Establishing Open Science Research Priorities in Health Psychology: A research prioritisation Delphi exercise

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Conflict of interest

None.

Abstract

Objective: Research on Open Science practices in Health Psychology is lacking. This study aimed to identify research question priorities and obtain consensus on the Top 5 prioritised research questions for Open Science in Health Psychology.

Methods and measures: An international Delphi consensus study was conducted. Twenty-three experts in Open Science and Health Psychology within the European Health Psychology Society (EHPS) suggested research question priorities to create a 'long-list' of items (Phase 1). Forty-three EHPS members rated the importance of these items, ranked their top five and suggested their own additional items (Phase 2). Twenty-four EHPS members received feedback on Phase 2 responses and then re-rated and re-ranked their top five research questions (Phase 3).

Results: The top five ranked research question priorities were: 1. "To what extent are Open Science behaviours currently practised in Health Psychology?", 2. "How can we maximise the usefulness of Open Data and Open Code resources?", 3. "How can Open Data be increased within Health Psychology?", 4. "What interventions are effective for increasing the adoption of Open Science in Health Psychology?" and 5. "How can we increase free Open Access publishing in Health Psychology?".

Conclusion: Funding and resources should prioritise the research questions identified here.

Keywords: Open Science, Delphi study, Research prioritisation, Health Psychology, Meta-research.

1. Introduction

Open Science practices constitutes a range of behaviours which aim to increase research transparency, reproducibility and collaboration across the research process (Munafò et al., 2017, 2022; Parsons et al., 2022). Practices within Open Science aim to mitigate against prevalent, long-standing 'Questionable Research Practices' (Banks et al., 2016): such as data dredging (also known as 'p-hacking'), Hypothesising After Results are Known 'HARKing' (Kerr, 1998), concealing conflicts of interests and selectively publishing results (Munafò et al., 2017). Such practices are largely driven by problematic incentive structures in academia (Edwards & Roy, 2017) where novel and significant findings traditionally receive publication in more prestigious journals (Higginson & Munafò, 2016). Cognitive biases in researchers, such as the confirmation bias (Bishop, 2020), also contribute to these questionable research practices where data and information challenging predisposing views or hypotheses is more likely to be rejected in favour of data adhering to an existing belief (U. Peters, 2021). Unlike questionable research practices, Open Science practices still remain relatively under-rewarded globally in hiring and promotion processes (Khan et al., 2022).

Open Science behaviours can be integrated across the research process (Crüwell et al., 2019; Kathawalla et al., 2021) and are relevant to all research disciplines (Farran et al., 2020). Prior to data collection, pre-registration involves an explicit, time-stamped declaration of hypotheses, methods and data analysis via an online repository such as Open Science Framework or AsPredicted (Haven et al., 2020; Henderson, 2022; O'Connor, 2021). Trial registrations such as via the International Standard Randomised Controlled Trial Number (ISRCTN) Registry or Clinicaltrials.gov have also more traditionally been used within health research and clinical trials to log new and ongoing studies. However unlike pre-registration, trial registrations can be logged prospectively (prior to data collection commencing) or retrospectively (after data collection had commenced) (Loder et al., 2018). Registered Reports are a form of journal article which elaborates pre-registration, whereby articles receive Stage 1 acceptance based on the quality of proposed hypotheses, methods and analysis, prior to Stage 2 acceptance once analysis and write-up is complete (Chambers & Tzavella, 2022; Henderson, 2022). After data collection, making datasets (Tenopir et al., 2020), materials such as questionnaires and other experimental measures, intervention resources, interview transcripts or schedules (Kidwell et al., 2016) and software (Fortunato & Galassi, 2021) publicly available are also key elements of Open Science. For publication of research findings, pre-prints in repositories such as PsyArXiv and MedRxiv make papers available for view and comments prior to and during peer review (Watson, 2022), alongside Open Access publishing providing free access to

final papers (Basson et al., 2021). Additionally, open educational resources provide no-cost access to taught academic teaching materials to widen access (Colvard et al., 2018; Hilton, 2020), including open educational resources to train on Open Science itself (Egan et al., 2020).

National networks are developing globally to support Open Science behaviours, such as the UK Reproducibility Network (Stewart et al., 2022; UK Reproducibility Network Steering Committee, 2021), German, Portugese, Slovak and Swiss Reproducibility Networks, alongside larger international bodies such as the US' Center for Open Science providing Open Science Framework as a free platform to preregister, share data, materials, software and publish preprints all in one place (Foster & Deardorff, 2017).

Benefits of Open Science for Health Psychology

Making the development, methods and results of research as openly available, accessible and collaborative as possible is crucial for Health Psychology. Open Science facilitates accurate replication, maximises research impact, and is particularly important for the effective implementation of research in the real world (Kwasnicka et al., 2021; O'Connor, 2020). For example, pre-registration and Registered Reports of Health Psychology research, as in other health disciplines, reduces publication bias based on novel or significant findings, as well as reducing false positive results (Hagger, 2019). Making materials available – such as intervention handbooks – facilitates the ability to replicate effective behavioural interventions in different contexts (Norris & O'Connor, 2019). Enabling easy access of data from Health Psychology interventions alongside published papers or via data repositories such as Open Science Framework (Foster & Deardorff, 2017) facilitates speedy evidence synthesis: essential to address emerging topics where answers are required at speed such as during COVID-19 (Metzendorf & Featherstone, 2021). Much of health research is also publicly-funded, involving patients and members of the public participating in research, bringing both a moral and ethical obligation to make such research widely available and as impactful as possible (Grant & Bouskill, 2019; Taylor & Gorman, 2022).

Open Science practices within Health Psychology

There has been an increasing focus on enhancing Open Science practices within Health Psychology. Leading Health Psychology journals have adopted Open Science policies, such as *Psychology and Health* (Norris & O'Connor, 2019), *Health Psychology Review* (Hagger, 2019), *Health Psychology Bulletin* (G.-J. Peters et al., 2017), *Health Psychology & Behavioural Medicine* (Hagger, 2022; Li & Doyle, 2013) and *British Journal of Health Psychology* (Shaw et al., 2019), including establishment of Registered Reports

and requiring preregistered protocols, use of recommended reporting guidelines, open peer-review, requiring open data and code, and commitments to publishing null results. Recent discussions have also highlighted the potential for Health Psychology to contribute to improving Open Science practices more broadly (O'Connor, 2020). For example, applying behaviour change research and frameworks to facilitate changing researchers' Open Science behaviours both within Health Psychology and across other disciplines (Norris & O'Connor, 2019; Osborne & Norris, 2022; Zečević et al., 2021), with Health Psychology researchers contributing a large proportion of behaviour change research globally (Davis et al., 2015; Kok et al., 2016; Kwasnicka et al., 2016).

Despite the growing initiatives to promote Open Science in Health Psychology, the impact and effects of such activities has been under-explored to date, and meta-research (i.e. research on research) in this area is limited. For example, understanding the reasons and factors influencing behaviour is crucial in order to develop and test theoretically-based behaviour change interventions, however the extent that Health Psychology researchers engage in Open Science, and factors influencing these practices, is unclear (Norris & O'Connor, 2019). Prevalence of Open Science behaviours have been estimated in fields related to Health Psychology. For example, an assessment of 188 papers across psychology published between 2014-2017 found that although 65% were open access, 62% disclosed sources of funding and 39% disclosed conflict-of-interests, only 3% were pre-registered and 2% had open data (Hardwicke et al., 2021). An assessment of 100 smoking cessation randomised controlled trial behaviour change papers published in 2018 and 2019 contrastingly found greater pre-registration at 74% (Norris, He, et al., 2021), contributed to by funder requirements in health science to pre-register clinical trials (Kaplan & Irvin, 2015; Kimmelman, 2021). Additionally, a scoping review of studies assessing the determinants of adherence to social distancing measures found that only 11% of studies were pre-registered and only 23% provided open data (Noone et al., 2021).

Assessment of barriers and enablers to Open Science practices amongst early career researchers working in health research found that cultural and academic pressures, the positives and negatives of increased accountability and transparency, and the need for more training and supporting resources were important facilitators (Zečević et al., 2021). However, the study was small (n=14) and only 35% of participants were specifically working in Health Psychology. Additionally, there are few examples of the development of theoretically-informed interventions targeting Open Science behaviours using behaviour change theory (Norris & O'Connor, 2019; Osborne & Norris, 2022), or evaluations of the impacts of interventions to change Open Science behaviours or policies.

