Towards Open and Reproducible Terrorism Studies: Current Trends and Next Steps

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Abstract

In recent years, the use of primary data in terrorism research has increased. In order to maximise the benefits of this trend, we want to encourage terrorism scholars to implement open science practices more systematically. This article therefore presents different avenues towards open and reproducible terrorism studies. After introducing the open science movement and advantages of open science, we report an online survey study (N = 75) that shows that terrorism researchers have favourable attitudes towards and are keen to engage in open science activities. Findings, however, also point to key challenges that might prevent the implementation of open science in terrorism studies. Survey respondents were particularly concerned about sharing sensitive data, the risk of malicious practices, publishing in low-impact open access outlets, and indicated that open science seemed mainly targeted at quantitative research. To illustrate how researchers from different backgrounds and with potential resource restrictions can adopt open science practices, we propose practical solutions to address and reflect on these barriers.

Keywords: Open science, reproducibility, meta science, terrorism studies

Introduction

Although terrorism scholarship grew considerably in the last two decades [1], secondary data analyses and literature reviews have long dominated the field.[2] A recent review of papers published in prominent terrorism journals between 2007 and 2016, however, suggests a change in this trend. Notably, the majority of assessed work relied, at least in part, on data collected through interviews, surveys, or experiments.[3] We believe that in order to maximise the benefits of the increased use of primary data, terrorism researchers should consider implementing open science principles more systematically. The aim of this paper, therefore, is to encourage the use of open science practices and emphasise different avenues towards open and reproducible terrorism studies.

To underpin our argument, we first introduce the open science movement and describe four pillars of open science as well as their advantages.[4] We then present results of an online survey study that documents current trends of open science activities in terrorism studies. Terrorism researchers reported open science practices they already engage in as well as perceived barriers to 'doing open science'. Addressing the concerns voiced by survey respondents, we conclude the paper by providing practical suggestions on how to apply open science throughout the research process.

Defining Open Science

Open science refers to a broad range of activities that increase transparency of the research process such that data as well as information about its collection and analysis are freely available, discoverable, and intelligible for evaluation and reuse by different stakeholders.[5] Importantly, open science aims to advance a process of knowledge production that is self-correcting, where falsehoods are rejected and veracity is established by accumulating evidence over time.[6] Open science practices encompass the full research cycle including data collection, analysis, and reporting, and can be summarised in four pillars [7]: (1) Transparent data, analytical methods and material; (2) Open source software; (3) Open access publishing; (4) and Open peer review.

Transparent Data, Analytical Methods and Material

Sharing primary data, methods protocols, and materials (e.g. surveys, interview schedules, experimental stimuli) is a central element of 'doing open science'.[8] Researchers may indicate in publications whether data and material used in a study are available for other stakeholders and if so, how and under what conditions these can be accessed. Access control is especially suitable for pseudo-anonymised personal and sensitive data. Alternatively, data as well as materials and documentation of the procedures used to prepare, clean, and then analyse data can be made publicly available by posting it directly in a trusted repository. Discipline-specific [9] and generic options, such as FigShare [10] or the Open Science Framework (OSF) platform [11] exist. The permanent and citable link to the data is ideally reported in publications.

In addition to sharing analytical methods and materials after data analysis, researchers are increasingly also recording study protocols *beforehand*.[12] This process is referred to as pre-registration.[13] Between 2012 and 2018 the number of pre-registrations on only one platform, the OSF, doubled every year.[14] Pre-registration documents include, for example, information on how many participants will be recruited and through which means, what exclusion criteria will be applied, and what hypotheses or research questions are to be assessed, as well as the kinds of statistical tests or analytical procedures that will be conducted. In research outputs, authors then document where analyses differ from the pre-registration to allow for distinction between confirmatory and exploratory analyses. The pre-registration document is ideally stored in a public repository where a time stamp indicates when it was submitted. Changes to the pre-registration are not possible after its submission. The Open Science Framework, which offers a pre-registration service, provides several templates for pre-registration forms. Pre-registration is traditionally only applied to quantitative and deductive studies that focus on hypotheses testing. In addition to work that is based on primary data, pre-registration is also valuable for analyses that employ existing data sets.[1]

Open Source Software

Sharing data and analytical scripts is especially useful if the files are stored in a format that can be easily accessed and if analyses can be carried out using the original software. In this context, open source software is proposed as another pillar of open science. Open source software refers to unlicensed software that anyone can access, use, and improve. Examples of such software packages for quantitative analysis include JASP [16], R [17] and Python [18]. QDA Miner Lite [19] is an example of an open source software to conduct computer-assisted qualitative data analysis.

