

## Two Views

# Advancing Scientific Integrity, Transparency, and Openness in Child Development Research: Challenges and Possible Solutions

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**ABSTRACT**—In 2019, the Governing Council of the Society for Research in Child Development (SRCD) adopted a Policy on Scientific Integrity, Transparency, and Openness (SRCD, 2019a) and accompanying Author Guidelines on Scientific Integrity and Openness in Child Development (SRCD, 2019b). In this issue, a companion article (Gennetian, Tamis-LeMonda, & Frank) discusses the opportunities to realize SRCD's vision for a science of child development that is open, transparent, robust, and impactful. In this article, we discuss some of the challenges associated with realizing SRCD's vision. In identifying these challenges—protecting participants and

researchers from harm, respecting diversity, and balancing the benefits of change with the costs—we also offer constructive solutions.

**KEYWORDS**—open science; transparency; reproducibility

These two 2 Views articles reflect the work and recommendations of the Society for Research in Child Development (SRCD) Task Force on Scientific Integrity and Openness. The Task Force was appointed by SRCD's Governing Council in 2017 and concluded its work in 2018, making recommendations to Governing Council on a range of policies and practices regarding scientific integrity and openness. The Task Force included SRCD members Pamela M. Cole, Lisa A. Gennetian, Rick O. Gilmore, Judith G. Smetana, Catherine S. Tamis-LeMonda, Marcel van Aken, Suman Verma, and Carol M. Worthman, and SRCD staff member Lisa Braverman.

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Science aims to deliver robust and actionable knowledge about issues of critical importance to humanity; success demands that child development researchers embody the highest standards of scientific integrity, openness, and transparency. Recent actions by the Society for Research in Child Development (SRCD)'s Governing Council make clear that SRCD strongly endorses openness and transparency in research, and views these practices as essential components of scientific integrity. Nevertheless, widespread agreement on overall goals and values does not guarantee agreement about what specific practices (e.g., Nosek et al., 2015) advance the goals or represent the values most effectively. Based on deliberations of the SRCD Task Force on Scientific Integrity and Openness on which we served, in this article, we discuss some of the challenges the child development community and its professional societies like SRCD face in seeking a more open, transparent, and robust science. In identifying the challenges—protecting participants and researchers from harm, respecting diversity, and balancing the benefits of change with the costs—we also offer constructive solutions.

## CHALLENGES TO THE RIGOR OF CHILD DEVELOPMENT RESEARCH

The last decade has seen an upsurge in scholarship focused on revealing the ways that many fields of scientific research produce published findings that do not withstand vigorous scrutiny. The social and behavioral sciences have come under especially intense criticism, much of it directed at specific weaknesses: Studies lack statistical power to detect reported effects (Szucs &

Ioannidis, 2017), analysis workflows cannot be readily reproduced, statistical errors are common (Nuijten, Hartgerink, van Assen, Epskamp, & Wicherts, 2015), attempts at independent replication too often fail to support prior claims (Open Science Collaboration, 2015), and failures to produce robust findings may stem from the careless or self-serving use of questionable research practices at numerous points in the research cycle (e.g., Munafò et al., 2017). Issues of reproducibility in science have also garnered widespread attention in the popular press (Harris, 2017; Lin, 2012; McEntee, 2019; Yong, 2018), and many scientists say they believe these problems constitute a crisis (Baker, 2016). Developmental research shares many of the features identified as weaknesses in other fields (e.g., Davis-Kean & Ellis, 2019). This elevates concerns about the reproducibility, replicability, and robustness of our work, and adds urgency to efforts to address them.

### PRACTICAL IDEALISM

How should the community of developmental scientists respond to these challenges? In answering the question, the Task Force deemed it essential to articulate a set of principles (SRCD, 2019a) to guide action:

- 1 Child development research is essential for improving the health and well-being of humanity; its practitioners must strive to produce robust and reliable findings and in doing so act with the utmost integrity.
- 2 Openness and transparency are (or should be) universal values that reflect the scientific ideals of child development researchers.
- 3 Diversity along multiple dimensions reflects the reality of the human condition. It is a specific strength of scientific research on child development and of SRCD.
- 4 Scientific societies like SRCD exist to support excellence in developmental research and among developmental researchers.