Open Science within the European Health Psychology Society

The European Health Psychology Society (EHPS) was established in 1986 and aims to promote empirical and theoretical research in and applications of Health Psychology within Europe, as well as the interchange of information related to Health Psychology with other associations throughout the world. EHPS has an active community of over 400 researchers and has actively engaged in the application of Open Science principles within Health Psychology. For example, in 2018 an expert 'Synergy' meeting was held amongst EHPS members to develop a position statement and recommendations for best practices for research integrity and Open Science practices in Health Psychology. These recommendations were aimed at Health Psychology researchers, educators and journal editors to provide a coordinated plan for enhancing research integrity and Open Science promotion across discipline (Kwasnicka et al., 2021). Recommendations included a focus on enhancing data sharing and availability, integration of Open Science principles into Health Psychology research curricula and education, and more explicit embedding of Open Science principles within journals, e.g. via open data policies and submission checklists. The EHPS Open Science Special Interest Group was established in 2019 and comprises a growing number of Health Psychology researchers across the world passionate about promoting Open Science behaviours (Norris & Toomey, 2020), with a core aim of conducting primary research into Open Science in Health Psychology.

Research prioritisation for Open Science in Health Psychology

There are several underexplored synergistic areas for meta-research in relation to Open Science and Health Psychology. How can we improve openness of Health Psychology, and how can Health Psychology be applied to improve Open Science? As such, a systematic way of identifying where to start and where to focus valuable research resources, such as research funding and time, is needed. Research prioritisation studies provide a process for key stakeholders to generate ideas and reach consensus on important research topics or questions (Byrne et al., 2020; Tong et al., 2019). The clear identification of research priorities also helps to reduce research waste (Glasziou & Chalmers, 2018) and facilitate collaborative research.

This study used a structured and systematic approach to identify the most pressing research priorities in relation to Open Science and Health Psychology as assessed by EHPS members. This output of this process aims to inform and guide the conduct of focused, prioritised research by both EHPS members and others interested in Open Science within Health Psychology, reducing the likelihood for research waste whilst maximising the potential for collaborative research. This study used a Delphi priority-

setting consensus approach, inviting all EHPS members to participate, informed by the methods of previous similar priority-setting exercises (Beecher et al., 2021; Byrne et al., 2020; Healy et al., 2018; Nyanchoka et al., 2019) to identify priorities for methodological research in health research trials. To avoid analytic flexibility and data mining common in Delphi studies (Grant et al., 2018), the full methods and analysis plan for this study was pre-registered on Open Science Framework (Norris, Toomey, et al., 2021).

The aims of this study were:

1. To identify research question priorities for Open Science in Health Psychology amongst members of the European Health Psychology Society
2. To obtain consensus on the Top 5 prioritised research questions for Open Science in Health Psychology

2. Methods

This Delphi study is reported following the Reporting guideline for priority setting of health research (REPRISE; Tong et al., 2019).

The Delphi process

In line with previous research prioritisation exercises (Byrne et al., 2020; Healy et al., 2018), this study used an electronic Delphi approach with online administration of questionnaires. The Delphi approach involves a structured process for gathering input and obtaining consensus through iterative rounds of questionnaires. Subsequent rounds provide feedback on how participants responded to questionnaire items in the previous round. It has previously been found to be useful for gaining input from large groups of participants spanning several geographic locations (Cheung et al., 2017; Garnett et al., 2015; J. Jones & Hunter, 1995), so beneficial for response collection across Europe for this context.

Delphi phases:

Phase 1: Expert research question generation

Experts were invited to suggest research questions that they saw as important for Open Science in Health Psychology. This brief questionnaire also assessed their previous experience of Open Science

behaviours: pre-registration, open data, open materials, pre-prints and Registered Reports, as well as research methods used, career level and country of residence. This phase stayed open for 2 weeks in September 2021.

Phase 2: E-Delphi Online survey

All members of the European Health Psychology Society were invited by email mailing lists and social media to participate in two online surveys, run using Qualtrics survey software. Participants were shown the long-list of research questions from Phase 1. They were asked to rate the importance of each research question on a 9-point scale (1 = lowest importance; 9 = highest importance). After rating all research questions, they were asked to select and rank their 'top 5' most important research questions. Participants also had the opportunity to make any additional suggestions for research questions in a free-text box. Brief demographic questions of previous Open Science practices used (pre-registration, open data, open materials, pre-prints and Registered Reports), research methodologies used, career stage and country of residence. This phase stayed open for 4 weeks from October to November 2021.

Phase 3: E-Delphi Online survey

In the second online survey (administered 2 weeks after the closing of survey 1), participants who participated in Phase 2 were shown information on how others rated and ranked items. Bar charts plotting group responses to each item were presented. Participants were asked to re-rate the Open Science in Health Psychology research questions with this information in mind. For the top-five ranking question, participants were reminded of their top-five selection from Phase 2 and presented with the percentage of respondents who ranked each item in their top five in Phase 2. Participants were asked to re-rank their top-five priority items with this information in mind. This phase stayed open for 6 weeks from December 2021 to January 2022. To encourage participation, the names of participants responding in Phase 3 were entered into a draw to win one of two €20 donations to their choice of GiveWell Top International Charities.

Participants

Purposive sampling was used to actively recruit participants who were active researchers in Health Psychology. Participants for Phase 1, the research question generation phase, were invited by email from the EHPS Open Science Special Interest Group (n=42 invited) and participants of the EHPS Synergy Expert meeting on Open Science (Kwasnicka et al., 2021; n=16 invited with n=9 also being members of the Special Interest Group). These participants had the expertise to advise on the research question

generation stage as they work in Health Psychology, use Open Science practices and are particularly knowledgeable in this area. Participants for Phases 2 and 3, the e-Delphi survey, were members of the European Health Psychology Society (EHPS) across all career stages, invited by EHPS newsletter emails and Twitter social media invitations. Participants of Phase 1 could also participate in Phases 2 and 3. Although the study was conducted amongst EHPS members only to provide a purposive sample frame, the extensive and international network of society members aimed to ensure that findings had relevance beyond EHPS members only.

Data analysis

Qualitative data was received from free-text questions to elicit research question priorities perceived in respondents (Phases 1 and 2). Quantitative data was received for demographic questions on previous Open Science experience, research methodologies used, career stage and country of residence (Phases 1 and 2) and ranking of suggested research question priorities (Phases 2 and 3).

Phase 1: Expert research question generation

Descriptive statistics were calculated for the demographic data received. All suggested free-text research question priorities were collated and categorised by three researchers (EN, AP & ET) to generate a long list of potential research questions. Duplicate research question responses were merged to allow minimal overlap in the subsequent analysis and phases. No pre-existing coding framework was used to categorise the research question suggestions. The long list of possible research questions were then cross-checked with published literature (by EN, AP & ET) to determine if they were: a) an answerable research question, b) if the question has been 'answered' by searching Google Scholar, Cochrane Library, Epistemonikos, all EHPS journals and top Health Psychology journals (Walden University Library, 2021) from 2010 to present to see if there was no systematic review of research evidence on the question (Healy et al., 2018), or 'unanswered'. This long list was then reviewed by four other members of the research team (JR, JG, CN & SG) before proceeding to Phase 2 of the study.

Phase 2: E-Delphi Online survey

Descriptive statistics were calculated for the demographic data received and ranking of research question priorities. Any additional research questions proposed were discussed by the full research team and included for rating in Phase 3 if the majority of team members agree that the item was a unique, novel and previously excluded item. As done in Phase 1, the long list of possible research questions were cross-checked with published literature (by EN, AP & ET) to determine if they were: a) an

answerable research question, b) if the question has been 'answered', i.e searching Google Scholar to see if there was no systematic review of research evidence on the question (Healy et al., 2018), or 'unanswered'. All unanswered research questions were brought forward for inclusion in Phase 3, where participants were asked to select up to five research questions that they consider of most importance.

Phase 3: E-Delphi Online survey

Participants who participated in Phase 2 were shown a summary of how the overall sample rated and ranked research questions in Phase 2. This is in a slight deviation to the pre-registered protocol, where an error with Phase 2 survey set-up meant that respondents could not be identified from Phase 2 to be reminded of their own responses in Phase 3. Bar charts plotting group responses to each item were presented. Participants were asked to re-rate the research questions from Phase 2 with this information in mind. Participants were also shown the top-five ranking questions across the sample from Phase 2 and asked to re-rank their top-five priority items with this information in mind.

Ethical approval

Ethical approval was obtained from Brunel University London (23797-LR-Mar/2021- 32205-4).

3. Results

Phase 1: Expert research question generation

Twenty-five respondents consented to participate but only twenty-three (92%) provided research question suggestions and were included in analysis (Table 1). Reported experience of Open Science behaviours ranged from 95.7% for study preregistration to 13% for publishing a Registered Report. 65.2% reported primarily using mixed method research, with respondents most commonly being Lecturers / Assistant Professors (39.1%) and most commonly residing in the United Kingdom (26.1%), the Netherlands (17.4%), Ireland (13%) or Finland (13%; Table 1).

In total, the twenty-three experts provided 89 items. Following the initial review (by EN, AP & ET) to remove duplicates and merge similar topics, the list was reduced to 41 items that were grouped into eight categorical themes (Table 2). The categorical themes were: Assessing and increasing adoption of Open Science in Health Psychology (12 research questions (RQs)), Assessing impact of interventions to

increase Open Science in Health Psychology (6 RQs), Determinants of Open Science in Health Psychology (6 RQs), Assessing impact of Open Science in Health Psychology (7 RQs), Open Science to improve research quality (4 RQs), Open Science teaching (2 RQs), Ethics and data protection (2 RQs) and Better organisation of research (2 RQs: Table 2).