Open Access Publishing

Perhaps the most widely known open science practice is open access publishing, understood as publishing research outputs in journals that allow for subscription-free access (usually online). Different forms of open access are available. Gold open access refers to publication in an open access outlet. Green open access describes self-archived versions of an output, not including publisher's formatting, that are publicly available through, for instance, university repositories or a researcher's website. Open access journals may request authors to pay publishing fees. Journals can be discipline-specific, such as *Perspectives on Terrorism* and *Journal for Deradicalisation*, or publish content across disciplines like *PLOS One*. Many publishers of subscription-based journals also allow authors to purchase open access to their paper (i.e., hybrid open access journals). University College London Press publishes open access monographs.

Open Peer Review

Lastly, open peer review—of manuscripts or research proposals—intends to make research evaluation itself more transparent. This practice may involve reviewers signing their reviews with their name, reviewers being known to readers (as is common in the Frontier's journals [20]), or reviews being published alongside an article. The latter, in particular, may not only improve the quality of reviews but also provides credit for reviewers' contributions. In addition, reviewers might choose to commit to the Open Science Peer Review Oath.[21] In

1. Please see [15] for advice on implementation and templates.

practical terms this implies that reviewers add a brief statement to their review in which they confirm that they worked with integrity and will offer constructive critique. Moreover, reviewers would indicate that it is practice for them to sign their reviews and, importantly, advise authors to introduce (additional) steps to increase transparency of the research process. If data and material are made available, reviewers are encouraged to take these into account to validate the claims made by the authors.

The Proliferation of the Open Science Movement

The recent advancement and promotion of the aforementioned open science practices has perhaps been most noticeable in the psychological sciences. In order to appreciate this development, as well as to provide a background for the proposed advantages of implementing open science in terrorism studies, it is necessary to recount a series of events that, taken together, have challenged beliefs in the integrity of seemingly well-established findings in psychology.[22] In their influential paper 'False-Positive Psychology: Undisclosed Flexibility in Data Collection and Analysis Allows Presenting Anything as Significant', published in the prominent journal Psychological Science, Simmons, Nelson, and Simonsohn [23] showed that given researchers' flexibility during data collection, analysis and reporting, it is possible to support just about any hypothesis. The authors conducted two experiments to examine the effects of listening to music on age. Study 2 demonstrated a statistically significant difference in the age of participants who listened to a Beatles song as compared to participants in the control condition, allowing the authors to draw the conclusion that listening to the Beatles makes people younger. In this case, it is of course easy to note that the implication of a statistically significant mean difference is nonsensical and that the identified effect cannot be a *true effect*. In other instances, however, when findings are less counter-intuitive, it may be more difficult to not simply base judgments of the validity of a result on a p-value that is below the significance level.

Simmons and colleagues, unlike what would be reported in 'conventional' published studies, provided full disclosure of the steps they took to achieve statistically significant results. The authors stated that in describing the studies, they did not mention all collected dependent measures but only those for which effects were significant. They further did not indicate results without including covariates that, as it turns out, were responsible for the 'age effect'. Finally, analyses were conducted *during* data collection, and data collection was stopped once significant results were achieved. These are just some examples of so-called questionable research practices (QRPs [24]): decisions made and actions taken in ambiguous situations during the research process, which are not necessarily driven by malicious intent and, in many cases, widely accepted in the research community.[25] As is described below, such QRPs can drastically impair the quality of data and integrity of findings.

Shortly after Simmons and colleagues published their paper, and somewhat facilitated by new publishing formats, a number of failed replication studies was widely publicised. Several researchers and lab collaborations aimed to replicate results of iconic as well as more recent studies with newly collected data, following the methods reported in the original work or (also) asking its authors for input.[26] The 'Reproducibility Project: Psychology', for instance, brought together more than 270 researchers to replicate 100 semi-randomly selected effects.[27] The conclusions from these initiatives were mixed and especially disappointing with regards to the replicability of contemporary studies.[28] The Reproducibility Project showed that only 35 of 97 original 'significant' effects could be replicated. These high rates of failed replications raised concerns about the quality of research outputs in the psychological sciences as well as the procedures and standards applied by its authors. Having said this, the medical sciences [29], economics [30], and the social sciences [31] are confronted with 'replication crises' as well.

