consult available national and institutional resources and evaluate before the beginning of a study whether their research falls under the category of human subjects research.

1.5. Natural scientists should be trained in navigating ethical, privacy, and data security issues as data from Natural Sciences can be abused by stakeholders in positions of power to the detriment of local disadvantaged and marginalised communities.

1.6. Researchers should respect indigenous data sovereignty when their research affects communities including indigenous populations.

1.7. Researchers whose work poses potential risks for communities should, therefore, consult existing national and institutional regulations regarding data security, ownership and sharing throughout the whole research process.

1.8. Researchers dealing with human subjects research should also be aware that their research might include third parties or broader communities which may still be affected even though the defined human subjects' data are protected.

1.9. Researchers should be aware that using aggregation protects individual privacy but limits the researchers' ability to explore fine-scale spatial and behavioural dynamics.

1.10. Researchers focusing on population-level statistics, as is often the case in Natural Sciences, should handle digital trace data with care and with the support of data experts as digital trace data are challenging to anonymise and the public is increasingly sceptical about its use. Whenever AI is utilised for the analysis of digital trace data, the application method should be communicated clearly and transparently.

1.11. Researchers should comply with OS principles as well as RE/RI principles such as the 3Rs (Replacement, Reduction, and Refinement) principle for ethical research on animals by using, for instance, the possibility of reusing protocols and data, as well as by striving for fast dissemination of protocols and findings.

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[4] Chapman, A.D. (2020). Current Best Practices for Generalizing Sensitive Species Occurrence Data. Copenhagen: GBIF Secretariat. https://doi.org/10.15468/doc-5jp4-5g10

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2. Open and Reproducible Research Practices

2.1. Open research practices

2.1.1. Researchers should provide detailed information regarding the anonymization procedure via metadata and sharing code. This should ideally be done using opensource tools to increase transparency, usability and interoperability for other researchers.

2.1.2. Researchers should be aware that Natural Sciences' field-based observations might not be perfectly replicable or reproducible and should, therefore, preferably use OS alternative reproducible practices such as computational reproducibility.[5]

2.1.3. Researchers should document their workflow throughout the research process.

2.1.4. Researchers should consult with experienced data managers and editors in order to anticipate potential RE and RI dilemmas in a quickly evolving field.

2.1.5. Researchers should preferably use data repositories that are familiar with Natural Sciences and the data formats they use in order to have appropriate infrastructure.

2.1.6. Researchers should also consider longevity and discoverability when choosing a repository.

2.1.7. Researchers should make sure that their observational studies with hypotheses based on exploratory analyses should be followed by replicative studies (e.g., preregistered experiments or observational studies addressing one or several preregistered correlations).

2.1.8. To enhance collaboration[6], researchers should preregister all their long-term datasets and experiments (including long-term experiments that may already be running but for which future series of replications have not been preregistered yet). Upon submission for publication, they should share all their data, metadata, code, and workflow documentation.

2.2. Open data

2.2.1. Researchers should provide all raw data and metadata, code, programming scripts, software, and supporting documentation necessary to evaluate their methodologies, reuse the data in new investigations and data syntheses, and guarantee the replicability and reproducibility of their analyses.

2.2.2. Researchers should also provide extensive information regarding their compliance with the FAIR principles and the context in which the data were collected.

2.2.3. Researchers should be aware and transparent about the kind of data they are working with and whether they are sensitive (e.g., high-resolution spatial data, consumer data, digital trace data) with a risk of being misused by third parties.[7]

2.2.4. Researchers should familiarise themselves with the existing standard practices in their fields in order to tackle risks related to sensitive data (e.g., obfuscate the location of endangered species or the location of sensitive infrastructure for human safety[8]).

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[5] Computational reproducibility can be achieved using open-source code and would allow researchers to test alternative analysis techniques and potentially improve the original author's code.

[6] Editors, reviewers and journals play a central role in supporting this kind of behaviour from researchers.

[7] Poachers, for instance, have already been using species location data openly available for wildlife tracking.

