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Promoting scientific integrity through open science in health psychology: results of the Synergy Expert Meeting of the European health psychology society

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ABSTRACT

The article describes a position statement and recommendations for actions that need to be taken to develop best practices for promoting scientific integrity through open science in health psychology endorsed at a Synergy Expert Group Meeting. Sixteen Synergy Meeting participants developed a set of recommendations for researchers, gatekeepers, and research end-users. The group process followed a nominal group technique and voting system to elicit and decide on the most relevant and topical issues. Seventeen priority areas were listed and voted on, 15 of them were recommended by the group. Specifically, the following priority actions for health psychology were endorsed: (1) *for researchers*: advancing when and how to make data open and accessible at various research stages and understanding researchers' beliefs and attitudes regarding open data; (2) *for educators*: integrating open science in research curricula, e.g., through online open science training modules, promoting preregistration, transparent reporting, open data and applying open science as a learning tool; (3) *for journal editors*: providing an open science statement, and open data policies, including a minimal requirements submission checklist. Health psychology societies and journal editors should collaborate in order to develop a coordinated plan for research integrity and open science promotion across behavioural disciplines.

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Introduction

Health psychology as an applied health science has the potential to contribute directly to the health and well-being of populations. Health psychologists conducting research and accumulating evidence have accountability to those who likely benefit from it, i.e., the general population, patients and those who practice it, i.e., practicing health psychologists (Norris & O'Connor, 2019). This accountability means researchers and others who produce and disseminate research findings in the discipline must be held to the highest possible standards of scientific integrity based on the principles of honesty, transparency, independence, and responsibility that guide researchers (Edwards & Roy, 2017; Lee & Moher, 2017; Peters et al., 2017). *Scientific integrity* may be defined as the adherence to professional values and practices when planning, executing, reporting, and applying the results of scientific activities that ensures transparency, openness, objectivity, clarity, and reproducibility, and that allows avoidance of bias, falsification, fabrication, plagiarism, inappropriate influence, other party interference, censorship, and inadequate procedural and information security and safety (Edwards & Roy, 2017; Macrina, 2014). *Replication* refers to the repetition of a research study, in different contexts and with different participants, to determine if the basic findings of the original study can be applied to other participants and circumstances; study *reproducibility* refers to following the analysis scripts and using raw data from the original study sample to create the same results (Open Science Collaboration, 2015). The *replication crisis* is defined as methodological 'crisis' to replicate or reproduce scientific studies; the term was coined (Pashler & Wagenmakers, 2012) to emphasise and raise awareness of the problem. Highly publicised cases of lack of transparency and failures to replicate findings (Hagger et al., 2016a; Open Science Collaboration, 2012, 2015; Ritchie et al., 2012) have catalysed increased scrutiny of current scientific practices of conducting and reporting of research findings, and even the development of new groups aimed at promoting better standards. This led to current initiatives and movements aimed at promoting 'open science' practices.

The ideas of open science have been embraced across scientific disciplines (Kretser et al., 2019; Laine, 2018; Wortner et al., 2019) and have led to the development of guidelines and codes of conduct for researchers on open science principles, such as the European Code of Research Conduct, which provide active support and guidance on open science (Laine, 2018). Open science encompasses a varying set of ideals, principles, policies, and practices with respect to research conduct and reporting. The term *open science* encompasses five schools of thought (Fecher & Friesike, 2014): (1) *the infrastructure school*, aiming to create openly available platforms, tools, and services; (2) *the public school*, aiming to make science accessible to citizens; (3) *the pragmatic school*, aiming to optimise the efficiency of knowledge creation; (4) *the democratic school*, aiming to make knowledge available for everyone; and (5) *the measurement school*, aiming to develop an alternative system to measure scientific impact.

The interest of psychologists in the open science 'movement' is, in part, a response to the non-replicability of findings, inappropriate use of statistical analyses, and lack of access to data and materials (Spellman et al., 2018). The current incentives for scientists (e.g., pressure to publish) do not always align with good practices and researchers sometimes rely on practices that undermine the quality of their science, e.g., data mining/fishing, *p*-hacking, adding or changing hypotheses (Chuard et al., 2019; Grimes et al., 2018; Masicampo & Lalande, 2012; Munafò et al., 2017). As a response, Spellman et al. (2018) provided a list of practical ways to practice open science for researchers, authors, and reviewers, based on the Findable, Accessible, Interoperable and Reusable (FAIR) principles (Wilkinson et al., 2016). Health psychology has a number of incentives for engaging in open science (Norris & O'Connor, 2019) as the potential impact of health psychology on society is substantial (Burgess et al., 2017; Levin et al., 2016); therefore, transition to open science is simultaneously particularly welcomed.

To establish a starting point for a wider academic debate in health psychology about open science practices that may benefit the field, the European Health Psychology Society (EHPS) organised a Synergy Expert Meeting on the topic of research integrity in 2018, in Galway, Ireland. The aim of the meeting was to develop a position statement on the actions and initiatives needed to support and develop open science best practices in health psychology. Specifically, participants identified key open science practices for health psychology research, the actions necessary to see those practices implemented, and the challenges involved and how to overcome them. A priority list of key prospective actions that can be taken by health psychologists as researchers, educators, and journal editors was developed. This priority list can facilitate reflection and discussion when revising curricula and courses, evaluating journal and research society policies, and planning and conducting studies.