The reasons for failed replications can be manifold.[32] Studies might not replicate successfully because the methods sections of published research do not include enough detail to conduct the replication exactly under the same conditions as the original study. Materials, interview schedules, or stimuli may not, or only partially, be available.[33] Analytical procedures might not be fully disclosed: for instance, the statistical procedure may be only broadly described, and control variables perhaps not specified. In qualitative studies, central coding decisions may not be shared or only selective interview questions get reported. Replication is in some cases also

hampered because researchers are not able to access the original work if it is published behind a paywall.[34]

In addition, replications might fail because the original findings are false positive outcomes, that is, instances where the null-hypothesis was rejected although no true effect exists in the population. Applying the null-hypothesis-significance testing approach, the rate of false positives, or the type-I error rate, is determined by the significance level. For instance, in setting a significance level of 0.05, researchers accept that, in the long run, they will reject the null-hypothesis although there is no true effect in the population in 5% of the analyses. Questionable research practices can inflate the likelihood of false positives beyond this set threshold. Simmons and colleagues [35] highlighted in simulation studies that by testing two dependent variables to find at least some effect or by analysing data during collection to continue if the finding is not significant the risk of false positive outcomes is almost doubled. At this point, it becomes evident that failed replications are not simply a matter of vanity but can point to a flawed process of knowledge production. If future research as well as practical implications are based on results that are false positives, valuable resources are wasted and important opportunities for innovation missed.

Advantages of Open Science

Scientific associations, editorial boards, as well as funders increasingly endorse open science, and numerous researchers across disciplines apply open science practices because doing so offers advantages for different stakeholders. First, pre-registering and sharing data or material make it easier to become aware of and reduce instances of questionable (and outright wrong) research practices. Open science thus enhances the reproducibility of findings and the quality of evidence that informs research, policy makers, and practitioners. McAuliff and colleagues state "it is [therefore] important to frame changes in these practices as signs of an evolving, maturing science."[36]

Greater transparency of the research process can also facilitate collaboration.[37] Publishing pre-registrations or sharing research materials and data could encourage others working on similar topics to develop joint research and distribute resources to achieve more ambitious goals. This is a clear advantage for terrorism studies where the number of collaborative projects and research outputs is currently comparatively low.[38] Open science is also a way to bring together scholars from different disciplines who agree on a shared approach to conducting research, which can foster cross-disciplinary work. The Society for the Improvement of Psychological Science, for instance, hosts productive conferences where psychologists from different specialisations meet. The UK Reproducibility Network, which has local networks at more than 40 UK universities, and the Focus on Open Science events, which are hosted across the world, bring together researchers from all fields.

By making manuscripts, data, and results openly available, it is also easier to collaborate with non-academic stakeholders or share outputs with practitioners, which increases the impact of research findings. In addition, it has been shown that articles that are accompanied with accessible data receive more citations even when controlling for journal impact factor, open access status, and author characteristics.[39] Open access publishing also engenders higher citation counts.[40] This effect is observed across various disciplines [41], and holds for publications in fully open access journals, hybrid journals, and online repositories.[42]

Lastly, observing current trends in research funding and governance, open science practices will over time become a required standard. The 'Plan S' initiative that mandates full open access to research outputs and FAIR data principles—which stands for making data Findable, Accessible, Interoperable, and Reusable—is endorsed by several European funding agencies.[43] Early adopters of these practices will benefit from a proven track record and established procedures of open science activities when applying for funding.

Open Science in Terrorism Studies: Current Trends

Terrorism studies has, to date, not engaged in the same level of public reflection on open science as some other disciplines. The central aim of this paper therefore is to initiate this discourse and encourage terrorism researchers to take first steps towards implementing open science activities. In order to develop suggestions for open and reproducible terrorism studies, it is first necessary to understand the extent to which open science is already practiced in the field and, importantly, to identify barriers and restrictions to doing so. In the autumn of 2018, we conducted an online survey study that pursued these questions.[2]

The survey was promoted through three channels. We invited attendants at the 2018 Society for Terrorism Research conference (through Twitter, conference presentations, flyers, and word of mouth) to participate. We also shared the survey link on the authors' personal Twitter accounts. Finally, we searched for openly available email addresses of authors with at least two publications in Schuurman's review of terrorism research and contacted these authors to ask them directly to complete our survey.[44]

A total of $N = 75$ respondents who self-identified as terrorism researchers completed the survey.[3] Relative to those who clicked on the survey link but did not complete all questions, this represents a completion rate of 6.48 percent, which is acceptable given the unincentivised data collection online and the target audience. Importantly, a non-response bias is likely, and the results reported below should not be generalized to all self-identified terrorism researchers but perhaps be seen as an optimistic estimation. Respondents represent early career as well as senior academics. Twenty-three respondents were professors, seven associate professors, 13 assistant professors, 10 post-docs, one respondent was a postgraduate student, and nine indicated 'other' as professional status. The publishing experience of respondents varied as well, with 32 percent reporting one to five publications and 27 percent of respondents having more than 20 publications.