[8] Such methods can include, for instance, the conversion of data into a nonspatial network with mapped relationship between nodes and elements, or the scaling of geographic coordinates when the spatial relation among data points is important but the absolute geographic coordinates are not (Whitney et al., 2016).

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2.2.5. Researchers working with sensitive data can use data repositories offering a "Private for Peer Review" status in which data can be accessible only to editors and reviewers.
2.2.6. The publication of open and ethical data management plans, in which researchers recognise and address all privacy and security considerations prior to the data collection and propose well-thought-through plans for data sharing, should become the norm.
2.2.7. Researchers using open data shared by other researchers should cite the source appropriately.
2.2.8. Researchers should consult relevant existing resources (e.g., LTER project https://lternet.edu/using-lter-data/) to obtain guidance and information regarding the use of long-term data.

2.3. Open Methods and Tools

2.3.1. Researchers should be familiar with the most important software engineering concepts such as automation, version control, literate programming and openness. These technologies should be part of the researchers' toolkit.
2.3.2. Researchers should handle their digital work with the same care as their ideal laboratory: tidy, well-labelled, and with appropriate documentation of procedures.
2.3.3. RPOs need to provide adequate support and training as well as physical infrastructure to enable proper data curation and archiving.

2.4. Open Access Publication

2.4.1. Editors of Behavioural Ecology journals should provide provisional acceptance of publications that are peer reviewed before the data collection and the observation of the study outcome.

3. Researcher Evaluation

3.1. Researchers should be aware that the current conventional assessment of scientists does not benefit all scientists fairly and does not reflect or encourage the dissemination of research, and should, therefore, encourage other forms of Open Evaluation. This is particularly relevant in Earth and Natural Sciences which often address local issues and, therefore, do not reach a wide public.
3.2. Researchers should engage with the media and disseminate their work via less traditional channels (e.g., social media, blog posts, videos).

4. Citizen Science

4.1. Researchers should involve local stakeholders, community members and educators in their research in order to increase impact.[9]
4.2. Researchers should consult existing CS projects (e.g., on platforms such as scistarter.org), for inspiration and re-use ready-made infrastructure supporting public involvement in data collection.
4.3. CS projects need oversight institutions to advocate for the interests of all stakeholders, and to develop and ensure a long-term open data preservation plan. This sustainability is crucial especially in the context of citizen science initiatives with long-term objectives, such as those monitoring environmental changes over extended periods.

5. Training and Education

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[9] The American Geophysical Union´s Thriving Earth Exchange, for instance, provides guidance for researchers willing to connect with communities seeking scientific support to resolve challenges requiring expertise in biogeochemistry.

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5.1. Trainers and educators should integrate Open Science approaches in their field courses as these methods are highly beneficial for participants who gain in adaptability thanks to the online communication tools and reproducible OS practices.
5.2. Trainers and educators should take advantage of the field course setting to teach participants about OS throughout the data collection exercise.
5.3. Trainers and educators should consider using datasets in their trainings as:
- they represent a valuable resource for teaching data management and analysis using course-specific examples.
- they can be used as substitutes during disrupted field courses (e.g., due to bad weather, equipment failure, or unexpected events).
- they provide the basis for potential publications.

5.4. Trainers and educators should integrate online OS resources into their existing field course designs in order to prioritise contact time, create online open access resources, and to develop and enhance local and global research networks.

6. Inclusivity

6.1. Researchers should consider involving local scientists and non-scientists in their research projects as they bring valuable contextual information.
6.2. Collaboration with society should involve better and more accessible journal databases, as well as research accessible in non-English languages.
6.3. Publishers, institutional communication specialists, science journalists or the researchers themselves should develop communication channels, where the outcomes of research, as well as their potential impacts are described in simple language, devoid of unnecessary technical jargon. One measure could be the open communication of “lay summaries” in various national languages other than English (to be integrated with the journal article and to potentially be used for communication purposes in different contexts).
6.4. Researchers should consider ways to better disseminate publications in languages other than English (in accordance with the Helsinki Initiative on Multilingualism in Scholarly Communication[10]) or using secondary non-conventional channels to reach the public (e.g., podcasts, videos). RPOs, RFOs and other relevant stakeholders should support the creation of translation financially, infrastructurally and in other appropriate ways.