Methods

Participants

Sixteen participants were selected from a pool of health psychology researchers who applied to join the Synergy Expert Meeting organised by the EHPS (Hagger et al., 2019a). Applicants responded to an online advertisement outlining the topic and agenda of the meeting. All applications were approved by the EHPS Synergy Committee and the meeting facilitators. The meeting participants were researchers from 14 universities in eight countries, with an average of 15.6 ($SD=8.74$) years of experience ($Range=3-35$ years; $Median=12.50$) in conducting health psychology research. Participants' lifetime research output ranged from 2 to 320 research articles ($Mean=86.25$, $SD=98.64$, $Median=40$). The majority ($n=9$) indicated several areas of expertise in the domain of health psychology: eleven investigated behaviour change; three focused on illness-related processes; and three reported a broad health sciences/health psychology expertise. In terms of the target population, participants' research dealt with the general population/adults ($n=7$), children, adolescents and families ($n=4$), as well as specific populations, such as older adults, people with chronic illnesses, etc. All participants reported experience with quantitative methods; eight participants reported expertise in randomised controlled trials (RCTs), five in qualitative research, and four in meta-analysis. The majority ($n=11$) served as an editor/associate editor of a health psychology or health sciences journal, including four participants serving as editor-in-chief (1–3 journals, 1–19 years of service), and nine reporting serving as associate editor (1–8 journals). All participants were active reviewers; four participants reported reviewing for fewer than 10 different journals, nine had reviewed for between 10 and 50 journals, and three had reviewed for over 50 journals. Additionally, six participants reported working for national/international funding agencies, advisory boards, or councils shaping research funding policies.

In terms of the prior open science-related activities, thirteen participants used open repositories to preregister their studies, with eleven reporting using the Open Science Framework, three reporting the use of the ClinicalTrials.gov repository, four using national/regional repositories in Germany, the Netherlands, Australia and New Zealand, and four using PROSPERO. Ten participants had made their data public in an open science repository, with the Open Science Framework being used most often ($n=8$). Additionally, five reported other open science-related activities, such as facilitating open science training, membership of open science committees or promotion groups.

Procedure

The position statement was developed over the course of a two-day meeting (held on August, 20–21, 2018 at the National University of Ireland, Galway, Ireland). During the meeting,

participants engaged in activities designed to stimulate discussion, promote debate, and identify points of common agreement. Meeting activities were facilitated by GJP, AL, and GK. In advance of the meeting, the facilitators circulated materials to all participants; including an agenda, a list of potential topics for discussion, and four review articles on scientific integrity issues (Gelman & Loken, 2013; Nosek et al., 2012; Nosek & Bar-Anan, 2012; Simmons et al., 2011). Participants were informed that the goal of the meeting was to develop a position statement and that their attendance at the meeting constituted the agreement to participate in the meeting activities and the subsequent preparation of the position statement. Participants were free to withdraw from the meeting and any subsequent activities related to the position statement. In general, procedures were similar to those applied to prepare a consensus statement on issues related to planning and implementation intentions (Hagger et al., 2016b).

The meeting followed the steps presented in the nominal group technique (Delbecq & Van de Ven, 1971; Fink et al., 1984; Van de Ven & Delbecq, 1972). The technique is defined as a structured meeting to elicit qualitative information from a target group of participants who are associated with the analysed area of interest (Fink et al., 1984). The nominal group method to develop consensus included three Steps, guided by the facilitators. In Step 1, prior to the meeting, participants were asked to generate a list of challenges, benefits, and actions required to achieve greater integrity through open science (Fink et al., 1984).

In Step 2, during the meeting, a structured discussion was conducted to further clarify the priority areas and actions; this discussion also aimed to clarify, refine, and evaluate the relevance of challenges, benefits, and potential actions required. Participants formed three groups and were asked to generate and discuss challenges, benefits, and actions required in one of the three contexts: (1) the perspective of researchers, (2) the perspective of 'gate-keepers', i.e., editors, reviewers, funding body representatives, and (3) the perspective of 'end-users', i.e., practitioners, stakeholders. Contexts were chosen by the meeting facilitators.

The small-group discussions were followed by a plenary discussion of all participants aimed at identifying and listing the key challenges, benefits and actions required, raised by a rapporteur from each of the groups, followed by comments and refining by all participants. Next, each participant was assigned to a follow-up group working on a different context (compared to the context assigned to the original group) and with a different composition of participants than the original groups. To increase heterogeneity and saturation of elicited ideas, facilitators reassigned participants to different groups. The three follow-up groups worked towards further elicitation, clarification, and refinement of priority challenges, benefits, and actions required to achieve greater integrity through open science. Throughout Step 2, plenary discussions were systematic, addressing items one at a time rather than the list in its entirety (Van de Ven & Delbecq, 1972). The issues identified were recorded in an online spreadsheet (Van de Ven & Delbecq, 1972). After the follow-up group discussions were completed, a final plenary discussion was conducted. Representatives from each small group referred to the key challenges, benefits, and actions required, identified in the follow-up groups, followed by the final comments addressed by participants. The result of the plenary discussion was further refinement and focusing of the list of the key potential actions required to achieve greater integrity through open science, whereas challenges and benefits of open science were considered a backdrop for selecting the priority actions.