Respondents expressed overall favourable attitudes towards open science ($M = 88.33$, $SD = 16.30$; range: 41 – 100; scale: 0 = *not at all favourable*, 100 = *favourable*). Consistent engagement in different open science practices, however, was low (Table 1).

Table 1. Current engagement in different open science activities in %.

Activity	*Never*	*I tried, but I don't do it systematically*	*I do it when it feels convenient*	*I do it for most research projects/studies*	*I do it for every research project/study*
Pre-register analysis or studies	70	10	10	4	1
Sharing data	30	15	24	24	6
Sharing code	51	8	17	10	10
Open access publishing	24	20	32	20	4
Posting preprints	54	10	18	8	8
Doing open peer reviews	79	6	13	1	0
Using open source software	30	17	24	20	10
Conducting replication studies	79	8	7	4	1
Other	42	3	4	3	0

2. A pre-registration of the study as well as the survey materials, analysis code, and data is available online: https://osf.io/zv3uc/?view_only=9056d91143f444c0883c21434c199c7a

3. One respondent did not complete the consent form and was excluded from the data set.

Having said this, almost one quarter of respondents stated that they shared data for most research; and around 20% published open access and used open software for most research. Respondents further indicated moderate to high intentions to pursue open science activities in the future, with a slight preference for publishing in open access outlets and using open source software (Table 2).

Table 2. Average intentions to pursue different open science activities in the future.

Activity	*M*	*SD*
Pre-register analysis or studies	3.04	1.41
Sharing data	3.83	1.25
Sharing code	3.59	1.34
Open access publishing	4.27	1.10
Posting preprints	3.73	1.36
Doing open peer reviews	3.46	1.39
Using open source software	4.07	1.29
Conducting replication studies	3.58	1.36
Other	2.31	1.55

Note. Scale ranged from 1 = *Not at all* to 5 =*Completely*

It is also noteworthy that respondents were less interested in engaging in open science practices to achieve individual benefits but believed that the activities would benefit the scientific community and society at large. Only 7 percent strongly agreed that they would 'do open science' because it was increasingly emphasized in hiring or promotion criteria, and that 13 percent strongly agreed that open science activities were relevant for obtaining grants. Open science was commonly seen as a way to reach a larger academic audience, to have a larger impact, and that it seemed 'like the right thing to do'. Respondents also acknowledged that open science facilitates cooperation and makes the research process more efficient.

A key goal of our study was to understand the barriers that restrict terrorism researchers from engaging in open science. These were, notably, financial costs (M = 3.31, SD = 1.52), a lack of concrete incentives (M = 3.10, SD = 1.41) and discipline-specific best practices (M = 3.10, SD = 1.28) as well as lack of knowledge (M = 3.06, SD = 1.34).[4] Time constraints seem to be somewhat less of a challenge (M = 2.64, SD = 1.29). These results were based on closed answers. Open-text answers highlighted four additional concerns regarding the implementation of open science in terrorism studies: 1) Sharing sensitive and personal data, 2) The risk of malicious practices, 3) Publishing in low-impact open access outlets, and 4) The dominance of quantitative and deductive methods in the open science discourse.

More precisely, it was not considered viable to share sensitive and personal data publicly. Further, it was suggested that in cases where data is anonymised for sharing purposes, it might lose much of its value. It was also mentioned that Institutional Review Board protocols and data protection laws would not allow researchers to share sensitive and personal data. Survey respondents further voiced concerns that open study materials and data may be intentionally misused, thereby hampering counter-terrorism efforts. With regards to the academic community, respondents were worried that their ideas might be 'scooped' by other researchers if a preprint or dataset is shared before publication.

Respondents also stated that many open access outlets do not (yet) have a high impact factor with the knock-on effect that such journals are regarded as less valuable for promotion or hiring. Subscription-based journals of interest might not offer an open access publication option, and the high costs associated with open access publishing in journals that require author fees were reported as a barrier. Lastly, some respondents thought that open science practices are primarily applicable to research that follows a deductive approach and relies on quantitative methods, in particular inferential statistical analyses. Consequently, open science would appear

4. *Note.* Scale ranged from 1 = *Not at all* to 5 =*Completely*

to be of limited use to those terrorism researchers who use qualitative, inductive methodologies. In fact, promoting open science practices in terrorism studies was regarded as a potential means to further advance quantitative rather than qualitative methods in the field.