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[10] Helsinki Initiative on Multilingualism in Scholarly Communication (2019). https://www.helsinkiinitiative.org.

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IV. Discipline-related Guidelines: Social Sciences

1. Introduction

1.1. Social scientists should be supported by relevant research ethics and integrity bodies (e.g., data protection officers (DPOs), research ethics committees, research integrity advisors and/or officers), specialised in their respective field. An effort on institutional level should be taken to raise awareness and offer training and prevention activities to elevate knowledge on Open Science practices, as research ethics and integrity issues can play a crucial role in the respective field (e.g. in research with and obtaining data from children or vulnerable groups).

1.2. Special attention should be given to Open Science practice in qualitative social sciences. Open sharing of qualitative data involves unique challenges compared to sharing quantitative data due to the nature of qualitative research.

1.3. There is a need for a careful and adjusted open data management in social sciences, especially in case of sensitive, complex, qualitative data or metadata.

2. Research Environment and Infrastructures

2.1. Principles of “ethics by design” and “privacy by design” should be observed and implemented at the earliest stage of research processes (e.g. to omit research that could lead to a breach of data privacy or discrimination).

2.2. Data collected in social science research often do not fit in the established formats for data sharing and standards of data repositories. Institutions should take into account the specific needs of social sciences researchers when establishing data repositories and developing data steward services.

2.3. Data protection officers should support social scientists with, i.e., the following aspects to ensure compliance with ethical and legal standards:
- support in gathering, processing, disseminating or using personal data;
- support in choosing and/or adapting the research design;
- support in choosing trustworthy data sharing platforms;
- advise in risk assessment and risk mitigation strategy or risk management.

2.4. Social Sciences involve a wide range of data types. When possible, researchers should therefore prioritise Open Science infrastructures (e.g. trustworthy open data repositories, fully open access journals or open data archives) where data is stored safely and that are already familiar with the format of data involved and provide the necessary infrastructure to host them, be it discipline-based or not.

2.5. Researchers should consider consulting with the relevant (discipline-specific) authorities (e.g. European, national and institutional such as data service centres and ethics board) throughout the whole research process (particularly when dealing with personal data), in order to implement Open Science with the highest degree of integrity and in accordance with the current legal and ethical requirements at all levels.[11]

2.6. Researchers should aim at creating networks of open collaboration where best practices for data sharing adequate to social sciences are shared.

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[11] Specific categories of research or groups may have targeted regulation in relation to specific risks.

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3. Protection of Research Participants, the Environment, Ecosystems, and Cultural Heritage

3.1. Researchers should follow national legal regulations, recommendations and guidelines on protection of research participants and personal data when planning open sharing of social sciences data.

3.2. Researchers should ensure that for open sharing of data informed consent of research participants is obtained, and the information includes clarification about forms of sharing of data and protection of confidentiality and privacy.

3.3. Researchers should evaluate risk/benefit ratio before open sharing of social sciences data, especially when sharing sensitive information.

3.4. For participatory research and in cases of involvement of specific communities (e.g. conflict regions, indigenous communities, troubled neighbourhoods or regions where the economic, political, environmental and health conditions may pose risks), researchers should ensure that Open Science practices respect those communities, e.g., by obtaining community consent for open sharing of data or incorporating community feedback into data management plan.

4. Open and Reproducible Research Practices

4.1. Open research practices

4.1.1. Social sciences disciplines are highly influenced by the (social) environment in which the research is produced, perfect replication and reproducibility is therefore quite unlikely. Researchers should therefore always provide as many data and metadata as available at the same time following the requirements for protection of privacy of research participants.

4.1.2. Researchers sharing social sciences research data should provide adequate information about the context of the collection of the data to explain the meaning of data, enhance its interpretability and allow its re-use in a meaningful way. Contextual information should include description of research design, research question, methods, keywords, coding schemes, analytical approaches. Standardised metadata should be used to describe the dataset.

4.1.3. Researchers should make sure to communicate the research results with the research’s subjects (e.g. by sharing an interview transcript with an interviewee and asking for a response), and their reaction should be assessed and incorporated within the research results whenever reasonable.