Our focus then turned to how to enact a practical idealism, one that reflects the personal and professional values of child development researchers while acknowledging the real and meaningful barriers to change we face as individuals and as a scientific community. Next, we address several of these challenges, and where possible, recommend solutions to mitigate or overcome them.

#### Protecting Against Harm

Developmental scientists study children and families more frequently than do researchers in other areas of the social, behavioral, and economic sciences. Many studies collect personally identifiable information (e.g., names, faces) of children, or study families from vulnerable populations, practices that invoke special ethical responsibilities to protect participants from harm, especially invasions of privacy and violations of confidentiality.

This means that special care must be taken to ensure that sharing data, a practice central to open and transparent scientific research, does not increase risks to participants. Numerous solutions exist to permit sharing data, analysis procedures, and materials in ways that protect participants.

#### *Seeking Permission to Share*

The most important way to protect participants from harm when sharing data involves securing permission. Participants and parents should be asked for their permission to share data beyond the research team, even if the data are nonsensitive and will be anonymized or pseudonymized prior to release. In seeking permission, researchers should make participants aware of potential risks and benefits. Asking permission builds on the principles of informed consent that have governed ethical research with human participants for decades. Perhaps surprisingly, even identifiable data such as photographs, video, or audio recordings or exact birth dates *can* be shared with participants' (or parents') permission. Asking permission to share is easier when child development researchers adapt template language that others have developed and shared openly (Gilmore, Kennedy, & Adolph, 2018), and when the levels of access to be granted use clear and standard conventions. When data are particularly sensitive, researchers should consider seeking permission to archive data for preservation; what is challenging to share today might not be in the not-too-distant future.

Researchers who plan to share data should also seek permission from the research ethics board, institutional review board (IRB), or equivalent entity that supervises their research. Research ethics boards and IRBs vary in their experience with, level of support for, and comfort with data sharing. So researchers seeking permission to share data should be prepared to consider questions about what data will be shared, via what mechanism, with whom, and for what length of time. Some of these questions have relatively easy answers: Data are best shared via academic or government data repositories that are specialized for curating data in standard ways and preserving them for the long term. Other questions are harder. For example, must minors whose data were shared with parental consent be contacted and asked to give consent when they reach majority age? If data are collected from infants or young children, researchers must consider the risk of storing identifiable contact information for extended periods to permit participants to be contacted and asked for consent. As with all questions in research, practitioners must weigh ethics, risks, and benefits, and strike a balance among them.

#### *Choosing What to Share, What Not to Share, and Where*

The field has longstanding and well-established practices for deidentifying research data: Standard personal identifiers can be removed, individual elements can be substituted with smoothed or imputed values, faces in images or videos can be blurred, voices can be altered, and so forth. These practices often

address concerns about data sharing that participants, researchers, and ethics committees raise, and we anticipate new developments in technologies that will help researchers better evaluate the risks of reidentification using various data and mitigate these risks more effectively.

The apparent ease of deidentifying data may make it seem that unrestricted public data sharing is the more open and transparent scientific practice, and thus preferred. Yet, we worry that the unrestricted public sharing of data about children and families poses unknown risks of disclosure as the number of such publicly shared datasets grows. The research community has a long and successful history of sharing behavioral data with restricted communities of researchers via domain-specific data repositories like the Inter-University Consortium for Political and Social Research, TalkBank, and more recently, Databrary. These repositories implement well-established models for sharing many of the most sensitive types of data safely and securely. Restricted sharing via a data repository can balance a researcher's desire for scientific openness with the requirement to protect individual participants. Data shared in this way can be subject to access restrictions (e.g., the requirement for review by the ethics board or IRB, researcher training), while eliminating case-by-case gatekeeping by researchers' intent on sharing only with specific colleagues for particular purposes.

