# SOCIETY FOR NEUROSCIENCE EFFORTS TO ENHANCE AWARENESS AND KNOWLEDGE OF SCIENTIFIC RIGOR IN NEUROSCIENCE TRAINEES

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Increasing reports of lower-than-expected replication rates in biomedical research is attracting attention from scientists, funding agencies, journals, scientific societies, and the public. In parallel, the scientific community recognizes the need for enhanced scientific rigor related to experimental design, data analysis, and reporting of methods and results to improve the reproducibility of scientific studies. Although rigor is vital to the scientific process, there is little standardized, formal training for the topic that researchers can turn to for instruction.

To help address gaps in scientific rigor training as they relate to neuroscience, the Society for Neuroscience (SfN), under the supervision of Principle Investigators Dr. Sisk and Dr. Emanuel DiCicco-Bloom, recently completed a training series, primarily intended for neuroscience graduate students and postdoctoral fellows, titled Promoting Awareness and Knowledge to Enhance Scientific Rigor in Neuroscience. The National Institute on Drug Abuse funded this project as part of the NIH program Training Modules to Enhance Data Reproducibility (TMEDR).

SfN is the world's largest organization of scientists dedicated to understanding the brain and nervous system and is committed to providing professional development and training resources for neuroscientists at all career stages. The Society has a successful record of developing and implementing high-quality and well-attended online and in-person scientific training and professional development programming. With a global membership of nearly 37,000 neuroscientists in more than 90 countries, SfN elected to pursue an online learning model when developing scientific rigor training resources. Online learning is accessible to populations that may not otherwise have access to instruction on these topics; permits users flexibility with where, when, how, and how often to engage with training content; and provides a modern and scalable global platform for continued expansion or updating of programs.

SfN's scientific rigor training series included six webinar-based training modules, offered throughout 2016, and two live Professional Development Workshops (PDWs) held at *Neuroscience 2015* and *Neuroscience 2016*, SfN's annual meetings. These PDWs were recorded for online dissemination. All of the webinar and PDW resources developed are available open-access in a digital collection on Neuronline, SfN's online home for learning and discussion. Training modules employed real-world examples and case studies from multiple different neuroscience disciplines to provide best practices in: experimental design and planning for data collection; minimizing experimental biases; statistical analysis and data management; and transparent reporting. PDWs included interactive presentations with experts on topics such as publishing negative data, open-source research tools, and meeting new NIH grant requirements concerning scientific rigor and reproducibility.

Each webinar-based training module in this series consisted of: a 60-90 minute webinar, featuring 2-4 leaders in neuroscience research and training; supplemental readings; in-webinar, interpolated assessment questions; a post-webinar discussion guide; an interactive question and answer session with the webinar speakers; pre and post-webinar surveys to measure self-reported changes in topical awareness, knowledge, and participants' ability to apply their knowledge; and an online discussion community for continued engagement. The two-hour, live PDWs held in 2015 and 2016 included presentations from experts, panel discussions, and

extended Q&A periods to provide attendees opportunities for real-time discussions with experts and colleagues.

**MAJOR FINDING 1: Use of this training series indicates high demand and interest for scientific rigor training content within the global neuroscience trainee community.** As of April 2017, SfN's six-part webinar series has attracted more than 2,700 total registrants and nearly 1,740 attendees, and for each training module, an average of 450 registrants, 123 live attendees, and 162 on-demand attendees. The two in-person PDWs were attended by more than 350 people total, while the workshop recordings have been viewed more than 1,000 times. Graduate students and postdocs made up the predominant attendee segment of the six training modules (average = 67% of total live attendance and 59% of on-demand attendance). Notably, these attendees were geographically dispersed, with live webinar attendees from an average of 18 unique countries and on-demand attendees from an average of 22. Post-webinar qualitative feedback suggests a demand for these training resources by early-career neuroscientists, with one postdoc participant commenting: *"…I anticipate the entire series will be very useful for enhancing our own practices within our lab, especially when new trainees join."* Another graduate student commented: "*I very much enjoyed this webinar [topic: experimental design & pre-planning for data collection], and it was very useful as a third-year neuroscience graduate student."* Other feedback suggests that these training modules are being integrated into graduate program curricula and/or are being used to seed experimental design and methods-based courses in neuroscience training programs. Overall, the series is proving to be a valuable training tool for the global neuroscience community.

**MAJOR FINDING 2: Trainees report gaining awareness and knowledge of scientific rigor issues through this training series, but multiple factors may underlie their abilities to apply this knowledge to their scientific practice.** To evaluate the impact of the training modules to enhance awareness and knowledge of scientific rigor issues and help trainees apply their knowledge, SfN employed pre and post-webinar surveys. Webinar participants self-reported their pre-webinar awareness and knowledge of the specific topics of scientific rigor that would be covered in each training module, and their current ability to use their knowledge to address those issues. Participants were then asked the same questions immediately after each webinar. Across the six training modules, graduate students and postdocs demonstrated gains in awareness and knowledge of the issues of scientific rigor covered during the webinars, with 62% of trainees reporting increased awareness and 68% reporting increased knowledge. Interestingly, only 44% of graduate students and postdocs reported that their ability to use their knowledge related to specific scientific rigor topics increased after attending the webinars. Based on the timeframe of the project, SfN predicted that changes in behavior (i.e. "ability to use knowledge") may come months or years after the webinar; indeed, quantitative and qualitative feedback from attendees underscores this prediction. As described by a graduate student, the length of a single webinar may not be enough time for a participant to alter his or her experimental practice: "*I'm aware of the issues and potential pitfalls, but exactly how to avoid them in my particular research will take time to digest before implementation is automatic. Essentially, old habits need to be scrutinized*." Furthermore, while most webinar attendees were early-career neuroscientists, they may not ultimately be responsible for implementing rigorous research practices, as illustrated by this feedback: "*As a graduate student, my PI has final say in most of my experiments. In lieu of the final discussion, doing more experiments and maximizing output supersedes performing a singular high powered experiment that may or may not be published. Until those things are prioritized by funding sources and review process, I don't expect this to change*." This feedback underscores the need for ongoing training in scientific rigor for neuroscience *trainees and trainers,* and for support at all levels of the biomedical research enterprise for behavioral changes that will enhance experimental reproducibility.