Steps Towards Open and Reproducible Terrorism Studies

The aforementioned findings highlight that, despite favourable attitudes towards and intentions to implement certain open science practices, the application of open science in terrorism studies is restricted by a range of barriers. To encourage more terrorism researchers to 'do open science', we aim to provide practical solutions as well as additional reflection that address the various concerns. Doing so, we hope to illustrate first steps that terrorism researchers with different methodological approaches and resources can implement in existing and future projects.

One principle underlies all our suggestions: The degree to which researchers apply open science practices must fit the specific study as well as individual conditions. For instance, if early career researchers do not feel comfortable with signing peer reviews because they fear repercussions from senior colleagues for criticising their work, it is nevertheless still possible to request authors to introduce transparent reporting. In other words, while we want to promote all activities, it is not our intention to stipulate that only those who share data, pre-register, publish open access, *and* sign their peer reviews 'really' engage in open science. Introducing even one of these practices contributes to the development of more open and reproducible terrorism studies.

Sharing Sensitive and Personal Data

Terrorism studies has a tradition of sharing data, and there are several large datasets publicly accessible.[45] At the same time, due to the use of sensitive data as well as the considerable resources that might be involved in its collection (often requiring intense negotiations, long-term professional relationships, and lengthy data collection), it is understandable that researchers are hesitant to share data, especially in public repositories that offer no control over who downloads data for what purpose.

In instances where data can be shared (see below) but researchers want to monitor its re-use, data can be made available through access control protocols that might be automated or require researchers to manually review requests. One prominent recent example is Aaron Zelin's *Jihadology* website. As part of a data sharing agreement, those who aim to access data could be asked to indicate what the data is used for or confirm that it only serves certain, for instance, non-commercial, purposes. Examples of templates for Data Access/Transfer/Processing Agreements, including such for personal data and compliant with data protection regulation, are usually provided by the institutional data protection officer or legal team. Applying licenses, such as Creative Commons licenses [46], offers additional control over data re-use. Access control also allows researchers to encourage collaboration, such that access is provided if the data controller is involved in the resulting research.

Researchers who are concerned that once they shared their data others will publish outputs before they are able to do so should keep in mind that it is possible to implement an embargo on public or access-controlled data. Research outputs can be prepared first, and data is then made available together with the (published) output. Journals such as *Terrorism and Political Violence* or *Behavioral Sciences of Terrorism and Political Aggression* do require data accessibility statements in which access control conditions can be specified or a permanent link to public data can be reported.

Importantly, we recommend that researchers only make participants' personal data available to others if they have included explicit data sharing statements in the participant's consent form.[5] This also implies that data retention and sharing plans must be reported in, and be approved by, institutional review board applications. In addition to asking participants whether they agree with the use and storage of personal information for the respective study, participants should approve data sharing with third parties. Participants should also be informed about the groups of people who might get access, and tiered consent could be implemented to give

5. More specific rules apply for researchers who need to comply with the European General Data Protection Regulation.

the opportunity to confirm sharing with some but not all recipients. Furthermore, the purposes of data use by third parties should be specified, such as replication studies or combined analyses with secondary data.[47]

Finally, if researchers collect personal and sensitive data and choose to share these in an access-controlled manner or publicly, measures must be taken to avoid the (re)identification of participants.[48] In a first instance, information such as names of persons and locations, ought to be suppressed. Data also may be generalised. For example, individuals' age can be presented as age brackets; instead of the full postcodes only the first three digits or a larger region where a participant is resident can be mentioned. Perturbation is a procedure during which (numeric) information is replaced with other values that maintain certain statistical properties, such as a variable's mean and standard deviation. Manual steps for anonymisation can be complemented with automated tools, such as the free web-based tool Netanos.[49]

The Risk of Malicious Practices

Some of the previously mentioned points (e.g. access-control and anonymising data) can also help reduce the risk of malicious practices that, as some fear, might be facilitated by open science activities. If data sharing and open access to a paper, for example, is considered a threat to efficient counter-terrorism measures, we would of course recommend that such research is kept confidential. However, we believe that this applies only to a small number of studies that employ primary research in terrorism studies. For most work the benefits of pre-registration, sharing data and materials, or open access publishing should outweigh the costs.