Nevertheless, scientific approaches to studying child development vary in the level of risk associated with sharing data. Research involving ethnographic methods, small samples, specific locations, certain types of biological data like DNA, or sensitive topics (e.g., sexuality, religious or political beliefs) may pose substantial risks of harm to individual participants or vulnerable communities even if data are altered or aggregated or access is restricted. Thus, notwithstanding the virtues of restricted data sharing via repositories, some data and materials associated with child development research cannot be shared practically or ethically, at least now, perhaps ever, and certainly not without extreme caution and careful, deliberate consideration. Rather than making the perfect the enemy of the good, we urge our colleagues to focus on realizing the substantial opportunities for expanding data sharing that pose less risk.

We have touched on only some of the challenges associated with sharing child development data. Professional societies like SRCD, working with experts on research ethics, have central roles to play in promoting best practices, sharing information, and fostering constructive conversations about the ethics of sharing.

#### *Acknowledging Potential Risks to Researchers*

While upholding ethical obligations to research participants is paramount, we recognize that some researchers view the push for more widespread sharing of data and materials as potentially harmful to them individually. Colleagues aware of the highly competitive nature of our work have expressed concerns about being scooped by another team and having their professional

reputation harmed if an error is found in a shared dataset or analysis workflow. They are also concerned about the substantial cost in time, labor, and money required to meet data sharing expectations, and the risk that some work could be perceived as inferior if data or materials were not shared. Considering the need for research that represents children in all types of communities around the world, the burdens of engaging in open science practices may fall unequally on scholars at under-resourced institutions who lack sufficient institutional support to prepare data and materials for sharing.

These sentiments highlight a conflict between an ideal—child development research should be open, transparent, and widely shared to accelerate progress—and the reality—sharing may put an individual researcher at greater risk of professional or reputational harm, especially in an environment in which open practices are neither widespread nor receive acknowledgment and reward commensurate with their contributions to scholarship. This conflict does not have a single or simple resolution. Scientific research carries intrinsic risk, research is competitive, and discoveries are more important to scientific progress than the career trajectories of individual researchers. But some simple and practical solutions can reduce the risk of scooping. For example, researchers can place a data sharing embargo on datasets until after their work has been published. Professional societies like SRCD can and should play constructive roles in mitigating other risks—by providing opportunities for professional development and access to information about best practices, and by advocating for more resources from scientific funders, among other approaches.

#### *Monitoring a Developing Landscape*

Attitudes toward open science practices—and the adoption of them—are changing rapidly, particularly in Europe and North America. Leading developmental researchers have become vocal advocates for a variety of open science practices (Adolph, Gilmore, Freeman, Sanderson, & Millman, 2012; Davis-Kean & Ellis, 2019; Gelman, 2012), while others express caution (Goldin-Meadow, 2016). Seeking permission from participants to share data is increasingly commonplace and sharing materials is becoming standard practice. New sharing platforms like Databrary, developed by developmental researchers with these issues in mind, have created a policy framework for sharing *identifiable* data like video and audio recordings (Gilmore et al, 2018). The framework includes template permission-to-share language for researchers to record participants' wishes concerning data sharing. The Databrary framework also builds on established practices of restricted data sharing: Access to data is limited to researchers who have formal institutional approval, involves data that participants have agreed to share, and can be used only for purposes approved by an authorizing institution. We see many challenges in the push to accelerate open data and sharing materials while protecting participants and researchers. Solutions exist or are emerging for many of these, and we welcome

leadership by SRCD in helping members navigate this rapidly changing landscape.

### Respecting Diversity

A second challenge confronting the effort to make child development research more open, transparent, and robust concerns respecting diversity across the many meanings of that term.

#### *One Size Won't Fit All*

Notwithstanding public challenges to the robustness of psychological research mentioned earlier, researchers disagree about whether psychology and its allied fields are in crisis (Barrett, 2015; Stroebe & Strack, 2014). The fields represented by SRCD are diverse—developmental science furthers the understanding of many human concerns—and the problems identified by advocates for open science may apply more readily to some kinds of work, specific methods, or specific findings than to others. For example, the focus on replicability can seem misplaced or inapplicable to scholarship that studies individuals longitudinally, investigates single events or conditions (e.g., disasters, policy changes), or works in unique and changing cultures. Mandating the application of specific open science practices to diverse forms of scholarship poses many risks. Doing so may devalue past work that did not anticipate these issues and undermine current work that has not adopted specific recommended practices for legitimate reasons. If a scholarly community lacks widespread consensus about the nature of a problem or its extent, caution seems warranted in mandating specific solutions. Indeed, even scholars known as strong advocates for greater openness and transparency in science have noted that the term open science can mean different things to different people (Yarkoni, 2019).