4.2. Open data

4.2.1. Researchers should identify throughout the research process which data and metadata (e.g. data documentation, materials and code) are used, their formats (e.g. quantitative or qualitative such as interviews, field observations, pictures, logbooks, personal notes, drawings, material objects), and assess if they are sensitive or not.

4.2.2. When giving contextual information for qualitative data, researchers should acknowledge multiple perspectives within the data by presenting contradictory findings, diverse participant voices, various themes. This information allows more nuanced understanding of the meaning of data.

4.2.3. Researchers should share metadata to accompany and contextualise their data. The metadata must be structured using recognised standards and controlled vocabularies in order to increase the standardisation and accessibility (notably by making them machine-readable) of data, either through discipline- or generic-based templates.

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4.2.4. Social scientists are encouraged to share reflections on their potential biases and limitations to help users of data understand the potential influence or researchers on the process of data collection and analysis. However, researchers must ensure that such biases or limitations do not contravene principles of research ethics and integrity and those of responsible open science.
4.2.5. Researchers are encouraged to be open to multiple interpretations of open data and especially recognise the interpretive flexibility inherent in qualitative research.
4.2.6. Researchers should develop Data Management Plans (DMPs) for each research study, even if not required to, including all the legal and ethical aspects of their data, and mentioning explicitly why some data are not made available in Open Access.
4.2.7. Researchers should be straightforward in their DMPs when explaining why some data and metadata are not accessible and under which conditions they are stored (e.g. the duty to protect research subjects; or the fact that some information are only relevant for biographical or historical purposes).
4.2.8. Researchers should always share their data and metadata in accordance with the FAIR and CARE principles and favour research projects including specific fundings for the implementation of the FAIR and CARE principles, as well as journals and repositories.
4.2.9. Special categories of data[12] are particularly important for social sciences but also requires greater attention to the anonymisation of data to reduce risks for individuals involved. Researchers should therefore always assess extensively which data and metadata are sensitive and ensure that the personal rights of third parties are respected in accordance with the "do not harm" principle, the legal and ethical requirements and the data protection regulations, notably by adding restriction (e.g. with password protection or ethical agreements) to the concerned data's Open Access.
4.2.10. Anonymisation of data is not always possible[13] nor desirable for social sciences as data are heavily context bounded. Researchers should however ensure to the highest possible extend that identities are disguised.
4.2.11. Researchers must be aware of the existing legal requirements and policies in place regarding their discipline and data format.
4.2.12. Social scientists should consider and minimise the risk of the so called "mosaic effect" which makes re-identification possible by linking data from different sources.

4.3. Open Methods and Tools

4.3.1. For quantitative datasets researchers should include a variable codebook providing detailed information about each variable, including labels, units of measurement etc., as well as provide the syntax or scripts used for statistical analysis to allow reproducibility of the results.
4.3.2. To recognise the often dynamic and iterative nature of qualitative research, data sharing platforms should accommodate updates, amendments, or changes in annotations of the data set over time.

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[12] According to the GDPR, these special categories of data include "personal data revealing racial or ethnic origin, political opinions, religious or philosophical beliefs, or trade union membership" and "genetic data, biometric data […] identifying a natural person, data concerning health or data concerning a natural person's sex life or sexual orientation".
[13] Fieldnotes are for instance often incomprehensible and impossible to anonymise.

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4.3.3. Researchers should share research instruments used for data collection, e.g., questionnaires, interview questions, observational protocols to provide context for datasets and enable replication of research studies.

4.3.4. For mixed methods research, researchers should describe how qualitative data integrates with quantitative data to enhance interpretability of the dataset.

4.4. Open Access Publication

4.4.1. In accordance with the adage “as open as possible, as closed as necessary”, researchers who are dealing with special categories of data should consider alternatives to open access sharing of data based on the specific circumstances. These alternatives can be either the anonymisation or pseudonymisation of the data before the publication, the availability of data only on request for research purposes, or the availability of metadata only. Any limitation of the availability should be explicitly mentioned and justified.