We are also confident that open science provides a way to undermine rather than foster 'scooping' by fellow researchers. First, in publishing a pre-registration of a study or preprint of a manuscript (discussed in the next section) researchers can present an idea as theirs long before the paper has made its way through lengthy peer review processes. Second, sharing data and material with a published paper, after peer review, can encourage cooperation, reproduction to demonstrate the findings' validity, as well as re-use of methods, which all can accrue citations.

Publishing Open Access

It is no surprise that a journal's impact factor influences the choice of a publication outlet, and several open access journals have not yet been assigned with any or a high (enough) impact factor. Tennant et al.'s [50] Cofactor Journal Selector Tool [51] allows a search for journals based on both open access policy and impact factor. If no designated open access journal is available, researchers have two options that still ensure that an article is openly accessible. First, authors can choose to purchase open access availability to their paper in hybrid open access journals and many publishers provide this possibility. We recommend that authors approach their library services or departments to inquire whether funds are available to cover these costs. Where the necessary resources are not available, authors can self-publish either postprints or preprints of their paper on their own website, the university's repository, or platforms such as the Open Science Framework, Figshare, and the Social Science Research Network.[52] Doing so complies with the criteria of green open access.

To clarify, postprints are author-accepted versions of peer-reviewed papers that do not include any of the publisher's formatting. These can always be shared without restrictions. Preprints, in turn, are versions of the manuscript that have not yet been submitted to a journal or have not yet undergone peer review. Authors can upload multiple preprints of the same article: for example, a first draft and the submitted manuscript. If storing these documents on a platform like the OSF all documents are time-stamped and downloads are recorded such that the researcher can derive a metric of the paper's impact before it is published. Early distribution of a manuscript as a preprint may further encourage valuable feedback. Although this effect has yet to be tested in the realm of terrorism studies, in the field of physics it also has been shown that posting a preprint is associated with higher overall citation rates.[53] Whether a journal supports the publication of a preprint, which remains accessible while an article is undergoing peer review, can be checked before submission using the SHERPA/RoMEO tool.[54] Most journals will also state whether this is allowed in their submission guidelines.

The Dominance of Quantitative and Deductive Methods in the Open Science Discourse

The open science movement is to date perhaps most widely promoted by quantitative researchers. However, open science seeks to enhance the integrity and transparency of all research regardless of its methodology. Notably, qualitative political science has initiated a productive debate on research transparency that highlights that open science is relevant and applicable in qualitative studies as well.[55] Reporting standards in qualitative research, for example, require researchers to reflect on their role, contextual embeddedness, and personal standpoints, in order to improve methodological integrity. It is further suggested that detailed information about the context of the source data, justification of sample size, origins of data collection protocols, as well as how these changed throughout the study, are provided.[56]

Moreover, the Qualitative Data Repository hosted at Syracuse University provides a platform to share and reuse qualitative and multi-method data "to evaluate scholarly claims, answer different research questions, and enhance teaching".[57] Pre-registration appears at first perhaps unsuitable for some qualitative research as it does not seem to support a dynamic adaption of hypotheses based on the interpretation of the data. However, documenting research questions, procedures of data collection and study design before the analyses and combining this pre-registered information with the analytical steps and final results allow researchers to clearly demonstrate their inferential processes. If research questions are adapted after researchers engaged with the data, this can be communicated transparently as well. Kern and Gleditsch provide further practical examples for open qualitative science including a template for pre-registration.[58] These approaches are to some extent still in its infancy and require researchers, including those in terrorism studies, to test them, adapt them, and, in doing so, develop sound practices that are purpose-fit to enhance the research process rather than hinder it.

Conclusion

Terrorism studies has a lengthy history of self-reflective critique over data availability. Now that primary data has become more commonplace and is accompanied with increasingly sophisticated methodologies, it is imperative to ensure the integrity and impact of study results. Introducing open science practices is an opportunity to proactively create an environment in which this can be achieved. This paper documented that a small but not negligible number of terrorism researchers are already engaging in open science and that, overall, attitudes towards the practices are favourable. It is, however, also important to acknowledge barriers and concerns that restrict the application of open science. It is our hope that this paper initiates a debate within the field to develop (further) best-practices that resonate with the interdisciplinary community of terrorism scholars to move over time towards open and reproducible terrorism studies.

Acknowledgement: *This project has received funding from The European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (Grant Agreement No. 758834).*

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