In Step 3, participants were encouraged to individually reflect on, and rate the priority of the actions required (Van de Ven & Delbecq, 1972). This was followed by a consensus voting, applying the voting procedure guidelines developed by Fink et al. (1984). Participants were asked to cast their vote as to whether they endorsed each item on the list of potential priority actions. In line with Fink et al. (1984) they were asked if the issue is perceived as a priority or not; there was no suggestion to order the items from highest to lowest priority issues. Participants agreed that any priority action that received at least 66% of participant's votes would be adopted (for similar threshold see Hagger et al., 2016b). The results of the voting were counted by two

participants, recorded, and displayed immediately in an online spreadsheet. Fifteen of the 16 participants were present during voting and cast their votes (one participant had to leave the meeting before voting due to other obligations and was counted as 'abstaining'). The voting was followed by a final round of discussions among all participants and summarised by the facilitators.

Results

Benefits, challenges and actions

The nominal group procedures led to the development of the three initial lists of candidate benefits ($n=18$; e.g., 'open science may benefit scientific progress directly through improving transparency of the research process and changes implemented throughout the process'), challenges ($n=14$; e.g., 'some researchers may fear that their errors will be pointed out'), and action points ($n=17$; e.g., 'researchers need to collaboratively develop interventions and share their content openly') representing 'the researcher perspective' (a total of $n=49$ benefits, challenges, and action points; see online Appendix 1). For the 'gatekeeper perspective', candidate opportunities ($n=23$; e.g., 'a faster translation from lab-based research to practice due to replication facilitation'), challenges for progress in health psychology ($n=21$; e.g., 'a need for developing funding schemes for managing open science datasets'), and action points ($n=19$; 'call for replication of interventions instead of full development each time') were listed. Finally, from the 'the end-user' perspective, candidate opportunities ($n=18$; e.g., 'more opportunities for various stakeholders to be involved throughout the research process'), challenges ($n=14$; e.g., 'difficulties to communicate the stages of research process and results to practitioners, general audience, and various stakeholders'), and action points ($n=15$; e.g., 'call for public and patients' involvement') were identified. In the next step, the small group discussion followed by a general discussion aimed at reducing the initial list of 49 challenges, benefits and action points and selecting those that are relevant according to the majority of participants. This process resulted in selecting 17 action points relevant from the researcher, gatekeeper or end-user perspective.

Next, participants casted their votes for/against 17 action points with 15 actions receiving sufficient support according to the nominal group procedure (i.e., $\geq 66\%$). The priority actions for embedding open science practices within health psychology were organised into three themes: (1) open data actions; (2) open science-related education; and (3) priority actions for journal editors (Table 1). Two actions did not receive sufficient support (i.e., $\leq 66\%$): 'open science education should foster self-monitoring among researchers for confirmation bias and transparent reporting' (receiving 9 votes in favour, 2 against, and 5 abstentions); and 'the methods applied by the journals to promote open science could be counted as an impact indicator, which would require developing ways to measure the impact of open science, e.g., counting the use of the open data files' (receiving 9 votes in favour, 2 against, and 5 abstentions).

Discussion

The Synergy Expert Group put forward a set of recommendations for actions to be taken to promote scientific integrity through open science in health psychology for EHPS members and other stakeholders, including behavioural researchers, gatekeepers, and end-users (Table 1). Our recommendations largely align with the existing recommendations and statements on open data and data management in psychological science (British Psychological Society, 2020; Gollwitzer et al., 2020). Next, we summarize each action and outline their implications for implementation by key stakeholders.

Table 1. Recommended actions for promoting scientific integrity through open science in health psychology for researchers, educators, journal editors and scientific societies.

