A Roadmap for Transparent Research in Special Education and Related Disciplines

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Author Note

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The motto of the Royal Society, "Nullius in verba" translates as, "Take nobody's word for it." Adopted in the 17th century, the motto implies transparency is a foundational value of the scientific community. Though widely espoused by scientists, actual use of open and transparent research practices has been limited and variable (e.g., Anderson et al., 2007; Levine, 2016; Stodden, Seller, & Ma, 2018). Open science initiatives aim to increase the transparency of all aspects of the scientific enterprise, thereby increasing research consumers' ability to trust and verify research findings. Researchers in psychology, education, and other fields have undertaken open-science reforms (Levine, 2016; Open Science Collaboration, 2015; van der Zee & Reich, 2018), which are beginning to be considered in special education and related disciplines (e.g., gifted education, rehabilitation; Cook, Lloyd, Mellor, Nosek, & Therrien, 2018; McBee, Makel, Peters, & Matthews, 2018).

Following a parallel meeting on open and transparent research practices in education research convened by the American Educational Research Association (AERA, 2017), representatives from journals, academic societies, and research funders in special education and related disciplines met in September, 2018, at the Center for Open Science in Charlottesville, VA, to discuss ways to increase research transparency (https://osf.io/s4z7n/). In addition to discussing open-science practices, attendees examined real and perceived barriers to their adoption. These convenings made clear that it is unreasonable to expect systemic adoption of open science without changes in resources, training, and culture. Accordingly, attendees generated recommendations for ways the special education research community can support and engage in transparent research. The grids in Figures 1-4 summarize these recommendations for four key stakeholder groups (funders, professional societies, journals, and individual researchers) across three levels of engagement (awareness, exploration, and adoption) for four core open-science practices (data and materials sharing, preregistration and Registered Reports, open-science reporting standards, and open access and preprints). We hope these grids provide a useful suite of options for increasing transparency and will serve as guideposts for supporting and enacting open science in special education and related disciplines.

Four Areas of Open Science

Sharing Data and Materials

Sharing data and materials involves providing open access, as ethically appropriate, to study data, analytical code, and materials (Meyer, 2018). These fundamental principles have a long history (National Research Council, 1985), and are enunciated in reporting standards (AERA, 2006) and ethical codes (AERA, 2011) in education research. Allowing open access to data and analytical code enables others to verify that analyses were conducted appropriately. Also, data that are freely available can be used to conduct additional analyses or be aggregated with data from other studies for meta-analyses. Providing open access to study materials (e.g., intervention protocols, fidelity checklists, assessments) allows other researchers to replicate studies and ensures potentially valuable intervention materials are available to practitioners. For

additional information on sharing data, code, and materials, please see
https://www.icpsr.umich.edu/icpsrweb/content/about/data-stewardship.html.

Preregistration and Registered Reports

Preregistration is the process of specifying key elements of the study's design and analysis plan *before* the study has been conducted. Creating and uploading a time-stamped, read-only preregistration to a public registry improves transparency, strengthens the credibility of the conducted analyses, and helps to distinguish confirmatory from exploratory analyses (Nosek, Ebersole, DeHaven, & Mellor, 2018). Registered Reports go one step further by submitting the proposed research plan to a journal for consideration for publication before collecting data (Nosek & Lakens, 2014). These submissions are subjected to peer review, and, pending approval, the author is granted an in-principle acceptance, which is a promise to publish the results regardless of the outcomes so long as (a) study protocols are followed or (b) any deviations are identified and justified. Registered Reports combat biased reporting (e.g., publication bias) and discourage researchers from "p-hacking" their data for positive, novel findings. For FAQs and additional resources on preregistration and Registered Reports, please see https://cos.io/prereg and https://cos.io/rr, respectively.

Open-Science Reporting Standards

Transparency in reporting research findings can be increased through guidelines that remind authors, reviewers, and editors of key study elements that need to be reported. Although reporting standards have been developed for different research designs (see https://www.equator-network.org/) and in education research (AERA, 2006), our focus here is standards specifically for reporting of (a) flexible research practices that may be exploited to attain desired findings (LeBel et al., 2013; Simmons, Nelson, & Simohnson, 2011) and (b) open-science practices that foster transparency. For example, psychdisclosure.org recommends authors report or disclose (a) total number of observations excluded and criteria for doing so, (b) all tested experimental conditions, including failed manipulations, (c) all administered measures and items, and (d) how sample size was determined and rules for stopping data collection. Such reporting standards discourage researchers from engaging in, but not reporting, questionable research practices. We also recommend authors report whether a study is preregistered (and, if so, where); whether data, code, and materials are shared (and, if so, where); and whether a publicly accessible preprint is available (and, if so, where). Please see https://psychdisclosure.org/FAQ.html for frequently asked questions regarding standards for disclosure of flexible research practices.