Phases 2 and 3: E-Delphi Online survey

In Phase 2, fifty-three consented to participate but only forty-three (81.1%) answered rating and ranking questions within the survey and were included in analysis. Reported experience of Open Science behaviours ranged from 79.1% for Open Materials and 25.6% for publishing a Registered Report. 53.5% reported primarily using mixed method research, with respondents most commonly being Lecturers / Assistant Professors (23.3%) or Professors (20.9%) and most commonly residing in the United Kingdom (23.3%), Ireland (16.3%) or the Netherlands (14%; Table 1). In Phase 3, thirty-nine consented to participate but only twenty-four (61.5%) answered questions within the survey and were included in the analysis. Reported experience of Open Science behaviours ranged from 87.5% for study preregistration to 20.8% for publishing a Registered Report. 66.6% reported primarily using mixed method research, with respondents most commonly being Lecturers / Assistant Professors (29.2%) or Professors (25%) and most commonly residing in Ireland (16.7%), Germany (12.5%) or USA (12.5%; Table 1).

Five new research questions were suggested in Phase 2: “How can we best reward Open Science behaviours within Health Psychology?” (RQ#42), “Do Health Psychologists want Open Science?” (RQ#43), “Do Open Science practices and determinants vary by country?” (RQ#44), “How can we enhance machine-readability of the products of Health Psychology research?” (RQ#45) and “What does Open Science mean to Health Psychologists?” (RQ#46). The highest that these additional items were rated was position 17 in Phase 3 (Table 3), with none of these rated more than as the top third research question priority within Phase 3 (Table 4).

The mean importance ratings for individual items in Phases 2 and 3 is presented in Table 3. The top five research questions rated as most important differed in order entirely between Phases 2 and 3, with two out of five top five instances in Phase 3 not having been present in Phase 2. The final top five rated research questions in Phase 3 were: ‘What are the perceived barriers and facilitators to practising Open Science behaviours in Health Psychology?” (RQ#19: M=7.88/10, SD=1.01), “What are the perceived barriers and facilitators to early career researchers practising Open Science behaviours in Health Psychology?” (RQ#20: M=7.6/10, SD=1.29), “How can Open Data be increased within Health

Psychology?" (RQ#4: M=7.48/10, SD=1.33), "What is the effect of adopting Open Science principles on research quality in Health Psychology?" (RQ#25: M=7.44/10, SD=1.58) and "Does Open Science increase the credibility of Health Psychology research?" (RQ#27: M=7.40/10, SD=1.19). The top two rated items were from the theme Determinants of Open Science in Health Psychology, the third top rated item was from the theme Assessing and increasing adoption of Open Science in Health Psychology and the fourth and fifth top rated items were from the theme Assessing impact of Open Science in Health Psychology.

The number and percentage of participants who ranked each item as their top priority in Phases 2 and 3 are shown in Table 4. The same top five research questions in Phase 2 were also ranked as the top five in Phase 3. In order of top five ranking, these research question priorities were: "To what extent are Open Science behaviours currently practised in Health Psychology?" (RQ#1: Ranked Top RQ by nine respondents in Phase 3), "How can we maximise the usefulness of Open Data and Open Code resources?" (RQ#5: Ranked Top RQ by six respondents in Phase 3), "How can Open Data be increased within Health Psychology?" (RQ#4: Ranked Top RQ by six respondents in Phase 3), "What interventions are effective for increasing the adoption of Open Science in Health Psychology?" (RQ#13: Ranked Top RQ by two respondents in Phase 3) and "How can we increase free Open Access publishing in Health Psychology?" (RQ#7: Ranked Top RQ by one respondent, 3rd ranked by two respondents and 4th ranked by one respondent in Phase 3; Table 4). The top one, two, three and fifth ranked items were from the theme Assessing and increasing adoption of Open Science in Health Psychology, with the fourth ranked item from the theme Assessing impact of interventions to increase Open Science in Health Psychology.

4. Discussion

Summary of findings:

The aims of this study were to identify research question priorities for Open Science in Health Psychology amongst members of the European Health Psychology Society and to obtain consensus on the Top 5 prioritised research questions for Open Science in Health Psychology. 89 research questions initially suggested in phase 1 were reduced via duplicate removal and merging of similar topics to 41 'long-list' items grouped into eight categorical themes. These 41 items were assessed in phases 2 and 3, alongside five additional research questions suggested in phase 2. The top five research questions rated as most important differed in order entirely between phases 2 and 3, with two out of five top five

instances in phase 3 not having been present in phase 2. However, the same top five research questions in phase 2 were also ranked as the top five in phase 3. The theme Assessing and increasing adoption of Open Science in Health Psychology was most commonly featured across top responses, with items featured in one of the top rated and four of the top five ranked research questions.

The top ranked research question priority was "To what extent are Open Science behaviours currently practiced in Health Psychology?" (RQ#1: Ranked Top RQ by 9/24 respondents in phase 3). Estimates of Open Science behaviours have been performed by meta-science studies in areas allied to health psychology. Within 250 studies across psychology published between 2014-2017, open access publication was relatively common (65%), whereas sharing of open materials (14%), data (2%) and analysis scripts (1%), pre-registration (3%) and study protocols (0%) were low (Hardwicke et al., 2021). Within behaviour change interventions as a subsection of health psychology, recent smoking cessation (Norris, He, et al., 2021) and physical activity interventions (Norris, Sulevani, et al., 2021) have been shown to have relatively common preregistration and Open Access publication but less engagement across the remainder of Open Science behaviours. Pre-registration (11%) availability was low but open data (23%) more available than in other meta-studies in the area of social distancing measures (Noone et al., 2021). However, the extent that Open Science behaviours are currently used across the range of health psychology research remains unclear. Future research is hence desired by members of the European Health Psychology Society to assess Open Science engagement across the full spectrum of health psychology research, from disease prevention and treatment to wellbeing promotion in individual and widescale interventions.

The second ranked research question priority was "How can we maximise the usefulness of Open Data and Open Code resources?" (RQ#5: Ranked Top RQ by 6/24 respondents in phase 3). Relatedly, the third ranked research question priority was "How can Open Data be increased within Health Psychology?" (RQ#4: Ranked Top RQ by 6/24 respondents in phase 3). These two prioritised research questions reflect the need to better represent the outputs of research in Health Psychology within publicly available forums to enable reuse. Health Psychologists use a broad range of research methods across qualitative, quantitative and mixed methods, making the need to represent these diverse outputs of data and code complex. For example, qualitative data within health psychology may be from hard to reach or underrepresented groups, providing a beneficial and rare opportunity to allow their unique voices to be heard (Chauvette et al., 2019). However, as participants from such groups represent a small but defined

pool of potential people, it is innately ethically problematic to assume all raw data can simply be anonymised and then made openly available (Jones et al., 2021; Mannheimer et al., 2019).

The fourth ranked research question priority was "What interventions are effective for increasing the adoption of Open Science in Health Psychology?" (RQ#13: Ranked Top RQ by 2/24 respondents in phase 3). Limited evaluations of Open Science initiatives and policies in areas allied to Health Psychology exist to-date. For example, an evaluation of the ten highest ranking pain journals found low engagement with research transparency and openness standards (Cashin et al., 2021). Initiatives to drive researcher behaviour have been developed by Health Psychologists themselves, such as the programme "Principles and Practices of Open Research: Teaching, Research, Impact, and Learning (PaPOR TRaIL)" (Egan et al., 2020), amongst wider initiatives to build lesson banks for Open Science in wider psychology (Pownall et al., 2021) and resources across-disciplines such as with the collaborative Framework for Open and Reproducible Research Training (FORRT) (Azevedo et al., 2022; Parsons et al., 2022). However, the evidence base of intervention effectiveness for such interventions is still currently lacking.

The fifth ranked research question priority was "How can we increase free Open Access publishing in Health Psychology?" (RQ#7: Ranked Top RQ by 1/24 respondent, 3rd ranked by 2/24 respondents and 4th ranked by 1/24 respondents in phase 3). Article Processing Charges (APCs) are currently still the norm for the majority of Health Psychology-related journals (such as *Behavioural Medicine, Psychology & Health* and *Psychology & Health*), making Open Access publishing prohibitive for many researchers especially from low and middle-income countries (Anane-Sarpong et al., 2018; Severin et al., 2020). However, examples of increasing free Open Access within Health Psychology are prominent, such as *Health Psychology Bulletin* (G.-J. Peters et al., 2017) which provides free, fully Open Access publication to all and *British Journal of Health Psychology* which offers free Open Access publishing to British Psychological Society members (Shaw et al., 2019). Although the increasing prominence of health-related pre-prints provides one opportunity for Open Access publishing prior to peer review (Añazco et al., 2021), the prominence of this research question indicates that further opportunities are needed to widen Open Access across Health Psychology outlets.