	Open Data Actions	Votes for the action
1	Uploading open data should consist of a series of actions. In particular, steps leading to the final open dataset should be developed (and include, e.g., information on study pre-/registration, study procedures).	Votes for 14, 1 against, 1 abstention
2	Any data and materials presented in a publication should be open. Any exceptions need to be reviewed and discussed in the publication.	Votes for 15, 0 against, 1 abstention
3	The functionality of data repositories (e.g., their usability, accessibility) should be improved. Scientific organisations (e.g., EHPS) should have a work plan for developing metadata and coding procedures to create data depositories that can support multiple datasets.	Votes for 12, 0 against, 4 abstention
4	Advocating for integrity in the access to and the use of open data.	Votes for 15, 0 against, 1 abstention
5	Understanding researchers' beliefs and attitudes about open data and open data practices should be a research priority	Votes for 13, 0 against, 3 abstention
Open Science-Related Actions for Educators		Votes for the action
1	Each graduate/undergraduate programme should include open science training in research in their curriculum (e.g., provide guidelines on how to register a trial, how to develop and register/publish a study protocol, how to conduct a replication study; explain open science research process). Curricula should be infused with open science principles and actions, integrated into existing workflows that are taught, rather than presented as separate modules.	Votes for 15, 0 against, 1 abstention
2	Online training modules, promoting and explaining open science practices, should be developed.	Votes for 14, 0 against, 1 abstention
3	Open science health psychology education should promote pre-/registration.	Votes for 15, 0 against, 1 abstention
4	Open science health psychology education should promote transparent reporting.	Votes for 15, 0 against, 1 abstention
5	Open science health psychology education should promote open data and materials.	Votes for 15, 0 against, 1 abstention
6	Educators should promote open science as a way for people to learn how to improve their research practices. It should be used as a tool to advance scientific progress not as a tool to police for errors in scientific practice.	Votes for 15, 0 against, 1 abstention
Open Science-Related Actions for Journal Editors and Scientific Societies		Votes for the action
1	The minimal requirements checklist, endorsed by journal editors should include:	Votes for 15, 0 against, 1 abstention
A	The pre-/registration information.	
B	A codebook for all measures (e.g., the actual questionnaire items), variables, labels, and values (preferably in English).	
C	Data and materials stored at a repository which is not in the hands of a private entity.	
D	The original data presented in a commonly available format (e.g., a comma separated values file).	
E	All analysis scripts and output of analyses.	
F	A statement regarding the changes to the original pre-/registration and/or published protocol (included into the article or the supplement). In cases where the authors are unable to share data, they need to provide a plausible reason which will be reviewed and then published.	
2	Editors should make an 'Open Science Challenges and Opportunities' statement (e.g., in a form of the editorial letter) in their journal, proposing that researchers should carefully plan for the process of preregistering, obtaining open data consents from the participants and ethics committees, registering, analysing, and reporting. The editors could reflect on the open science approach in their journal (the past, present, and future).	Votes for 13, 0 against, 3 abstention
3	There is a need to understand and elicit reasons (beliefs, attitudes, skills, emotions, knowledge, etc.) why some editors or associate editors do not embrace open science, whereas others do.	Votes for 14, 0 against, 2 abstention
4	Research societies, such as the EHPS, should be encouraged to initiate a discussion and collaboration with other societies and their journals in order to develop a coordinated plan for open science.	Votes for 15, 0 against, 1 abstention

Open data practices

In order to benefit from data collected through the research process, data should be open and accessible, or reasons should be provided why data are not accessible. Openly sharing datasets has several

benefits, such as other researchers can access the data, data flow is accessible and transparent, and data can be reanalysed by other researchers providing avenues for alternative data interpretation (Lowndes et al., 2017; Molloy, 2011). However, uploading data openly at any stage of the research process can also have its drawbacks. For example, data may be used in a different way than initially intended, unintentionally causing harm (Murray-Rust, 2008). In addition, a dataset should only be provided if the authors can ensure that research participants cannot be reidentified from their data (El Emam et al., 2011).

Another recommendation made by the meeting participants was in relation to data repositories and their functionality. In order for datasets to be useful, they need to be clearly set up and they need to be discoverable and easy to locate for other users. Recently scientists coined the label of 'open silos', meaning that the scientific community strives towards open science (Hekler et al., 2016). However, researchers in health psychology need a clear direction on how to navigate through the databases in order to make them useful. A recently proposed solution is the use of persistent identifiers (PIDs) for datasets to link them with individual researchers (Pierce et al., 2019). One idea is that every researcher will use their unique Open Researcher and Contributor ID (ORCID) identification number (Haak et al., 2012) to associate it with every dataset they deposit. Then data repositories would be able to issue unique identifiers for each dataset and connect them to all researchers contributing to the dataset (similar to DOIs for publications). Journals would require the PIDs to be cited in every submitted manuscript (both primary outcomes and any secondary analysis articles). The processes for generating and recording these PIDs have been well defined but the implementation is still at its establishment (Pierce et al., 2019).

The health psychology and behavioural medicine research societies may also develop goals and strategies for developing metadata and coding procedures, allowing for the combining of multiple datasets (e.g., see the Human Behaviour Change Project, Michie et al., 2017). Further efforts need to be undertaken in order to combine multiple datasets and to set the datasets in the most cohesive and user-friendly way to facilitate cross-lab and cross discipline collaborations. Meeting participants were also in favour in promoting greater access to, and use of, open data, highlighting the need for following basic principles of honesty, transparency, independence, and responsibility (Algra et al., 2018). The group further suggests that researchers' beliefs and attitudes towards open data should be examined in comprehensively designed studies. Understanding researchers' motives, beliefs, and attitudes towards open data practices will support shifting social norms and effectively changing practices (May et al., 2009).

Recommendations for educators

The Synergy Expert Meeting participants recommended that educators in health psychology include open science training in their curriculum. They suggest that the educators teach best principles of open science and encourage these principles in practice while designing and conducting under- and postgraduate research projects. In the education terminology this process is coined as 'learning by doing' (De Brún et al., 2016; Harris-Roxas & Harris, 2007) meaning to not only teach the principles of science integrity but to also require students to follow them when they conduct their own empirical research. The Synergy Expert Meeting participants also encourage the development and use of freely accessible online training modules, promoting and explaining open science practices in health psychology. Generic online courses on open science exist already, such as Harvard University's open online course '*Open Science: Sharing Your Research with the World*'. However, these courses should be embedded in teaching curricula in health psychology and customised and tailored to behavioural and health scientists.

