

EDITORIAL

Resources to assist EEG/ERP researchers during the COVID-19 pandemic

The electroencephalogram (EEG) and event-related potential (ERP) techniques provide unique insights into the typical operation of the human mind, and these methods also play an important role in efforts to understand, diagnose, and treat a variety of psychological and neurological conditions that cause enormous human suffering. However, EEG/ERP data collection has slowed or paused throughout much of the world as a result of the coronavirus disease 2019 (COVID-19) pandemic. Even in places where data collection has continued or resumed, special precautions are needed to minimize the spread of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus. To avoid postponement of research that is important for both the accumulation of fundamental knowledge and the reduction of human suffering, the field must develop methods for safe resumption of data collection and alternative research approaches that make use of existing data. We have, therefore, developed several new resources for EEG/ERP researchers that build on our ERP Boot Camp workshops (<https://erpinfo.org/the-erp-boot-camp>) and our ERPLAB Toolbox software package (Lopez-Calderon & Luck, 2014).

To help researchers safely resume data collection as soon as possible given their local health conditions and regulatory environments, we have published a formal protocol for EEG data collection that is designed to reduce the risks of COVID-19 transmission (Simmons & Luck, 2020). This protocol—which is an extension of our standard EEG recording protocol (Farrens, Simmons, Luck, & Kappenman, 2019)—is designed to make the risks of EEG data collection no greater than the other risks an individual faces in daily life during the COVID-19 pandemic (e.g., the risks involved in grocery shopping or getting a haircut). We could not possibly anticipate the needs of every EEG/ERP study, so this protocol focuses on relatively simple paradigms and adult participants. However, it could be easily modified for other paradigms and participant populations. The protocol was based on a careful reading of the emerging COVID-19 literature, existing guidelines for clinical electrophysiology, input from basic scientists, and feedback from neurologists who are familiar with both research and clinical EEG recordings, and comments from the worldwide EEG/ERP research community.

Similar resources are also available for clinical EEG recordings (San-Juan et al., 2020), other electrodiagnostic

procedures (Desai et al., 2020), and noninvasive brain stimulation (Bikson et al., 2020). We would like to stress that researchers should not resume data collection until allowed by their institutions and the relevant government authorities, and data collection may need to ramp up and down multiple times as conditions change.

For researchers who are looking for interesting data to analyze while the acquisition of new EEG/ERP data is slowed or paused, we have released the ERP CORE (Compendium of Open Resources and Experiments; Kappenman, Farrens, Zhang, Stewart, & Luck, 2020, May 22). The ERP CORE is a free online resource available at <https://doi.org/10.18115/D5JW4R>. It consists of six standard ERP paradigms that together isolate seven common ERP components (N170, mismatch negativity, N2pc, N400, P3, lateralized readiness potential, and error-related negativity). Each paradigm was carefully optimized to produce robust ERP effects in only about 10 min of data collection. The online resource contains the experiment control scripts, data from 40 neurotypical adults in all six paradigms, and complete EEGLAB/ERPLAB data processing pipelines and analysis scripts. We know of no other data set that contains such a broad range of neurocognitive ERP measures from a single set of participants. The ERP CORE provides a unique opportunity for researchers to test new hypotheses (e.g., regarding correlations across ERP components) or to examine the effects of signal processing techniques across multiple paradigms. The ERP CORE also provides an excellent resource for individuals who would like to learn basic ERP data processing procedures using EEGLAB and ERPLAB, or for more experienced ERP researchers to augment their skills by learning how to write professional-quality Matlab scripts.

We have also created the “Virtual ERP Boot Camp,” which builds on our in-person ERP Boot Camp workshops by providing online training for ERP researchers in a broadly accessible webinar format. The first webinars, which were held on June 29–30, 2020, focused on ERP decoding methods and included contributions from Gi-Yeul Bae and Aaron Simmons. The first day focused on explaining how ERP decoding works and providing concrete examples, and the second day focused on teaching the participants how to implement decoding using Matlab scripts that we provided. These decoding methods can be readily applied to existing data sets to answer new questions, so they should be helpful

to researchers who cannot collect new data at the present time. We plan to repeat these webinars later in the summer or fall of 2020. The Virtual ERP Boot Camp will also include webinars on other topics, such as the ERP CORE, so that ERP researchers can be productive even if they are unable to collect new data. Information about these webinars can be obtained on our ERPinfo.org website.

Finally, we are creating a resource that will be useful for people who teach about ERPs in their courses, especially at institutions where remote teaching will be necessary during the COVID-19 pandemic. Specifically, we will soon release a series of online educational videos about the ERP technique. These videos will be appropriate for anyone who is interested in learning about ERPs, ranging from students in undergraduate courses to faculty who are considering adding this technique to their methodological toolkit. The videos will be available in a free online course, which will include extensive quizzing to promote comprehension and retention. The individual videos will also be freely available for instructors to use in their own courses (via a Creative Commons license). Information will be available soon on the ERPinfo.org web site. We would also like to note that additional materials for teaching about ERPs are available from the PURSUE initiative (Preparing Undergraduates for Research in STEM-related fields Using Electrophysiology; <https://pursue.richmond.edu>).

We hope that these resources help EEG/ERP researchers continue to make progress in their research during the COVID-19 pandemic. This is important to avoid delays in our field's efforts to understand the fundamental nature of the human mind and to reduce the suffering caused by neurological and psychological conditions. It will also be EDITORIAL important in helping students, postdocs, and junior faculty continue progressing in their careers so that the next generation of scientists can continue this important research.

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