Strengths and limitations

This is the first study which has attempted to systematically assess research questions priorities relating to Open Science. The study was preregistered (Norris, Toomey, et al., 2021) and all data and materials

made available via the Open Science Framework (https://osf.io/kguh6/). The study was also reported following the Reporting guideline for priority setting of health research (REPRISE; Tong et al., 2019) and informed by the methods of previous similar priority-setting exercises related to health research (Byrne et al., 2020; Healy et al., 2018; Nyanchoka et al., 2019). All members of the EHPS were invited to participate in phases 2 and 3 (approximately 300 at the time of the study). However, final conclusions are based on a relatively small sample of responses received for phases 2 (n=43) and phase 3 (n=24). Due to EHPS members residing in developed countries, lower income countries are not represented in these findings. Findings are only applicable to the specific European context of Health Psychology. Additionally, the majority of EHPS members are academic researchers or doctoral researchers, meaning that the views of wider health psychology practitioners are not represented in this study.

5. Conclusion

This study used a systematic and structured Delphi approach to identify the top-five research question priorities for Open Science in Health Psychology. The top five ranked research question priorities were: 1. “To what extent are Open Science behaviours currently practised in Health Psychology?”, 2. “How can we maximise the usefulness of Open Data and Open Code resources?”, 3. “How can Open Data be increased within Health Psychology?”, 4. “What interventions are effective for increasing the adoption of Open Science in Health Psychology?” and 5. “How can we increase free Open Access publishing in Health Psychology?”. Research funding and resources should prioritise the exploration of these research questions to enable a concerted effort to understanding and improving Open Science in Health Psychology, whilst also applying teachings from Health Psychology to Open Science itself.

6. References

Anane-Sarpong, E., Wangmo, T., Ward, C. L., Sankoh, O., Tanner, M., & Elger, B. S. (2018). "You cannot collect data using your own resources and put It on open access": Perspectives from Africa about public health data-sharing. *Developing World Bioethics*, *18*(4), 394–405. https://doi.org/10.1111/dewb.12159

Añazco, D., Nicolalde, B., Espinosa, I., Camacho, J., Mushtaq, M., Gimenez, J., & Teran, E. (2021). Publication rate and citation counts for preprints released during the COVID-19 pandemic: The good, the bad and the ugly. *PeerJ*, *9*, e10927. https://doi.org/10.7717/peerj.10927

Azevedo, F., Liu, M., Pennington, C. R., Pownall, M., Evans, T. R., Parsons, S., Elsherif, M. M., Micheli, L., Westwood, S. J., & Framework for Open, R. R. T. (FORRT). (2022). Towards a culture of open scholarship: The role of pedagogical communities. *BMC Research Notes*, *15*(1), 75. https://doi.org/10.1186/s13104-022-05944-1

Banks, G. C., Rogelberg, S. G., Woznyj, H. M., Landis, R. S., & Rupp, D. E. (2016). Editorial: Evidence on Questionable Research Practices: The Good, the Bad, and the Ugly. *Journal of Business and Psychology*, *31*(3), 323–338. https://doi.org/10.1007/s10869-016-9456-7

Basson, I., Blanckenberg, J. P., & Prozesky, H. (2021). Do open access journal articles experience a citation advantage? Results and methodological reflections of an application of multiple measures to an analysis by WoS subject areas. *Scientometrics*, *126*(1), 459–484. https://doi.org/10.1007/s11192-020-03734-9

Beecher, C., Toomey, E., Maeso, B., Whiting, C., Stewart, D. C., Worrall, A., Elliott, J., Smith, M., Tierney, T., Blackwood, B., Maguire, T., Kampman, M., Ling, B., Gravel, C., Gill, C., Healy, P., Houghton, C., Booth, A., Garritty, C., … Devane, D. (2021). *What are the most important unanswered research questions on rapid review methodology? A James Lind Alliance research methodology Priority Setting Partnership: the Priority III study protocol* (4:80). HRB Open Research. https://doi.org/10.12688/hrbopenres.13321.2

Bishop, D. (2020). How scientists can stop fooling themselves over statistics. *Nature*, *584*(7819), 9–9. https://doi.org/10.1038/d41586-020-02275-8

Byrne, M., McSharry, J., Meade, O., Lavoie, K. L., & Bacon, S. L. (2020). An international, Delphi consensus study to identify priorities for methodological research in behavioral trials in health research. *Trials*, *21*(1), 292. https://doi.org/10.1186/s13063-020-04235-z

Cashin, A. G., Bagg, M. K., Richards, G. C., Toomey, E., McAuley, J. H., & Lee, H. (2021). Limited engagement with transparent and open science standards in the policies of pain journals: A cross-sectional evaluation. *BMJ Evidence-Based Medicine*, *26*(6), 313–319. https://doi.org/10.1136/bmjebm-2019-111296

Chambers, C. D., & Tzavella, L. (2022). The past, present and future of Registered Reports. *Nature Human Behaviour*, *6*(1), 29–42. https://doi.org/10.1038/s41562-021-01193-7

Chauvette, A., Schick-Makaroff, K., & Molzahn, A. E. (2019). Open Data in Qualitative Research. *International Journal of Qualitative Methods*, *18*, 1609406918823863. https://doi.org/10.1177/1609406918823863

Cheung, K. L., de Ruijter, D., Hiligsmann, M., Elfeddali, I., Hoving, C., Evers, S. M. A. A., & de Vries, H. (2017). Exploring consensus on how to measure smoking cessation. A Delphi study. *BMC Public Health*, *17*(1), 890. https://doi.org/10.1186/s12889-017-4902-7

Colvard, N. B., Watson, C. E., & Park, H. (2018). The Impact of Open Educational Resources on Various Student Success Metrics. *International Journal of Teaching and Learning in Higher Education*, *30*(2), 262–276.

Crüwell, S., van Doorn, J., Etz, A., Makel, M. C., Moshontz, H., Niebaum, J. C., Orben, A., Parsons, S., & Schulte-Mecklenbeck, M. (2019). Seven Easy Steps to Open Science. *Zeitschrift Für Psychologie*, *227*(4), 237–248. https://doi.org/10.1027/2151-2604/a000387

Davis, R., Campbell, R., Hildon, Z., Hobbs, L., & Michie, S. (2015). Theories of behaviour and behaviour change across the social and behavioural sciences: A scoping review. *Health Psychology Review*, *9*(3), 323–344. https://doi.org/10.1080/17437199.2014.941722

Edwards, M. A., & Roy, S. (2017). Academic Research in the 21st Century: Maintaining Scientific Integrity in a Climate of Perverse Incentives and Hypercompetition. *Environmental Engineering Science*, *34*(1), 51–61. https://doi.org/10.1089/ees.2016.0223

Egan, S., Tobin, M., Palmer, B., Coffey, A., Dahly, D., Houghton, C., Ó Carragáin, E., Toomey, E., Dockray, S., & Matvienko-Sikar, K. (2020). Developing an open educational resource for open research: Protocol for the PaPOR TRAIL project. *HRB Open Research*, *3*, 84. https://doi.org/10.12688/hrbopenres.13171.1

Farran, E. K., Silverstein, P., Ameen, A. A., Misheva, I., & Gilmore, C. (2020). *Open Research: Examples of good practice, and resources across disciplines*. OSF Preprints. https://doi.org/10.31219/osf.io/3r8hb

Fortunato, L., & Galassi, M. (2021). The case for free and open source software in research and scholarship. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, *379*(2197), 20200079. https://doi.org/10.1098/rsta.2020.0079

Foster, E. D., & Deardorff, A. (2017). Open Science Framework (OSF). *Journal of the Medical Library Association*, *105*(2), 203–206. https://doi.org/10.5195/jmla.2017.88

Garnett, C., Crane, D., West, R., Brown, J., & Michie, S. (2015). Identification of Behavior Change Techniques and Engagement Strategies to Design a Smartphone App to Reduce Alcohol Consumption Using a Formal Consensus Method. *JMIR MHealth and UHealth*, *3*(2), e73. https://doi.org/10.2196/mhealth.3895

Glasziou, P., & Chalmers, I. (2018). Research waste is still a scandal—An essay by Paul Glasziou and Iain Chalmers. *BMJ*, *363*, k4645. https://doi.org/10.1136/bmj.k4645

Grant, S., Booth, M., & Khodyakov, D. (2018). Lack of preregistered analysis plans allows unacceptable data mining for and selective reporting of consensus in Delphi studies. *Journal of Clinical Epidemiology*, *99*, 96–105. https://doi.org/10.1016/j.jclinepi.2018.03.007

Grant, S., & Bouskill, K. E. (2019). Why institutional review boards should have a role in the open science movement. *Proceedings of the National Academy of Sciences of the United States of America*, *116*(43), 21336–21338.