Specific areas that the meeting participants wanted to emphasize in open science education were promoting preregistration of studies, transparent reporting, and open data and materials. Preregistration separates exploratory from confirmatory research, the first one involves hypothesis-generating, the latter involves hypothesis-testing. Only studies with pre-specified hypotheses can be

confirmatory and these should always be preregistered (Gonzales & Cunningham, 2015; Nosek et al., 2019). Transparent reporting is crucial regardless of the chosen study design. For instance, the Consolidated Standards of Reporting Trials (CONSORT) Statement sets standards for authors to prepare reports of trial findings, facilitating their complete and transparent reporting, aiding their critical appraisal and interpretation (Turner et al., 2012). Extensions of the CONSORT statement provide recommendations for other designs including cluster (Campbell et al., 2012), pragmatic (Zwarenstein et al., 2008), and pilot and feasibility (Eldridge et al., 2016) trials and many other designs. Regardless of the study design, teaching young researchers about transparency in reporting is crucial for the future of science, including replicability of findings. Educating future researchers to pursue the standards of transparency and openness of data and materials provide vast opportunities for the scientific progress (Kitchin, 2014).

Synergy Expert Meeting participants also highlighted that open science aims to improve research integrity and should not be used as a policing tool by the scientific community. Students should be encouraged to follow open science practices in order to improve their research methods and the means by which they disseminate research findings. The encouragement to publish full datasets, questionnaires, syntax for study analysis, and to clearly report research methods, findings and interpretations is not to expose research shortcomings but to learn from each other (Woelfle et al., 2011). Future generations of researchers should be self-determined to use these practices to promote scientific discovery (Reeve, 2002).

Recommendations for journal editors

The Synergy Expert Meeting participants came to the consensus that minimum information requirements for published articles should increase in order to progress science effectively. Publications should include information regarding study pre/registration, e.g., using AsPredicted (Credibility Lab, 2020) or Open Science Framework (Center for Open Science, 2020a), a codebook for all measures, variables, labels, and values, link to data stored in a repository, the original dataset presented in a commonly available format, a syntax and an output of analyses; a statement regarding any changes to the original pre-/registration and published protocol.

Currently most biomedical journals require study registration, especially for RCTs, and researchers can register their experimental and observational studies and systematic reviews in several online open-access registries, such as the International Clinical Trials Registry Platform (ICTRP) by the World Health Organization, the ClinicalTrials.gov by the US National Library of Medicine, Australian New Zealand Clinical Trials Registry (ANZCTR), EU Clinical Trials Register (EU-CTR), Chinese Clinical Trial Registry (ChiCTR), and PROSPERO (for systematic reviews). Most are searchable databases allowing researchers to investigate ongoing research projects and provide a mechanism for patients or others to register their interest in participating in studies. The rationale for preregistering studies is to state upfront clearly defined research hypotheses, primary and secondary outcome variables, measurement points, treatment and control conditions, statistical power analyses and data analysis plans.

Most journals publishing reports of primary research studies do not require a codebook with all measures, variables, labels, and values to be published. Meeting participants appreciated that some measures and questionnaires are copyrighted. However, in order to move science forward and to facilitate inclusive and open science, researchers need to be encouraged to make the measurement instruments they use publicly available. Journal editors are also encouraged to recommend the use of questionnaires that can be freely and openly accessed and to recommend the reporting of question items, variables, levels, and values. These recommendations hold for qualitative research as well, where codebooks and datasets can be reanalysed, if data are accessible, increasing transparency of qualitative research (Campbell et al., 2013; MacQueen et al., 1998). In order to make replications easier, the publication of intervention/behavioural treatment manuals, intervention contents, and all underlying structural and causal assumptions was recommended by the meeting participants.

The Transparency and Openness Promotion (TOP) guidelines (Center for Open Science, 2020b) addressing journals' procedures and policies for publication set eight standards; each aiming to move scientific communication toward greater openness and provide a template to enhance transparency in the science that journals publish. Several behavioural science and health psychology journals already encourage publishing study data or providing a link to data repositories, and some promising developments are in place for the implementation of PID (Center for Open Science, 2020a; Pierce et al., 2019); however, many journals still do not require analysis scripts and sign up to different levels of the TOP guidelines. Sharing both analysis scripts and raw data can speed up the scientific progress. Researchers could easily access the exact methods used to conduct a particular analysis so that it can be easily reproduced. Open data and analysis scripts can also have a learning function – new generations of scientists can use them to rerun and interpret studies they may want to build on or replicate (Chin, 2014).

Another recommendation for journal editors from the Synergy Expert Meeting was to publish an open science statement, i.e., an article or editorial that explicitly addresses the specific open science approach undertaken by their journal. Editors should consider what their current open science practices are, and what is currently required by their journals, in terms of pre-/registration, open data, ethics, reporting, sharing manuals, and tools used in the research process. Editors may provide an explicit statement on their vision for the future and what challenges prevent the journal to become fully open and transparent (for example see Hagger, 2019b). Such statements are essential to inform and guide the authors, reviewers, and the readership.