#### *Engaging a Global Community*

Outside the United States, the situation appears even more complicated. SRCD has a large, diverse, and international membership, and the society rightly views this as a strength. Nevertheless, researchers from developing countries have been largely absent from discussions about openness, and discussions about open science policies or practices make scant reference to research originating from under-resourced settings. Moreover, ethical, cultural, and regulatory differences make it especially complex to determine what sort of data can be collected from human research participants, by whom, and for what purposes, as well as where the data can be stored, with whom it can be shared, and for how long. For example, no standard, widely embraced policy framework permits researchers to share data about human research participants across international borders. Even among economically developed countries, cultural and regulatory (e.g., the European Union's General Data Protection Regulation) differences exist over the definition of personal information, the value of personal privacy, and the extent to which entities that collect data about people must protect it.

#### *Making Child Development Research Less WEIRD*

Knowledge about the science of human behavior has been collected primarily in Western, educated, industrial, rich, democratic (WEIRD) countries (Henrich, Heine, & Norenzayan, 2010). We should strive to ensure that research on child development reflects non-WEIRD countries, too. Increasing expectations for open data, materials, and sharing analysis workflow could inadvertently adversely and disproportionately affect researchers and institutions from low- and middle-income countries or those who work with populations largely underrepresented in the current literature. SRCD's diverse international membership offers the society a unique opportunity and special responsibility to provide leadership in collaborative efforts to make child development research substantially more representative of the diversity of the world's families *and* more open, transparent, and rigorous.

#### **Balancing the Benefits of Change With the Costs**

We see significant benefits to promoting greater openness and transparency in child development research. At the same time, we recognize that seemingly positive changes come with sometimes unforeseen costs that must be acknowledged, reduced when possible, and funded as needed.

#### *Bolstering Reproducibility Requires New Skills*

As a practical example, some researchers use data analysis workflows that involve graphical user interfaces (GUIs) consisting of sequences of button presses, mouse clicks, or manual procedures. The extent to which these workflows can be reproduced depends on the analyst and strict adherence to a predetermined, ideally written, protocol. The extent to which these workflows can be shared depends on how well *post hoc* written descriptions match what the analyst actually did. Automated data gathering, cleaning, visualization, and analysis pipelines can be generated in any number of computer packages or languages (e.g., SAS, SPSS, R, Python, MATLAB), and the underlying code can be shared easily via free open source sites (e.g., Open Science Framework, GitHub, GitLab, BitBucket). But how does a researcher trained to use paper-and-pencil procedures, spreadsheets, or the SPSS GUI for data analysis acquire a new skill set to embrace the move toward greater openness, transparency, and reproducibility? Among the many answers: SRCD plans to support in-service training opportunities and provide information about free or low-cost training offered by others on the society's website and at its meetings.

#### *Openness May Conflict With Intellectual Property Rights*

Other challenges may be harder to solve. Consider a common approach to the problem of small sample sizes and underpowered studies—using measures developed and normed with large samples. Many if not most standardized research instruments (usually questionnaires or computer-based tests) that meet these criteria are subject to copyright or have other restrictions on

open sharing of item-level data (which is the most valuable to others). In this case, open materials sharing could violate intellectual property restrictions. Yet without open materials sharing, the value of shared data is diminished. This situation poses thorny and unresolved questions related to ownership rights over data and research materials, issues related to the debate about open access to scholarly publications that go far beyond the scope of the Task Force or this article. Nevertheless, a more open science of child development faces possibly costly barriers related to unresolved tensions between openness and intellectual property rights that require strong leadership from the community and from SRCD.