Open Access and Preprints

Much of the published research base is behind a paywall and inaccessible to many practitioners, researchers in developing nations, and other consumers (e.g., parents) who are unable or unwilling to pay access fees. Limited accessibility diminishes the influence of research on practice and slows scientific progress. Options for researchers to make their studies freely accessible include publishing in open-access journals and making traditional journal articles open access; these options typically involve a substantial cost to authors. One cost-free option for authors is to post versions of articles for which they own the copyright (for many journals,

authors retain copyright to unformatted pdf versions of manuscripts) to an openly accessible preprint server (e.g., PsyArXiv, SocArXiV, or the generalist server OSF Preprints; see Berg et al., 2016). See https://asapbio.org/preprint-info for more information about preprints and http://www.sherpa.ac.uk/romeo/index.php for journals' policies on copyrighting and self-archiving.

Three Levels of Engagement

The Transparency and Openness Promotion (TOP) Guidelines (Nosek et al., 2015) inspired the three levels of engagement with open-science practices and policies used in these grids (i.e., awareness, exploration, and adoption). These levels encourage stakeholders to support and utilize open science flexibly to the extent appropriate for them. For example, an individual researcher may be ready and able to adopt preprints and reporting standards, but may be at the awareness level for data and materials sharing, or for preregistration and Registered Reports. We encourage stakeholders to engage in all four open-science practices at least at the awareness level and to work toward exploration and adoption.

Four Stakeholder Communities

As reflected in Figures 1-4, research funders, leaders of scholarly societies, journal editors and publishers, and individual researchers have unique and complementary roles for supporting and implementing open science. Funders and society leaders are particularly well suited to curate and disseminate training materials, as well as provide training. Society leaders are especially well-positioned to formulate and disseminate norms for increased transparency. Journal editors and publishers have an opportunity to implement policies that encourage and require increased transparency and openness. Finally, individual researchers can act on recommendations and utilize resources as early adopters of emerging best practices in transparent research.

A Call to Action

As a mechanism to improve the transparency of scientific research, open science can be thought of as the most recent reform in ongoing efforts to make research in special education and related disciplines more trustworthy (e.g., Cain et al., 1952; Gersten, Baker, & Lloyd, 2000; Odom et al., 2005), with the ultimate goal of improving the policies and practices that research informs. We encourage members of the special education research community to support and employ multiple open-science practices using the grids in Figures 1-4 as a guide. Although we advocate for adoption of open science when possible, we echo the Italian proverb that the best is the enemy of the good. That is, engaging in some open-science practices (i.e., at the awareness and exploration levels) is always better than engaging in none. As obstacles are clarified and addressed, resources and incentives are developed, and norms for conducting and reporting research evolve, we envision corresponding growth in the adoption of transparent and open research.

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Funders

Level of Engagement	Data and Materials Sharing	Preregistration & Registered Reports	Open-Science Reporting Standards	Open Access and Preprints
Awareness	Provide resources related to data and materials sharing	Provide resources related to preregistration and Registered Reports	Provide resources for reporting flexible and open research practices (identify practices to be reported)	Provide resources related to preprints and other open access options
Exploration	- Provide training related to data and materials sharing - Require data and materials sharing for selected calls	- Provide training related to preregistration and Registered Reports - Require preregistration for selected competitions	- Encourage voluntary reporting standards in grant outputs - Require open-science reporting standards in grant outputs from selected competitions	- Provide training related to posting preprints - Require researchers preprint or otherwise provide open access to grant outputs for selected competitions
Adoption	- Routinely require data and materials sharing for selected competitions - Verify shared materials or check for computational reproducibility	- Routinely require preregistration - Partner with journals on Registered Reports - Establish a funder registry - Verify compliance with preregistered plans	Routinely require open-science reporting standards in grant outputs	Routinely require researchers preprint or otherwise provide open access to grant outputs