The Synergy Expert Meeting participants also suggested that not only for researchers but also for the editors, it may be relevant to elicit and analyse barriers preventing some editors from supporting and embracing open science. They suggest that the scientific community should assess beliefs, attitudes, skills, emotions, and knowledge of editors in relation to open science. To achieve a culture shift towards openness and transparency, the reasons for why some editors (or professional societies or publishers) may be unsupportive towards open science, and what would be possible drivers, motives and opportunities for change need to be investigated, as is the case for researchers. Open science is often disincentivized through financial and career progression concerns (Leonelli et al., 2015). These need to be further explored in order to achieve ongoing transparency and progress.

Finally, the Synergy Expert Group recommended that health psychology and behavioural medicine research societies initiate a discussion and between-group collaboration to develop a coordinated plan for open science. Other societies, like the Society of Behavioral Medicine have established working groups to promote open science. The collaboration between these open science groups and their advocacy is a prominent avenue to establish a coordinated effort in defining how health psychology, behavioural medicine and health sciences can develop best practice for open science publishing, research transparency, openness, and sharing and reusing resources. The societies can collaborate to develop best practices for open science publishing, resource and data sharing and promoting citizen science (a topic that was not fully explored within the Synergy Expert Group meeting).

The final action that was not endorsed by the Synergy Expert Meeting participants was measuring journal impact through open science metrics. It was agreed that open science needs to be promoted and there are several avenues in highlighting open science impact. For example, the Centre for Open Science 'badges' attached to research articles can be used to explicitly acknowledge and incentivize researchers for sharing data, materials, or to preregister and to signal to readers that the content has been made available and certify its accessibility in a persistent location. Currently, 67 journals offer these badges; however, none of the EHPS journals do at present. Nonetheless, recent research shows that the badges facilitate an increasing rate of data sharing (Kidwell et al., 2016) and promoting new open science norms; however, they are insufficient to permanently change the norms in absence of other incentives (Rowhani-Farid et al., 2020). The group recommends that health psychology and behavioural medicine research societies explore various avenues of implementing open science

practices and collaborate to make open science a new norm for conducting and disseminating research in these science fields.

Another open science development has received growing attention is a publication procedure called *registered study reports* (Obels et al., 2020). This is a two-stage publication process accounting for: (1) publication of a peer-reviewed research protocol that guarantees the subsequent acceptance of papers containing results of the protocol; (2) publication of a peer-reviewed research paper containing the results of the protocol regardless of the results (Center for Open Science, 2020c). This publication format is designed to enhance transparency and reduce publication bias and consequently to eliminate a variety of questionable research practices, including selective reporting of results, and a publication bias, while allowing complete flexibility to report unexpected findings (Scheel et al., 2020). Some journals in health psychology (e.g., *Health Psychology Bulletin*), include this article type as an option.

Conclusions

In sum, there are several incentives from the perspective of the researchers, educators, journal editors, gatekeepers and science consumers to engage in open science practices. Key incentives include facilitating an easy access to research know-how, science transparency, opportunities for faster breakthroughs and collaboration, as well as learning and building on each other's expertise quickly and effectively. The art of balancing open science promotion with careful implementation of its practices and ensuring safety will guide the progress of future research. Health psychology is interconnected and can benefit from inter-disciplinary, inter-group and inter-nation data sharing and openness. Now, we all need to ensure that scientific integrity underpins open science endeavours as we strive towards connected, cohesive and impactful behavioural science.