Hagger, M. S. (2019). Embracing Open Science and Transparency in Health Psychology. *Health Psychology Review*, *13*(2), 131–136. https://doi.org/10.1080/17437199.2019.1605614

Hagger, M. S. (2022). Developing an open science 'mindset.' *Health Psychology and Behavioral Medicine*, *10*(1), 1–21. https://doi.org/10.1080/21642850.2021.2012474

Hardwicke, T. E., Thibault, R. T., Kosie, J. E., Wallach, J. D., Kidwell, M. C., & Ioannidis, J. P. A. (2021). Estimating the Prevalence of Transparency and Reproducibility-Related Research Practices in Psychology (2014–2017). *Perspectives on Psychological Science*, 1745691620979806. https://doi.org/10.1177/1745691620979806

Haven, T. L., Errington, T. M., Gleditsch, K. S., van Grootel, L., Jacobs, A. M., Kern, F. G., Piñeiro, R., Rosenblatt, F., & Mokkink, L. B. (2020). Preregistering Qualitative Research: A Delphi Study. *International Journal of Qualitative Methods*, *19*, 1609406920976417. https://doi.org/10.1177/1609406920976417

Healy, P., Galvin, S., Williamson, P. R., Treweek, S., Whiting, C., Maeso, B., Bray, C., Brocklehurst, P., Moloney, M. C., Douiri, A., Gamble, C., Gardner, H. R., Mitchell, D., Stewart, D., Jordan, J., O'Donnell, M., Clarke, M., Pavitt, S. H., Guegan, E. W., … Devane, D. (2018). Identifying trial

recruitment uncertainties using a James Lind Alliance Priority Setting Partnership – the PRioRiTy (Prioritising Recruitment in Randomised Trials) study. *Trials*, *19*, 147. https://doi.org/10.1186/s13063-018-2544-4

Henderson, E. L. (2022). *A guide to preregistration and Registered Reports*. MetaArXiv. https://doi.org/10.31222/osf.io/x7aqr

Higginson, A. D., & Munafò, M. R. (2016). Current Incentives for Scientists Lead to Underpowered Studies with Erroneous Conclusions. *PLOS Biology*, *14*(11), e2000995. https://doi.org/10.1371/journal.pbio.2000995

Hilton, J. (2020). Open educational resources, student efficacy, and user perceptions: A synthesis of research published between 2015 and 2018. *Educational Technology Research and Development*, *68*(3), 853–876. https://doi.org/10.1007/s11423-019-09700-4

Jones, A., Caes, L., Rugg, T., Noel, M., Bateman, S., & Jordan, A. (2021). Challenging issues of integrity and identity of participants in non-synchronous online qualitative methods. *Methods in Psychology*, *5*, 100072. https://doi.org/10.1016/j.metip.2021.100072

Jones, J., & Hunter, D. (1995). Consensus methods for medical and health services research. *BMJ : British Medical Journal*, *311*(7001), 376–380.

Kaplan, R. M., & Irvin, V. L. (2015). Likelihood of Null Effects of Large NHLBI Clinical Trials Has Increased over Time. *PLOS ONE*, *10*(8), e0132382. https://doi.org/10.1371/journal.pone.0132382

Kathawalla, U.-K., Silverstein, P., & Syed, M. (2021). Easing Into Open Science: A Guide for Graduate Students and Their Advisors. *Collabra: Psychology*, *7*(1). https://doi.org/10.1525/collabra.18684

Kerr, N. L. (1998). HARKing: Hypothesizing After the Results are Known. *Personality and Social Psychology Review*, *2*(3), 196–217. https://doi.org/10.1207/s15327957pspr0203_4

Khan, H., Almoli, E., Franco, M. C., & Moher, D. (2022). Open science failed to penetrate academic hiring practices: A cross-sectional study. *Journal of Clinical Epidemiology*, *144*, 136–143. https://doi.org/10.1016/j.jclinepi.2021.12.003

Kidwell, M. C., Lazarević, L. B., Baranski, E., Hardwicke, T. E., Piechowski, S., Falkenberg, L.-S., Kennett, C., Slowik, A., Sonnleitner, C., Hess-Holden, C., Errington, T. M., Fiedler, S., & Nosek, B. A. (2016). Badges to Acknowledge Open Practices: A Simple, Low-Cost, Effective Method for Increasing Transparency. *PLOS Biology*, *14*(5), e1002456. https://doi.org/10.1371/journal.pbio.1002456

Kimmelman, J. (2021). Clinical Trials to authors: Please pre-register your studies! *Clinical Trials*, *18*(6), 645–646. https://doi.org/10.1177/17407745211057186

Kok, G., Gottlieb, N. H., Peters, G.-J. Y., Mullen, P. D., Parcel, G. S., Ruiter, R. A. C., Fernández, M. E., Markham, C., & Bartholomew, L. K. (2016). A taxonomy of behaviour change methods: An Intervention Mapping approach. *Health Psychology Review*, *10*(3), 297–312. https://doi.org/10.1080/17437199.2015.1077155

Kwasnicka, D., Dombrowski, S. U., White, M., & Sniehotta, F. (2016). Theoretical explanations for maintenance of behaviour change: A systematic review of behaviour theories. *Health Psychology Review*, *10*(3), 277–296. https://doi.org/10.1080/17437199.2016.1151372

Kwasnicka, D., ten Hoor, G. A., van Dongen, A., Gruszczyńska, E., Hagger, M. S., Hamilton, K., Hankonen, N., Heino, M. T. J., Kotzur, M., Noone, C., Rothman, A. J., Toomey, E., Warner, L. M., Kok, G., Peters, G.-J., & Luszczynska, A. (2021). Promoting scientific integrity through open science in health psychology: Results of the Synergy Expert Meeting of the European health psychology society. *Health Psychology Review*, *15*(3), 333–349. https://doi.org/10.1080/17437199.2020.1844037

Li, X., & Doyle, F. (2013). The new open access journal on health psychology and behavioral medicine: Why do we need it? *Health Psychology and Behavioral Medicine*, *1*(1), 1–4. https://doi.org/10.1080/21642850.2013.780401

Loder, E., Loder, S., & Cook, S. (2018). Characteristics and publication fate of unregistered and retrospectively registered clinical trials submitted to The BMJ over 4 years. *BMJ Open*, *8*(2), e020037. https://doi.org/10.1136/bmjopen-2017-020037

Mannheimer, S., Pienta, A., Kirilova, D., Elman, C., & Wutich, A. (2019). Qualitative Data Sharing: Data Repositories and Academic Libraries as Key Partners in Addressing Challenges. *American Behavioral Scientist*, *63*(5), 643–664. https://doi.org/10.1177/0002764218784991

Metzendorf, M.-I., & Featherstone, R. M. (2021). Evaluation of the comprehensiveness, accuracy and currency of the Cochrane COVID-19 Study Register for supporting rapid evidence synthesis production. *Research Synthesis Methods*, *12*(5), 607–617. https://doi.org/10.1002/jrsm.1501

Munafò, M. R., Chambers, C., Collins, A., Fortunato, L., & Macleod, M. (2022). The reproducibility debate is an opportunity, not a crisis. *BMC Research Notes*, *15*(1), 43. https://doi.org/10.1186/s13104-022-05942-3

Munafò, M. R., Nosek, B. A., Bishop, D. V. M., Button, K. S., Chambers, C. D., Percie du Sert, N., Simonsohn, U., Wagenmakers, E.-J., Ware, J. J., & Ioannidis, J. P. A. (2017). A manifesto for reproducible science. *Nature Human Behaviour*, *1*(1), 1–9. https://doi.org/10.1038/s41562-016-0021

Noone, C., Warner, N. Z., Byrne, M., Durand, H., Lavoie, K. L., McGuire, B. E., McSharry, J., Meade, O., Morrissey, E., Molloy, G. J., O'Connor, L., & Toomey, E. (2021). A scoping review of research on the determinants of adherence to social distancing measures during the COVID-19 pandemic. *Health Psychology Review*, *15*(3), 350–370. https://doi.org/10.1080/17437199.2021.1934062

Norris, E., He, Y., Loh, R., West, R., & Michie, S. (2021). Assessing Markers of Reproducibility and Transparency in Smoking Behaviour Change Intervention Evaluations. *Journal of Smoking Cessation*, *2021*, e6694386. https://doi.org/10.1155/2021/6694386

Norris, E., & O'Connor, D. B. (2019). Science as behaviour: Using a behaviour change approach to increase uptake of open science. *Psychology & Health*, *34*(12), 1397–1406. https://doi.org/10.1080/08870446.2019.1679373

Norris, E., Sulevani, I., Finnerty, A. N., & Castro, O. (2021). *Assessing Open Science practices in physical activity behaviour change intervention evaluations* (p. 2021.12.01.21267126). medRxiv. https://doi.org/10.1101/2021.12.01.21267126

Norris, E., & Toomey, E. (2020). Open Science in Health Psychology: Launching the EHPS Open Science SIG. *European Health Psychologist*, *21*(5), 679–682.

