Extensions of Open Science for Applied Behavior Analysis: Preregistration for Single Case Experimental Designs

Matt Tincani[1], Shawn P. Gilroy[2], and Art Dowdy[1]

[1]Department of Teaching and Learning, Temple University, Philadelphia, Pennsylvania, USA

[2]Department of Psychology, Louisiana State University, Baton Rouge, Louisiana, USA

Correspondence:

Matt Tincani, Temple University, 1301 Cecil B. Moore Ave., Philadelphia, PA, 19122, USA

Email: tincani@temple.edu

Abstract

Open science practices are designed to enhance the utility, integrity, and credibility of scientific research. This paper highlights how preregistration as a key open science practice can be leveraged to enhance the rigor and transparency of single-case experimental designs (SCEDs) within an applied behavior analysis (ABA) framework. We provide an overview of the benefits of preregistration, including increased transparency, reduced risk of researcher bias, and improved replicability, and we review the specific contexts under which these practices most benefit the proposed framework. We discuss potential concerns with and unique considerations for preregistering SCED experiments, with practical guidance for researchers seeking to preregister their studies. We present a checklist as a tool for ABA researchers to engage in preregistration and provide recommendations for our field to strengthen the contingencies for open science practices inclusive of preregistration.

KEYWORDS

applied behavior analysis, open science, preregistration, single-case experimental design

Extensions of Open Science for Applied Behavior Analysis: Preregistration for Single Case Experimental Designs

High-profile replication failures in the social and behavioral sciences have encouraged researchers and funding agencies to embrace open science practices (Open Science Collaboration, 2015). These practices include a variety of procedures to enhance scientific openness, researcher accountability, and public access to study data and experimental protocols. We argue that applied behavior analysis (ABA) as a research discipline is not unique from other disciplines in its susceptibility to questionable research practices and related challenges with replication. Preregistration is a key open science practice that outlines research questions, procedures, and analysis techniques in a public repository before conducting a study (Nosek et al., 2018).

Preregistration is a relatively new practice for social and behavioral scientists, particularly applied behavior analysts, and is not without unique considerations and caveats for ABA researchers. In this paper, we explain how ABA researchers can benefit from incorporating preregistration practices into their experimental work, outline features of preregistration practices intrinsic to ABA research, describe specific steps for ABA researchers seeking to preregister their studies, and discuss strategies for enhancing contingencies for preregistration in our field. We begin with a discussion of the open science movement as a framework for embracing open science practices, including preregistration.

The Replication Crisis and Open Science

In 2015, the Open Science Collaboration reported the results of an effort by 270 researchers to replicate the findings of 100 studies published in three prominent psychology journals, *Psychological Science*, *Journal of Personality and Social Psychology*, and *Journal of*

Experimental Psychology: Learning, Memory, and Cognition. In aggregate, the replications produced only half the mean effect size of the original studies, and only 39% of replication study effects were rated as replicating the original study results. This seminal study cast widescale doubt on the reproducibility of findings in the scientific psychology literature. It was a catalyst for efforts among the scientific community, at large, to promote practices aimed at enhancing the reproducibility and, ultimately, the credibility of science (Nosek et al., 2022). Other high-profile replication failures (e.g., Doyen et al., 2012), coupled with significant allegations of data falsification and data fraud (e.g., Simonsohn et al., 2023), further highlighted the need for robust efforts to bolster scientific transparency in psychology. In clinically driven scientific fields, concerns with reproducibility are uniquely problematic because they call into question the effectiveness of treatments validated in the published literature (e.g., Zwanenburg, 2019). To address these concerns, open science is a movement toward greater transparency, accessibility, and openness in scientific research (Cook et al., 2018; Peters, 2014; Vicente-Saez & Martinez-Fuentes, 2018). Open science practices have become the norm in many scientific disciplines (e.g., Christensen et al., 2020), with endorsements by diverse organizations ranging from the United Nations (UNESCO, 2021) to the American Psychological Association (Bosnjak et al., 2022).

Nosek et al. (2015) created the Transparency and Openness Promotion Guidelines as a framework for shaping the behavior of researchers and journal editors in ways that foster openness and transparency in research. The standards and a brief description of each are provided in Table 1. Most standards, such as creating citations for open data and materials, focus on enhancing open access and supporting replicability. Other standards relate to transparency in conducting and reporting research. Practices such as preregistration of studies and study analysis

plans increase transparency and discourage researchers from engaging in questionable research practices (e.g., conducting their analyses in ways that tilt outcomes toward pre-existing biases). When viewed in concert, the guidelines in Table 1 support openness and transparency throughout the research-to-publication pipeline and highlight myriad practices that enhance the credibility and reproducibility of all research.