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Appendices

Appendix A. Online Supplement

	Benefits	Challenges	Action Points
Researcher perspective	<ol style="list-style-type: none"> 1. Good practice: transparency of the process/ throughout the process 2. Transparency in what is confirmatory work and what is exploratory work 3. What's the robust contribution to knowledge? Replicability, perspective and reaching evidence-based practice 4. Transparent plan and then clarifications what has changed 5. Defining bad science versus good science, questionable reporting of science 6. Discrepancy between registration / protocol / actual trial 7. Capturing small changes throughout the trial through notes is time consuming and may bring transparency but is it worth an effort? 8. Do we need a 'Transparentist' in order to keep our science open – how do we understand what is useful to capture, e.g., variations from the protocol 9. Reporting (and pre-registering) exploratory analysis of all the outcomes captured in the study 10. Registering all main outcomes coming in 11. Open Science is not out there to 'catch you', the usefulness of it is in learning from each other (journey process) 12. Define Open Science not a policing system but an opportunity for collaboration and benefits 13. Pejorative evaluative language, all being as bad or good and 'punishing' may result in a problem 14. Open Science as opportunity to learn more and contribute to a robust approach 15. Open Science is not a contract that you cannot change, do we promote transparent 16. Exploratory variables registration could also benefit science, accepting changes and variations is useful to understand processes 	<ol style="list-style-type: none"> 1. Practical organizations have problems disclosing data, even anonymized, sometimes 2. Procedures will get adapted; law will get increasingly adjusted to openness 3. Transition period call for flexibility 4. Fear of errors being pointed out and other issues: we should promote a culture of 'to err is human' 5. Some Open Science advocates are quite militant/self-righteous; may be off-putting 6. Pushing the button (to open up) can be scary 7. Adopting a different mindset; 'working for openness', solves some problems 8. Apply the same mindset when writing the narrative; a documentation, a 'paper trail' of the project – Relate to pre-registration 9. Author contributions could be more clear 10. We all have to be supportive advocates of open science issues 11. Training early-career scientists needs to be an integral part of education and issues around open science – this includes undergraduate, postgraduate, and doctoral training 12. EHPS could have fields in the submission system for preregistration, open data, repository 13. There could be badges and links to the repositories in the abstract book 14. We could suggest people to add the link to the repositories, preprint, etc. in the abstract. 	<p>Publishing</p> <ol style="list-style-type: none"> 1. Gaming citations (-) 2. Not stringent enough/poor quality peer review (-) 3. Authorship, e.g., co-author networks (-) 4. Open peer review, post pub peer review (+) 5. ICMJE authorship guidelines, Credit taxonomy (http://journals.plos.org/plosone/s/authorship) (+) <p>Career Progression</p> <ol style="list-style-type: none"> 6. Current incentive structure rewards quantity over quality – priority is number of publications for jobs etc. (-) 7. Establishing hiring policy that recognizes Open Science practices (e.g., http://www.fak11.lmu.de/dep_psychologie/osc/open-science-hiring-policy/index.html) (+) <p>Questionable research practices</p> <ol style="list-style-type: none"> 8. These are often taught as the standard approach, or the result of biases (e.g., confirmation bias), rather than intentional misconduct (-) 9. We need ways of evaluating single studies rather than p-values which are only informative about the long run (-) 10. Distinguishing exploratory from confirmatory research (+) 11. Pre-registration and checking of pre-registration against published article (e.g., Goldacre's work) (+) <p>Collaboration</p> <ol style="list-style-type: none"> 12. Collecting more data until significance is reached (-) 13. Team-based research; division of labour (+)

17. Accepting variations on the way
18. Open Science as an opportunity to improve robust knowledge

14. Access to statistician(+)
15. Develop intervention and share content openly (+)

Protocols

16. Develop intervention for profit (copyright) (-)
17. Develop intervention and share protocols openly (+)

	Benefits	Challenges	Action Points
Gate-keeper perspective	<ol style="list-style-type: none"> 1. Exploratory, confirmatory analysis and sensitivity analysis included in the final reports – good communication practices 2. Showing very transparently what is confirmatory what is exploratory study 3. Having an easy way to link all the results together instead of slicing your data, having separate papers isn't really moving science forward 4. Language and writing consistency is really important 5. Using block-chain-like system to combine data: https://en.wikipedia.org/wiki/Blockchain 6. We need useful structural changes that can be implemented throughout the transition period 7. Propose structural changes in a transition period where sections of results making it clear what is confirmatory and what is exploratory 8. Open Science is huge work for reviewers and editors 9. Open Science and data sharing requires resources in terms of time, money etc. 10. Incentive for data sharing and open science is achieving a meta view of what's happening across different studies/ populations (e.g., meta-study on depression) 11. Open Science managerial positions in funding – analogy to Producer Price Index growth 12. How do we measure constructs in a meaningful way that can be applicable across populations and studies (what are best practices, most useful constructs to capture and tools to use) 13. Current demand for culture shift towards collaborative/ Open Science research 14. Creating data repositories when open data from various trials is entered (with basic information, e.g., the behavior measurement, sociodemographic) 	<ol style="list-style-type: none"> 1. Funders often look at the wrong criteria when looking at researchers 2. Founders' policies are often not formulated by researchers / 'academia-literate' people 3. Funders don't have mechanisms in place to stay up to date 4. Funders also care about the public's idea 5. Funders, like publishers, journals, etc. have workflows in place; that are sometimes challenged, but not universally; these organizations become, to a degree, fixated on those mechanisms 6. It would help if funders are more explicit about their criteria; e.g., 'sensation value', or 'rigour', etc. 7. Replications are extremely hard for e.g., intervention evaluations 8. Some replications are more urgent, e.g., when something is used in practice 9. A checklist for when to replicate stuff can be useful 10. Lakens is doing a project to determine replication value 11. Trying to do a consensus approach to determine what determines replication value 12. The EHPS can add fields to the journal submission form 13. We should help people; link to more resources, explanations, etc. 14. Link people to the Open Science MOOC (https://opsciencemooc.eu/) 15. On peer reviewer forms, add checkboxes for the actions of the peer reviewers 16. Make peer review forms public; show them in the submission process 	<p>Funders</p> <ol style="list-style-type: none"> 1. Funders want novelty, not replication(-) 2. Reviewers often do not have expertise in health psychology e.g., doctors, psychologists from other fields(-) 3. Complex applications waste research resources (-) 4. Most applications are unblinded, but perhaps impossible to avoid (-) 5. Some outcomes are not desirable – leads to conflict of interests (-) 6. Called-for (i.e., relevant for policy/ society) interventions as replications, not starting from scratch each time 7. Open Science policies (+) 8. Incentivize reviewing of funding applications (+) 9. Less strict bureaucracy (+) 10. More open calls (not restricted funding lines) (+) 11. Priority-setting exercises (http://www.jla.nihr.ac.uk/about-the-james-lind-alliance/) (+) 12. Psychological science accelerator (+) <p>Journals</p> <ol style="list-style-type: none"> 13. Biggest journals are closed (-) 14. Few publish replications (-)