#### *There Is No Free Lunch*

Finally, we come to a question colleagues often raise when the issue of promoting greater sharing arises: Who pays? Curating data and materials for storage in a repository takes time and expertise. The development, maintenance, ongoing operation, and enhancement of repositories take time, expertise, and money. For the most part, repositories in the fields represented by SRCD (COS/OSF, ICSPR, Databrary, TalkBank) offer no-cost data-storage options to researchers with few limits on the amount or duration of storage offered. But the costs of programmers, transcribers, curators, trainers, and administrators required to manage and improve these services are high. Moreover, the costs of most repositories are funded by time-limited project-specific grants, individual contributions, and institutional subscriptions. Few if any have core support from institutional hosts, such as a university library, or stable long-term funding for ongoing operations from a government source like the National Science Foundation or the National Institutes of Health. Funding agencies invite researchers to add the costs of data curation to their grant proposals, but researchers may be reluctant, absent mandates, to set aside funds for sharing old data that could be used for new science—data collection and analysis. Moreover, data stored indefinitely over the long term generate ongoing costs to the repository. Researchers in some countries (e.g., the Netherlands) have access to funds set aside for these purposes, but the United States has no federal funding source dedicated to supporting the core operations of data repository services in the social, behavioral, and neural sciences.

As a possible way to address this problem, 15% of the U.S. federal research budget could be set aside for open science activities: 5% for data repositories; 5% for curation of existing, high-value datasets; and 5% for secondary analysis of existing data. Whether the research community wishes to embrace this sort of proposal is unknown, and the plan would not address the needs of researchers without access to U.S. federal support. SRCD is committed to a science representing knowledge about all children around the world and can contribute to collaborative international efforts to fund data sharing and reuse in research on child development. Scientists who study child development who aspire to foster greater openness, transparency, and

robustness must work collaboratively with our professional societies and funding agencies to ensure that shared data and materials have stable long-term homes that can seed scholarship for decades to come.

## CONCLUSION

In many ways, child development researchers occupy an enviable position: We enjoy the privilege and pleasure of making discoveries about vital, essential questions concerning the development of the world's children and the health and well-being of their families. But that position carries responsibilities, among them, the requirement to apply critical scrutiny, the “organized skepticism” that sociologist Robert Merton (1942/1973, pp. 277–278) suggested is central to the practice of scientific research. That scrutiny by us and our colleagues on the Task Force has led to a new policy statement by SRCD and new guidelines to authors that we are proud to have helped shape.

Nevertheless, the work to create a field of child development research that is a model of openness, transparency, and integrity is not finished. We must overcome the challenges we have discussed in this article: protecting participants and researchers from harm, respecting diversity, and balancing benefits and costs. Readers will be able to identify challenges we have overlooked. Some have asked: If challenges to the rigor of child development research constitute a crisis, should the policies and guidelines to authors not go further? Here is our response: What seem like small steps to some members of our community are substantial ones for others. We expect to take more steps— together, thoughtfully, and in time. Central to all that we have written here is the belief that openness and transparency in research are integral to the principles of research ethics and inclusiveness in producing knowledge (Brakewood & Poldrack, 2013; Frank, 2019) that are the hallmarks of our research community.

## REFERENCES

- Adolph, K. E., Gilmore, R. O., Freeman, C., Sanderson, P., & Millman, D. (2012). Toward open behavioral science. *Psychological Inquiry*, 23, 244–247. <https://doi.org/10.1080/1047840X.2012.705133>
- Baker, M. (2016). 1,500 scientists lift the lid on reproducibility. *Nature*, 533, 452–454. Retrieved from <http://www.nature.com/news/1-500-scientists-lift-the-lid-on-reproducibility-1.19970>.
- Barrett, L. F. (2015, September 1). Psychology is not in crisis. *The New York Times*. Retrieved from <http://www.nytimes.com/2015/09/01/opinion/psychology-is-not-in-crisis.html>
- Brakewood, B., & Poldrack, R. A. (2013). The ethics of secondary data analysis: Considering the application of Belmont principles to the sharing of neuroimaging data. *NeuroImage*, 82, 671–676. <https://doi.org/10.1016/j.neuroimage.2013.02.040>
- Davis-Kean, P., & Ellis, A. (2019, July). *An overview of issues in infant and developmental research for the creation of robust and replicable science*. PsyArXiv Preprints. Retrieved from <https://psyarxiv.com/m4576>