Norris, E., Toomey, E., Reynolds, J., Green, J., Noone, C., Grant, S., & Prescott, A. (2021). Establishing Open Science Research Priorities in Health Psychology: A research prioritisation Delphi exercise. *OSF Registries*. https://doi.org/10.17605/OSF.IO/PHKSQ

Nyanchoka, L., Tudur-Smith, C., Thu, V. N., Iversen, V., Tricco, A. C., & Porcher, R. (2019). A scoping review describes methods used to identify, prioritize and display gaps in health research. *Journal of Clinical Epidemiology*, *109*, 99–110. https://doi.org/10.1016/j.jclinepi.2019.01.005

O'Connor, D. B. (2020). The future of health behaviour change interventions: Opportunities for open science and personality research. *Health Psychology Review*, *14*(1), 176–181. https://doi.org/10.1080/17437199.2019.1707107

O'Connor, D. B. (2021). Leonardo da Vinci, preregistration and the Architecture of Science: Towards a More Open and Transparent Research Culture. *Health Psychology Bulletin*, *5*(1), 39–45. https://doi.org/10.5334/hpb.30

Osborne, C., & Norris, E. (2022). *Pre-registration as behaviour: Developing an evidence-based intervention to increase pre-registration uptake by researchers using the Behaviour Change Wheel*. PsyArXiv. https://doi.org/10.31234/osf.io/w3qg9

Parsons, S., Azevedo, F., Elsherif, M. M., Guay, S., Shahim, O. N., Govaart, G. H., Norris, E., O'Mahony, A., Parker, A. J., Todorovic, A., Pennington, C. R., Garcia-Pelegrin, E., Lazić, A., Robertson, O.,

Middleton, S. L., Valentini, B., McCuaig, J., Baker, B. J., Collins, E., … Aczel, B. (2022). A community-sourced glossary of open scholarship terms. *Nature Human Behaviour*, 1–7. https://doi.org/10.1038/s41562-021-01269-4

Peters, G.-J., Kok, G., Crutzen, R., & Sanderman, R. (2017). Health Psychology Bulletin: Improving Publication Practices to Accelerate Scientific Progress. *Health Psychology Bulletin*, *1*(1), 1–6. https://doi.org/10.5334/hpb.2

Peters, U. (2021). Illegitimate Values, Confirmation Bias, and Mandevillian Cognition in Science. *The British Journal for the Philosophy of Science*, *72*(4), 1061–1081. https://doi.org/10.1093/bjps/axy079

Pownall, M., Azevedo, F., Aldoh, A., Elsherif, M., Vasilev, M., Pennington, C. R., Robertson, O., Tromp, M. V., Liu, M., Makel, M. C., Tonge, N., Moreau, D., Horry, R., Shaw, J., Tzavella, L., McGarrigle, R., Talbot, C., & Parsons, S. (2021). Embedding open and reproducible science into teaching: A bank of lesson plans and resources. *Scholarship of Teaching and Learning in Psychology*, No Pagination Specified-No Pagination Specified. https://doi.org/10.1037/stl0000307

Severin, A., Egger, M., Eve, M. P., & Hürlimann, D. (2020). Discipline-specific open access publishing practices and barriers to change: An evidence-based review. *F1000Research*, *7*, 1925. https://doi.org/10.12688/f1000research.17328.2

Shaw, R. L., Bishop, F. L., Horwood, J., Chilcot, J., & Arden, M. A. (2019). Enhancing the quality and transparency of qualitative research methods in health psychology. *British Journal of Health Psychology*, *24*(4), 739–745. https://doi.org/10.1111/bjhp.12393

Stewart, S. L. K., Pennington, C. R., da Silva, G. R., Ballou, N., Butler, J., Dienes, Z., Jay, C., Rossit, S., Samara, A., & U. K. Reproducibility Network (UKRN) Local Network Leads. (2022). Reforms to improve reproducibility and quality must be coordinated across the research ecosystem: The view from the UKRN Local Network Leads. *BMC Research Notes*, *15*(1), 58. https://doi.org/10.1186/s13104-022-05949-w

Taylor, N. J., & Gorman, D. M. (2022). Registration and primary outcome reporting in behavioral health trials. *BMC Medical Research Methodology*, *22*(1), 41. https://doi.org/10.1186/s12874-021-01500-w

Tenopir, C., Rice, N. M., Allard, S., Baird, L., Borycz, J., Christian, L., Grant, B., Olendorf, R., & Sandusky, R. J. (2020). Data sharing, management, use, and reuse: Practices and perceptions of scientists worldwide. *PLOS ONE*, *15*(3), e0229003. https://doi.org/10.1371/journal.pone.0229003

Tong, A., Synnot, A., Crowe, S., Hill, S., Matus, A., Scholes-Robertson, N., Oliver, S., Cowan, K., Nasser, M., Bhaumik, S., Gutman, T., Baumgart, A., & Craig, J. C. (2019). Reporting guideline for priority setting of health research (REPRISE). *BMC Medical Research Methodology*, *19*(1), 243. https://doi.org/10.1186/s12874-019-0889-3

UK Reproducibility Network Steering Committee. (2021). From grassroots to global: A blueprint for building a reproducibility network. *PLOS Biology*, *19*(11), e3001461. https://doi.org/10.1371/journal.pbio.3001461

Walden University Library. (2021). *Academic Guides: Top Psychology Journals*. https://academicguides.waldenu.edu/library/subject/psychology/journals/lists

Watson, C. (2022). Rise of the preprint: How rapid data sharing during COVID-19 has changed science forever. *Nature Medicine*, *28*(1), 2–5. https://doi.org/10.1038/s41591-021-01654-6

Zečević, K., Houghton, C., Noone, C., Lee, H., Matvienko-Sikar, K., & Toomey, E. (2021). *Exploring factors that influence the practice of Open Science by early career health researchers: A mixed methods study* (3:56). HRB Open Research. https://doi.org/10.12688/hrbopenres.13119.2

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Materials availability statement: All materials from this study are available here: https://osf.io/am8jq/

Table 1. Open Science and research method experience, career level and country of residence across participants.

	Phase 1: Expert Research Question generation n=23	**Phase 2: E-Delphi online survey n=43**	**Phase 3 E-Delphi online survey n=24**
Open Science experience			
Pre-registered any research	n=22 (95.7%)	n=30 (69.8%)	n=21 (87.5%)
Made data open	n=20 (87%)	n=30 (69.8%)	n=17 (70.8%)
Made research materials open	n=19 (82.6%)	n=34 (79.1%)	n=19 (79.2%)
Published a preprint	n=20 (87%)	n=28 (65.1%)	n=17 (70.8%)
Published a Registered Report	n=3 (13%)	n=11 (25.6%)	n=5 (20.8%)
No response	-	n=2 (4.7%)	-
Research methods experience			
Quantitative	n=7 (30.4%)	n=17 (39.5%)	n=8 (33.3%)
Qualitative	n=1 (4.3%)	n=1 (2.3%)	-
Mixed	n=15 (65.2%)	n=23 (53.5%)	n=16 (66.6%)
Other	-	-	-
No response	-	n=2 (4.7%)	-
Career level			
Professor	n=3 (13%)	n=9 (20.9%)	n=6 (25%)
Senior Lecturer / Reader / Associate Professor	n=4 (17.4%)	n=6 (14.0%)	-
Lecturer / Assistant Professor	n=9 (39.1%)	n=10 (23.3%)	n=7 (29.2%)
Professional Services	-	-	
Research Fellow	n=1 (4.3%)	n=6 (14.0%)	n=3 (12.5%)
Post-doctoral Research Associate	n=3 (13%)	n=4 (9.3%)	n=3 (12.5%)
Postgraduate student (e.g PhD student, MSc student	n=3 (13%)	n=5 (11.6%)	n=5 (20.8%)
Pre-doctoral research assistant	-	n=1 (2.3%)	-
Undergraduate student	-	-	-
Other	-	-	-
No response	-	n=2 (4.7%)	-
Country of residence			
United Kingdom	n=6 (26.1%)	n=10 (23.3%)	n=1 (4.2%)
The Netherlands	n=4 (17.4%)	n=6 (14%)	n=2 (8.3%)
Ireland	n=3 (13%)	n=7 (16.3%)	n=4 (16.7%)
Finland	n=3 (13%)	n=2 (4.7%)	n=1 (4.2%)
France	n=2 (8.7%)	n=1 (2.3%)	n=2 (8.3%)
Germany	n=1 (4.3%)	n=1 (2.3%)	n=3 (12.5%)

Portugal	n=1 (4.3%)	n=1 (2.3%)	-
Australia	n=2 (8.7%)	n=1 (2.3%)	n=1 (4.2%)
USA	n=1 (4.3%)	n=1 (2.3%)	n=3 (12.5%)
Luxemburg	-	n=1 (2.3%)	-
Belgium	-	n=1 (2.3%)	n=1 (4.2%)
Cyprus	-	n=1 (2.3%)	-
Greece	-	n=1 (2.3%)	-
Israel	-	n=1 (2.3%)	-
Italy	-	n=1 (2.3%)	n=1 (4.2%)
Switzerland	-	n=1 (2.3%)	n=1 (4.2%)
Spain	-	n=1 (2.3%)	n=2 (8.3%)
No response	-	n=5 (11.6%)	n=2 (8.3%)