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	Benefits	Challenges	Action Points
	15. How do we get credit for shared/ open science? 16. Credits for the open science manager at the journal/paper 17. Creating open data practices that allow for collaboration and collaboration within science community 18. Virtual social network of dataset: 19. Managing Open Science data sets as an impact aspect on one's own cv 20. Coding data that is meaningful across different research groups, having data depositories that are easy to data mine 21. Creating joint datasets with a quality meta-data (description of measures, procedures, participants) 22. How do we assess the quality of shared data 23. Who does the data belongs to? Sometimes founders 'own the data', they don't want it to be open 24. Open Science /sharing as an impact indicator – e.g., journals could have an Open Science factor – how much submitted data are used by other researchers	17. An overview of the health psychology journals and their Open Science practices and policies would be useful – can be useful to get them on board as well 18. Involve the editors; think about what mechanisms can be used 19. We should not just write a paper, but think about what we can do to realize change, be advocates, etc. 20. The EHPS can add Open Science practices as a criterion for the awards, and mention this when the award is awarded 21. Maybe instate a methodology/operations	Policy-makers 15. Poor understanding of research (-) 16. Biased towards 'hot topics' (-) 17. Naive reliance on simple answers and a need for certainty (-) 18. Open access funds (+) 19. Open Science repositories (+)
End-user perspective	1. Interventions/studies that may cause harm and reporting any negative effects that science may have had 2. Individual level negative effects and public health programs unintended effects or campaigns that are not evaluated 3. Narrative around science may influence what is evaluated, funded etc. 4. How to navigate and find good programs/interventions which were evaluated and can be easily accessed as good practice examples and build evidence-based practice 5. Using examples of good quality programs to showcase good examples of Open Science practices 6. What practitioners need now are concise summaries and solutions and open science may create extensive content that is difficult to navigate through 7. Large scale organizations (e.g., the World Health Organization) need to come on board to help us answer large scale questions to address large scale problems 8. Prioritization: starting from the researchers/stakeholders before we move to end users as currently we work in isolation 9. Collectively construct knowledge to involve end users 10. Importance of informing users about the outcome of the research	1. PHP can pay a role to disseminate this to practitioners and patients 2. The public partly sets the research agenda 3. Research integrity also involves how we communicate our results 4. Marketing and communications people are gatekeepers re: communication to end users; we should work with them to 'oversell' less 5. There could be a Practical Health Psychology (https://practicalhealthpsychology.com/) post about the risks of overselling/sensationalizing 6. We could identify key phrases as 'risky' in press releases and form guidelines for science communication in health psychology 7. Some researchers have conflict of interest. 8. There should be a conflict of interest disclosure for EHPS submissions 9. Practical Health Psychology (https://practicalhealthpsychology.com/) blog post: be critical when reading research; some researchers can make money with it 10. Science should be boring; if you're not bored, you're doing it wrong. 11. Success in science is independent of outcomes; it's about the design of the study.	Patients 1. Poor understanding of evidence – e.g., anti-vaccine movements show that people don't recognize bad science (-) 2. Communication of evidence is poor (-) 3. Media representations of research – often those with less focus on scientific integrity are more willing to speak to the media (-) 4. Ritualistic use of statistics does not provide information that informs patient decision-making (-) 5. Public and patient involvement (+) 6. Lay abstracts (+)
			Health professionals 7. Averse to de-implementation (-) 8. Some psychologists will give health professionals the simple answers that they want (-)

11. Taking into account the perspective of your end user; open science perspective to inform strategies implemented for end users
12. Working towards depositories that can be synthesized later to develop data synthesis over time
13. Policymakers need fast responses and they don't have 'depositories of knowledge' to find answers
14. Focus our efforts and attention on generating high quality evidence and synthesis of evidence with a longer term goal to inform policy and practice, realising that current benefits are not yet in sight
15. Agree on constructs, measures, and ways of reporting and then generate evidence to inform practice, creating large scale datasets
16. Using block-chain-like system to combine data to inform end users: <https://en.wikipedia.org/wiki/Blockchain>
17. Is it always good to involve the user in decision making and is it always best to personalize treatments?
18. Informing end users about having Open Science depositories
12. The Practical Health Psychology (<https://practicalhealthpsychology.com/>) blog post could be offered to The Conversation as well
13. Maybe contact the League of European Research Universities (<https://www.leru.org/>) to get them to commit to certain policies
14. Should projects involve, like they do statisticians, 'copywriters' to translate findings to the general audience? And/or to practitioners?

Other relevant professionals

9. Psychologists are too silent about their ability to contribute to policy-making (-)

Organizations which implement interventions

10. Implementing interventions which are not evidence-based (-)
11. Not understanding the need to involve psychologists from the design stage of interventions (-)
12. Null results are not respected (-)

Educational institutions

13. Training programmes do not change quickly in response to scientific progress (-)
14. Opening up universities to the public; increase knowledge of the scientific method

Policy-makers

15. Science being used to justify policies already in place or decided upon, rather than to identify better policies (-)