5. Citizen Science

5.1. Citizen scientists should not be instrumentalised as collectors and contributors of data but actively included in the research process:

- researchers should aim to keep the citizen scientists engaged throughout the whole research process starting with development of research questions and ending with publication of results.
- researchers should acknowledge the contributions of citizen scientists for the sake of transparency, honesty and respect and to help build and maintain trust in science.

5.2. Aligning with both personal privacy requirements and open science principles, researchers should offer clear terms and conditions to participants of citizen science and participatory research projects and let them to be involved in decision-making processes where suitable.

5.3. Research ethics committees should adapt their practices to encompass not only citizen science and participatory research involving human subjects but also citizen science and participatory research projects, where community members actively contribute by submitting observations, photos, sensor data, and geolocation data. By adhering to the FAIR principles, which are aligned with the transparency and reproducibility goals of open science, the ethical reviews must include a detailed data management plan, to eliminate the risks associated with this type of data.

5.4. Citizen science projects need oversight institutions to advocate for the interests of all stakeholders, and to develop and ensure a long-term open data preservation plan. This sustainability is crucial especially in the context of citizen science initiatives with long-term objectives, such as those monitoring environmental changes over extended periods.

6. Training and Education

6.1. When existing, researchers should prioritise Open Science’s discipline-based trainings which address the specific form of data used in their research.

6.2. As social sciences often involve a high degree of multidisciplinary research, researchers should follow Open Science’s multidisciplinary training or Open Science’s trainings from the other relevant disciplines when they exist.

6.3. Researchers would benefit a lot from informal training within their research groups for instance and should therefore enhance and foster discussion within their own institutions and peers about the best Open Science practices in line with their own disciplines needs and specificities.

6.4. Researchers should not only follow trainings focused on the implementation of Open Science but also on the relevant legal aspects, data security and protection, as well as on research ethics

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and research integrity, in order to implement Open Science in accordance with the existing ethical and legal requirements and adhering to the highest standards of research integrity.

6.5. Whenever possible, Open Science practices should be incorporated in curricula and courses by, e.g., adapting existing courses, using open-source tools such as Python, or by including replication research in courses.

6.6. Researchers should analyse and share existing best practices of the implementation of Open Science in social sciences or with similar data formats as the ones they are using.

6.7. Researchers should consult with their discipline-based peers on their Open Science experiences. Colleagues can share relevant best practices examples tailored to their subfield.

7. Inclusivity

7.1. Researchers, especially when involving indigenous participants as well as marginalised or at-risk communities, should respect the FAIR and CARE principles for Indigenous Data Governance. Extensive cooperation and the use of contributorship (the CRediT offers good guidance) should be established throughout the whole research process to include the participants' perspectives, consent and rights in order to respect their safety and voices.

7.2. Researchers should, to the best of their capabilities, provide their research in as many languages as possible (in particular in international languages, local languages and the languages of the research participants) with the highest degree of translation quality, in order to be inclusive and to avoid quality-loss due to third actors' mistranslation. RPOs and RFOs should provide the necessary resource to achieve this goal.

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References from the ROSiE Project:

WP1: D1.1: Report on the relationship (tensions, challenges, overlaps) between RI, the wider RE perspective and OS.
WP1: D1.2: Suggested framework for addressing the (epistemic-ethical) challenges
WP2 Report on social challenges and implications related to Open Science
WP3: D3.1: Report on a strategy to engage stakeholders.
WP3: D3.3: Report on interviews.
WP3: D3.4: Recommendations resulting from the analysis of the consultation process.
WP3: MS3.1: Report on focus group 3.
WP5: D5.1: Report on existing policies and guidelines.
WP5: D5.2: Strategic Policy Paper on Responsible Open Science
WP5: D5.3: Policy Document Complementing the ECoC: The ROSiE General Guidelines on Responsible Open Science
WP6: D6.1: Preliminary analysis and mapping of existing European and national Open Science infrastructures with regard to promoting responsible Open Science.
WP6: D6.3: Comparison of existing blockchain technologies to safeguard responsible OS.
WP7: D7.1: Didactic framework.

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