Table 2. The 'long-list' of Open Science in Health Psychology research questions agreed in Phase 1

Categories	Item
Assessing and increasing adoption of Open Science in Health Psychology	1. To what extent are Open Science behaviours currently practiced in Health Psychology?
	2. How is the adoption of Open Science principles in Health Psychology currently evaluated?
	3. How often are Open Data and Open Code reused in Health Psychology?
	4. How can Open Data be increased within Health Psychology?
	5. How can we maximise the usefulness of Open Data and Open Code resources?
	6. How can systems be developed to facilitate the sharing and use of Open Data?
	7. How can we increase free Open Access publishing in Health Psychology?
	8. What is the current adoption of Open Science principles in Health Psychology journals?
	9. How can we increase adoption of Registered Reports in Health Psychology journals?
	10. What are the different target behaviours involved in practicing Open Science?
	11. How can qualitative data be more open in Health Psychology?
	12. How can flexibility and subjectivity be maintained in Open qualitative research?
Assessing impact of interventions to increase Open Science in Health Psychology	13. What interventions are effective for increasing the adoption of Open Science in Health Psychology?
	14. How is the adoption of Open Science in Health Psychology currently incentivised?
	15. What behaviour change interventions have already been developed to increase Open Science?
	16. What behaviour change techniques are effective at increasing Open Science?
	17. What theories of behaviour change are most relevant for increasing Open Science?
	18. Who are the beneficial targets of behaviour change interventions for Open Science? eg journal editors, individual researchers etc
Determinants of Open Science in Health Psychology	19. What are the perceived barriers and facilitators to practicing Open Science behaviours in Health Psychology?
	20. What are the perceived barriers and facilitators to early career researchers practicing Open Science behaviours in Health Psychology?
	21. What is the current knowledge and awareness of Open Science in Health Psychology researchers?
	22. Do the individual determinants of Open Science in Health Psychology researchers vary depending on the type of research and Open Science behaviour?
	23. What do Health Psychology researchers wish to achieve using Open Science in their work?
	24. What are the costs of adopting Open Science in Health Psychology research?

Assessing impact of Open Science in Health Psychology	25. What is the effect of adopting Open Science principles on research quality in Health Psychology?
	26. What is the impact of adopting Open Science principles on academic careers in Health Psychology?
	27. Does Open Science increase the credibility of Health Psychology research?
	28. How can "curiosity-driven science" be maintained in line with Open Science principles?
	29. Why is it important to use Open Science behaviours at different career stages?
	30. How can Open Science influence participants' decision to take part in Health Psychology studies?
	31. How can Open Science support behaviour change interventions to be adapted and reproduced in low- and middle-income countries?
Open Science to improve research quality	32. How often are mistakes subsequently identified through reproducibility exercises reported in Health Psychology? How have these mistakes been dealt with?
	33. How can errors in the research process be logged in a standardised format in Health Psychology?
	34. Should there be internationally recognised standards for Open Science behaviours within Health Psychology, and how can these be implemented?
	35. How can reproducibility of health behaviour change interventions be improved?
Open Science teaching	36. How can teaching of Open Science principles to early career researchers in Health Psychology be improved?
	37. How can we better support undergraduate and postgraduate training in Health Psychology to include Open Science principles?
Ethics and data protection	38. How can we share Open Data within Health Psychology?
	39. How can we support researchers to make their data open whilst protecting participant anonymity?
Better organisation of research	40. How can we create a centralised repository of existing open health data to avoid collecting unnecessary data collection?
	41. How can digital health be made more open?

Table 3. Mean importance ratings for individual Open Science in Health Psychology research questions in Phases 2 and 3, ordered by Phase 3 importance ratings (possible score range: 1-9: 1 = lowest importance, 9 = highest importance)

Research questions	Phase 2 (n=43)			Phase 3 (n=24)		
	Mean	SD	Rank	Mean	SD	Rank
19. What are the perceived barriers and facilitators to practicing Open Science behaviours in Health Psychology?	7.48	1.52	3	7.88	1.01	1
20. What are the perceived barriers and facilitators to early career researchers practicing Open Science behaviours in Health Psychology?	7.02	1.75	9	7.6	1.29	2
4. How can Open Data be increased within Health Psychology?	7.59	1.20	2	7.48	1.33	3
25. What is the effect of adopting Open Science principles on research quality in Health Psychology?	7.30	1.34	5	7.44	1.58	4
27. Does Open Science increase the credibility of Health Psychology research?	7.00	1.68	10	7.40	1.19	5
5. How can we maximise the usefulness of Open Data and Open Code resources?	7.48	1.31	3	7.28	1.49	6
6. How can systems be developed to facilitate the sharing and use of Open Data?	7.33	1.65	4	7.28	1.54	6
7. How can we increase free Open Access publishing in Health Psychology?	7.33	1.59	4	7.28	1.86	6
13. What interventions are effective for increasing the adoption of Open Science in Health Psychology?	6.78	1.62	14	7.28	1.46	6
39. How can we support researchers to make their data open whilst protecting participant anonymity?	7.11	1.62	7	7.16	1.65	7
35. How can reproducibility of health behaviour change interventions be improved?	7.72	1.39	1	7.08	1.58	8
9. How can we increase adoption of Registered Reports in Health Psychology journals?	6.65	1.48	15	6.84	1.31	9
18. Who are the beneficial targets of behaviour change interventions for Open Science? eg journal editors, individual researchers etc	6.57	1.73	17	6.84	1.52	9
40. How can we create a centralised repository of existing open health data to avoid collecting unnecessary data collection?	6.91	1.68	13	6.84	1.80	9
10. What are the different target behaviours involved in practicing Open Science?	6.22	1.87	22	6.8	1.32	10
37. How can we better support undergraduate and postgraduate training in Health	7.02	1.45	9	6.72	1.77	11

Psychology to include Open Science principles?						
38. How can we share Open Data within Health Psychology?	7.14	1.52	6	6.72	1.93	11
8. What is the current adoption of Open Science principles in Health Psychology journals?	6.15	1.49	24	6.68	1.49	12
21. What is the current knowledge and awareness of Open Science in Health Psychology researchers?	7.05	1.55	8	6.64	1.41	13
31. How can Open Science support behaviour change interventions to be adapted and reproduced in low- and middle-income countries?	6.05	2.06	23	6.64	1.73	13
24. What are the costs of adopting Open Science in Health Psychology research?	6.20	2.02	23	6.60	1.68	14
16. What behaviour change techniques are effective at increasing Open Science?	6.20	1.86	23	6.52	2.06	15
36. How can teaching of Open Science principles to early career researchers in Health Psychology be improved?	6.95	1.64	11	6.52	1.78	15
14. How is the adoption of Open Science in Health Psychology currently incentivised?	6.28	1.85	21	6.44	1.58	16
26. What is the impact of adopting Open Science principles on academic careers in Health Psychology?	6.32	1.79	20	6.44	1.61	16
34. Should there be internationally recognised standards for Open Science behaviours within Health Psychology, and how can these be implemented?	6.93	1.65	12	6.44	1.87	16
42. How can we best reward Open Science behaviours within health psychology?	n/a	n/a	n/a	6.36	1.93	17
28. How can "curiosity-driven science" be maintained in line with Open Science principles?	5.95	1.61	28	6.32	1.46	18
41. How can digital health be made more open?	6.64	1.70	16	6.32	1.99	18
11. How can qualitative data be more open in Health Psychology?	6.04	1.83	26	6.2	2.16	19
17. What theories of behaviour change are most relevant for increasing Open Science?	5.96	1.85	27	6.2	1.73	19
32. How often are mistakes subsequently identified through reproducibility exercises reported in Health Psychology? How have these mistakes been dealt with?	6.57	1.69	17	6.20	1.76	19

15. What behaviour change interventions have already been developed to increase Open Science?	6.43	1.60	18	6.16	1.80	20
1. To what extent are Open Science behaviours currently practiced in Health Psychology?	5.93	1.88	29	6.14	1.86	21
22. Do the individual determinants of Open Science in Health Psychology researchers vary depending on the type of research and Open Science behaviour?	6.20	1.50	23	6.04	1.62	22
33. How can errors in the research process be logged in a standardised format in Health Psychology?	6.36	1.91	19	5.96	1.88	23
43. Do health psychologists want Open Science?	n/a	n/a	n/a	5.92	2.18	24
2. How is the adoption of Open Science principles in Health Psychology currently evaluated?	5.76	1.83	32	5.88	1.67	25
44. Do open science practices and determinants vary by country?	n/a	n/a	n/a	5.88	1.90	25
23. What do Health Psychology researchers wish to achieve using Open Science in their work?	5.85	2.06	31	5.76	1.48	26
12. How can flexibility and subjectivity be maintained in Open qualitative research?	5.63	2.21	35	5.48	2.18	27
30. How can Open Science influence participants' decision to take part in Health Psychology studies?	5.70	2.24	34	5.40	2.14	28
46. What does Open Science mean to health psychologists?	n/a	n/a	n/a	5.36	2.27	29
3. How often are Open Data and Open Code reused in Health Psychology?	5.91	1.82	30	5.28	1.84	30
45. How can we enhance machine-readability of the products of health psychology research?	n/a	n/a	n/a	5.16	1.91	31
29. Why is it important to use Open Science behaviours at different career stages?	5.73	1.91	33	4.92	2.04	32

Table 4. Number and percentage of participants who ranked each item within their top 5 priorities in Phases 2 and 3, listed in order of the items that were most often selected as the top priority in Phase 3.