- Frank, M. C. (2019, July). *The ethical duty to practice open science*. Unpublished manuscript.
- Gelman, S. (2012). *Rigor without rigor mortis: The APS board discusses research integrity—Association for Psychological Science*. APS Observer, 25. Retrieved from <http://www.psychologicalscience.org/index.php/publications/observer/2012/february-12/scientific-rigor.html#gelman>
- Gilmore, R. O., Kennedy, J. L., & Adolph, K. E. (2018). Practical solutions for sharing data and materials from psychological research. *Advances in Methods and Practices in Psychological Science*, 1, 121–130. <https://doi.org/10.1177/2515245917746500>
- Goldin-Meadow, S. (2016). *Why preregistration makes me nervous*. APS Observer, 29. Retrieved from <https://www.psychologicalscience.org/observer/why-preregistration-makes-me-nervous>
- Harris, R. (2017). *Rigor mortis: How sloppy science creates worthless cures, crushes hope, and wastes billions*. New York, NY: Basic Books.
- Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *The Behavioral and Brain Sciences*, 33, 61–83. <https://doi.org/10.1017/S0140525X0999152X>.
- Lin, T. (2012, January 16). “Open science” challenges journal tradition with web collaboration. *The New York Times*. Retrieved from <https://www.nytimes.com/2012/01/17/science/open-science-challenges-journal-tradition-with-web-collaboration.html>
- McEntee, C. (2019, July 23). Convergence: A call for more robust global science collaboration. *Eos*. Retrieved from <https://eos.org/agu-news/convergence-a-call-for-more-robust-global-science-collaboration>
- Merton, R. K. (1973). The normative structure of science. In R. K. Merton (Ed.), *The sociology of science: Theoretical and empirical investigations* (pp. 228–253). Chicago, IL: University of Chicago Press. (Original work published 1942)
- Munafò, M. R., Nosek, B. A., Bishop, D. V. M., Button, K. S., Chambers, C. D., du Sert, N. P., Ionnadis, J. P. A. (2017). A manifesto for reproducible science. *Nature Human Behaviour*, 1. Retrieved from <http://www.nature.com/articles/s41562-016-0021>
- Nosek, B. A., Alter, G., Banks, G. C., Borsboom, D., Bowman, S. D., Breckler, S. J., . . . Yarkoni, T. (2015). Promoting an open research culture. *Science*, 348, 1422–1425. <https://doi.org/10.1126/science.aab2374>
- Nuijten, M. B., Hartgerink, C. H. J., van Assen, M. A. L. M., Epskamp, S., & Wicherts, J. M. (2015). The prevalence of statistical reporting errors in psychology (1985–2013). *Behavior Research Methods*, 48, 1205–1226. <https://doi.org/10.3758/s13428-015-0664-2>
- Open Science Collaboration. (2015). Estimating the reproducibility of psychological science. *Science*, 349, aac4716. <https://doi.org/10.1126/science.aac4716>
- SRCD. (2019a). *Policy on scientific integrity, transparency, and openness*. Retrieved from <https://www.srcd.org/about-us/policy-scientific-integrity-transparency-and-openness>
- SRCD. (2019b). *Author guidelines on scientific integrity and openness in child development*. Retrieved from <https://www.srcd.org/author-guidelines-Scientific-Integrity-Openness-ChildDevelopment>
- Stroebe, W., & Strack, F. (2014). The alleged crisis and the illusion of exact replication. *Perspectives on Psychological Science*, 9, 59–71. <https://doi.org/10.1177/1745691613514450>
- Szucs, D., & Ioannidis, J. P. A. (2017). Empirical assessment of published effect sizes and power in the recent cognitive neuroscience and psychology literature. *PLoS Biology*, 15, e2000797. <https://doi.org/10.1371/journal.pbio.2000797>
- Yarkoni, T. (2019, July 13). *I hate open science [Blog post]*. Retrieved from <https://www.talyarkoni.org/blog/2019/07/13/i-hate-open-science/>
- Yong, E. (2018, November 19). Psychology’s replication crisis is running out of excuses. *The Atlantic*. Retrieved from <https://www.theatlantic.com/science/archive/2018/11/psychologys-replication-crisis-real/576223/>