Figure 1. Recommendations for Funders Engaging in Transparent and Open Practices

Professional Societies

Level of Engagement	Data and Materials Sharing	Preregistration & Registered Reports	Open-Science Reporting Standards	Open Access and Preprints
Awareness	Provide resources related to data and materials sharing	Provide resources related to preregistration and Registered Reports	Identify flexible and open research practices to be reported	Provide resources related to preprints and other open access options
Exploration	- Endorse data and materials sharing - Provide training related to data and materials sharing	- Endorse preregistration and Registered Reports - Provide training related to preregistration and Registered Reports	- Establish a set of open-science reporting standards - Endorse open-science reporting standards - Provide training related to open-science reporting standards	- Endorse preprints - Provide training related to posting preprints
Adoption	Routinely require sharing data and materials for relevant society products (e.g., society-sponsored studies, society-affiliated journals)	Routinely require preregistering relevant society products (e.g., society-sponsored studies, society-affiliated journals)	Routinely require adherence to open-science reporting standards in relevant society products (e.g., society-sponsored studies, society-affiliated journals)	- Routinely post society products as preprints (e.g., white papers, position statements, society-sponsored studies) - Policies in society-affiliated journals for accepting preprints as submissions

Figure 2. Recommendations for Professional Societies Engaging in Transparent and Open Practices

Journal Editors and Publishers

Level of Engagement	Data and Materials Sharing	Preregistration & Registered Reports	Open-Science Reporting Standards	Open Access and Preprints
Awareness	- Provide information and resources related to data and materials sharing - Post clear statements, guidelines, or policies related to data and materials sharing for the journal	- Provide information and resources for preregistration and Registered Reports - Post clear statements, guidelines, or policies related to preregistration and Registered Reports for the journal	- Provide information and resources for open-science reporting standards - Post clear statements, guidelines, or policies regarding open-science reporting standards for the journal	- Provide information and resources for open access and preprints - Post clear statements, guidelines, or policies on accepting preprints for submission and other open access options for the journal
Exploration	- Publish papers that share data and materials - Recognize (e.g., award open science badges) papers and authors that share data and materials	- Publish special issue(s) of Registered Reports - Recognize (e.g., award open science badges) papers and authors that preregister studies	- Recommend specific open-science reporting standards - Publish special issue(s) requiring disclosure of open-science reporting standards	Accept preprints for submission
Adoption	- Require that authors of empirical studies share data and materials, as feasible - Verify shared materials or check for computational reproducibility	- Provide reviewers link to preregistered plans for studies under review - Require that authors provide link to preregistration when empirical studies are submitted (with rare exceptions) - Adopt Registered Reports as an ongoing submission option - Verify compliance with preregistered plan	Require that authors disclose whether open-science reporting standards are addressed	Upon acceptance, recommend authors post manuscripts as preprints

Figure 3. Recommendations for Journal Editors and Publishers Engaging in Transparent and Open Practices

Individual Researchers

Level of Engagement	Data and Materials Sharing	Preregistration & Registered Reports	Open-Science Reporting Standards	Open Access and Preprints
Awareness	- Review resources regarding sharing data and materials - Share resources regarding data and material sharing with colleagues and students	- Review resources regarding preregistering a study - Identify journals that accept Registered Reports - Share resources regarding preregistration and Registered Reports with colleagues and students	- Review resources regarding open-science reporting standards - Share resources regarding open-science reporting standards with colleagues and students	- Review journal policies related to preprints - Share resources regarding preprints with colleagues and students
Exploration	- Create shareable data sets, codebooks, and unique materials - Submit IRB application that allows for data and materials sharing - Share data and materials for selected studies	- Preregister selected studies on a publicly accessible registration repository - Submit study plans for a Registered Report	Apply open-science reporting standards in selected research reports (i.e., disclose whether and which open-science practices were used)	Post selected work on publicly accessible preprint server (in accordance with journal policies)
Adoption	Routinely share data and materials for studies as ethically feasible	- Routinely preregister research on publicly accessible registration repositories - Submit for multiple Registered Reports	Routinely apply open-science reporting standards in research reports	Routinely post work on publicly accessible preprint server (in accordance with journal policies)

Figure 4. Recommendations for Individual Researchers Engaging in Transparent and Open Practices