Research questions	Phase 2 (n=43)										Phase 3 (n=24)									
	1		2		3		4		5		1		2		3		4		5	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
1. To what extent are Open Science behaviours currently practiced in Health Psychology?	11	25.6 %	-	-	-	-	-	-	-	-	9	36 %	-	-	-	-	-	-	-	-
5. How can we maximise the usefulness of Open Data and Open Code resources?	7	16.3 %	5	11.6 %	1	2.3%	-	-	1	2.3%	6	24 %	2	8%	2	8%	-	-	-	-
4. How can Open Data be increased within Health Psychology?	5	11.6 %	1	2.3%	1	2.3%	1	2.3%	-	-	2	8%	1	4%	-	-	-	-	-	-
13. What interventions are effective for increasing the adoption of Open Science in Health Psychology?	3	7%	4	9.3%	3	7%	2	4.7%	-	-	2	8%	2	8%	3	12%	3	12%	1	4%
7. How can we increase free Open Access publishing in Health Psychology?	2	4.7%	6	14%	1	2.3%	2	4.7%	-	-	1	4%	-	-	2	8%	1	4%	-	-
10. What are the different target behaviours involved in practicing Open Science?	2	4.7%	-	-	-	-	-	-	1	2.3%	1	4%	1	4%	-	-	-	-	-	-
18. Who are the beneficial targets of behaviour change interventions for Open Science? eg journal editors, individual researchers etc	1	2.3%	-	-	1	2.3%	2	4.7%	-	-	1	4%	-	-	-	-	1	4%	1	4%
28. How can "curiosity-driven science" be	-	-	1	2.3%	-	-	1	2.3%	-	-	1	4%	1	4%	1	4%	2	8%	-	-

maintained in line with Open Science principles?																				
35. How can reproducibility of health behaviour change interventions be improved?	-	-	-	-	2	4.7%	5	11.6 %	2	4.7%	1	4%	11	44%	-	-	1	4%	1	4%
2. How is the adoption of Open Science principles in Health Psychology currently evaluated?	-	-	2	4.7%	-	-	-	-	-	-	-	-	1	4%	-	-	-	-	-	-
3. How often are Open Data and Open Code reused in Health Psychology?	2	4.7%	2	4.7%	1	2.3%	-	-	-	-	-	-	2	8%	-	-	-	-	-	-
6. How can systems be developed to facilitate the sharing and use of Open Data?	2	4.7%	4	8.7%	3	7%	1	2.3%	-	-	-	-	3	12%	1	4%	-	-	-	-
8. What is the current adoption of Open Science principles in Health Psychology journals?	-	-	-	-	-	-	1	2.3%	-	-	-	-	2	8%	-	-	-	-	-	-
9. How can we increase adoption of Registered Reports in Health Psychology journals?	-	-	1	2.3%	2	4.7%	-	-	-	-	-	-	1	4%	-	-	-	-	-	-
11. How can qualitative data be more open in Health Psychology?	1	2.3%	1	2.3%	1	2.3%	-	-	1	2.3%	-	-	-	-	-	-	-	-	-	-
12. How can flexibility and subjectivity be maintained in Open qualitative research?	1	2.3%	-	-	3	7%	-	-	-	-	-	-	-	-	1	4%	-	-	-	-
14. How is the adoption of Open Science in Health Psychology currently incentivised?	-	-	1	2.3%	2	4.7%	-	-	-	-	-	-	1	4%	1	4%	1	4%	-	-

15. What behaviour change interventions have already been developed to increase Open Science?	-	-	-	-	1	2.3%	2	4.7%	-	-	-	-	-	-	-	-	-	-	-	-
16. What behaviour change techniques are effective at increasing Open Science?	1	2.3%	2	4.7%	3	7%	-	-	-	-	-	-	1	4%	-	-	1	4%	-	-
17. What theories of behaviour change are most relevant for increasing Open Science?	-	-	-	-	2	4.7%	1	2.3%	-	-	-	-	-	-	-	-	-	-	-	-
19. What are the perceived barriers and facilitators to practicing Open Science behaviours in Health Psychology?	1	2.3%	6	14.0 %	3	7%	4	9.3%	4	9.3%	-	-	3	12%	4	8%	1	4%	3	12%
20. What are the perceived barriers and facilitators to early career researchers practicing Open Science behaviours in Health Psychology?	1	2.3%	-	-	-	-	1	2.3%	1	2.3%	-	-	1	4%	-	-	-	-	-	-
21. What is the current knowledge and awareness of Open Science in Health Psychology researchers?	-	-	3	7%	-	-	1	2.3%	-	-	-	-	-	-	-	-	2	8%	-	-
22. Do the individual determinants of Open Science in Health Psychology researchers vary depending on the type of research and Open Science behaviour?	-	-	-	-	1	2.3%	-	-	-	-	-	-	-	-	1	4%	-	-	-	-
23. What do Health Psychology researchers wish	-	-	-	-	-	-	1	2.3%	-	-	-	-	-	-	-	-	-	-	-	-

to achieve using Open Science in their work?																				
24. What are the costs of adopting Open Science in Health Psychology research?	-	-	-	-	3	6.5%	2	4.7%	1	2.3%	-	-	-	-	2	8%	1	4%	-	-
25. What is the effect of adopting Open Science principles on research quality in Health Psychology?	-	-	-	-	3	6.5%	-	-	1	2.3%	-	-	-	-	1	4%	-	-	-	-
26. What is the impact of adopting Open Science principles on academic careers in Health Psychology?	-	-	-	-	-	-	1	2.3%	2	4.7%	-	-	-	-	-	-	-	-	-	-
27. Does Open Science increase the credibility of Health Psychology research?	-	-	-	-	2	4.7%	1	2.3%	-	-	-	-	-	-	1	4%	-	-	-	-
29. Why is it important to use Open Science behaviours at different career stages?	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30. How can Open Science influence participants' decision to take part in Health Psychology studies?	-	-	-	-	-	-	2	4.7%	-	-	-	-	-	-	-	-	-	-	-	-
31. How can Open Science support behaviour change interventions to be adapted and reproduced in low- and middle-income countries?	-	-	-	-	-	-	1	2.3%	4	9.3%	-	-	-	-	1	4%	2	8%	-	-
32. How often are mistakes subsequently identified through reproducibility	-	-	-	-	-	-	2	4.7%	1	2.3%	-	-	-	-	-	-	-	-	1	4%

exercises reported in Health Psychology? How have these mistakes been dealt with?																				
33. How can errors in the research process be logged in a standardised format in Health Psychology?	-	-	-	-	-	-	1	2.3%	-	-	-	-	-	-	-	-	1	4%	-	-
34. Should there be internationally recognised standards for Open Science behaviours within Health Psychology, and how can these be implemented?	1	2.3%	1	2.3%	1	2.3%	1	2.3%	3	7%	-	-	-	-	1	4%	1	4%	-	-
36. How can teaching of Open Science principles to early career researchers in Health Psychology be improved?	1	2.3%	-	-	1	2.3%	3	6.5%	1	2.3%	-	-	-	-	1	4%	2	8%	2	8%
37. How can we better support undergraduate and postgraduate training in Health Psychology to include Open Science principles?	-	-	1	2.3%	-	-	-	-	5	11.6 %	-	-	-	-	-	-	1	4%	-	-
38. How can we share Open Data within Health Psychology?	-	-	2	4.7%	1	2.3%	1	2.3%	3	7%	-	-	-	-	-	-	-	-	-	-
39. How can we support researchers to make their data open whilst protecting participant anonymity?	-	-	-	-	1	2.3%	2	4.7%	2	4.7%	-	-	1	4%	-	-	-	-	3	12%
40. How can we create a centralised repository of existing open health data to	-	-	-	-	-	-	1	2.3%	7	16.3 %	-	-	-	-	-	-	1	4%	2	8%

avoid collecting unnecessary data collection?																				
41. How can digital health be made more open?	-	-	-	-	-	-	-	-	3	7%	-	-	-	-	-	-	-	-	3	12%
42. How can we best reward Open Science behaviours within health psychology?	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	1	4%	-	-	2	8%
43. Do health psychologists want Open Science?	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	1	4%	-	-
44. Do open science practices and determinants vary by country?	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	1	4%	1	4%
45. How can we enhance machine-readability of the products of health psychology research?	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-	1	4%
46. What does Open Science mean to health psychologists?	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-	2	8%