Why We Need Open Science Practices in ABA

Applied Behavior Analysis researchers rely primarily on single-case experimental designs (SCED) to conduct their scientific experiments. These designs typically employ visual analysis of graphically depicted data and inductive reasoning to derive functional relationships among experimental variables (Ledford & Gast, 2018). Historical concerns with data integrity associated with calls for open science practices (i.e., the replication "crisis") have been largely localized to researchers using group experimental designs and the null hypothesis statistic testing model, and as such, ABA researchers may feel a degree of immunity from scientific integrity concerns identified within the larger scientific community (Tincani & Travers, 2019). Methodological differences notwithstanding, we contend there are many reasons for SCED researchers working within an ABA framework to consider adopting open science practices. These reasons include (a) amplifying the ABA tradition of research transparency, (b) addressing contingencies for questionable research practices in ABA research, (c) ensuring transparency in statistical analyses of ABA data, (d) increasing exposure of ABA research, and (e) enhancing research collaborations.

Amplifying ABA Research Transparency

Research traditions in ABA reflect a long history of carefully designed studies with documented evidence of replicability. Interventions that are "completely identified and described" are a definitional characteristic of SCED studies within an ABA framework (Baer et al., 1968, p. 95). Published work in ABA is unique in that readers can turn to the pages of ABA journals that publish SCED research and find precisely described interventions that can be implemented across a myriad of clinical contexts (Cooper et al., 2020; Gilroy & Kaplan, 2019). Open science practices have the potential to amplify the ABA tradition of research transparency by adding an additional layer of visibility within which researchers can more thoroughly describe and disseminate the research process (e.g., minimizing risks of certain forms of bias via preregistered protocols). This increased degree of transparency, in turn, provides an opportunity to enhance mainstream confidence in ABA research findings. More directly, practices such as open sharing of research protocols increase opportunities for replication, which is a longstanding hallmark of behavior science (Sidman, 1960).

Addressing Contingencies for Questionable Research Practices in ABA Research

Motivated reasoning in mainstream psychology is said to occur when "extraneous concerns beyond accuracy" affect how scientists conduct and report their research, or evaluate and interpret others' research (Clark et al., 2022, p. 46). From a behavior analytic perspective, "extraneous concerns" are translatable to contingencies of reinforcement that affect researcher behavior, often with direct benefit to the scientist whose behavior is controlled by them (i.e., risks of bias). Consider a researcher who develops a clinical behavior intervention, which they evaluate in a series of studies conducted by their research team. If successful, the intervention may garner rewards for the scientist and their team in the form of publications, grant funding, invited presentations, consulting, commercialization opportunities, and the like. It may be

unsurprising, then, when the scientist is inclined to selectively report in journal article submissions more successful demonstrations of the strategy and to leave less successful, or less "clean" ones, in the file drawer (i.e., the "file drawer" effect; Rosenthal, 1979). The resulting published body of research will be skewed in favor of studies showing positive benefits of the strategy.

Shadish et al. (2016) surveyed 243 ABA researchers and found that 4% to 15% of respondents would omit data from a study submitted for publication if it reflected weak experimental control. These survey results suggest that treatment effects in the published ABA literature are likely to be positively skewed (see Dowdy et al., 2020, for an example of such in the ABA literature). Similarly, given the heavy reliance on graphical depictions of behavior in SCED, researchers may graphically combine dependent variables in ways that bolster the visual appearance of functional relations, graphically omit outlier data points or series of data that reflect visual instability, or depict data in formats (e.g., box plots) that emphasize central tendency and deemphasize variability to enhance the overall appearance of treatment effect (Tincani & Travers, 2022).

Ensuring Transparency of Quantitative Analyses

Various statistical tests and metrics are currently available to summarize SCED datasets (see Dowdy et al., 2021, for a review) and these are increasingly prevalent in the SCED research literature (Tanious & Onghena, 2021). The appropriateness of a particular metric for a given SCED dataset depends on a host of study-specific variables (e.g., design type, dependent variables; Manolov et al., 2022). Moreover, the SCED research community has not achieved consensus regarding which metrics are most appropriate (Kratochwill et al., 2023) and statistical training is not yet well reflected in most graduate training in behavior analysis (Young, 2018).

The complexity of statistical analysis and various choices available to SCED researchers introduce the possibility for ABA researchers to engage in practices like *p*-hacking, in which researchers select some statistical test *post hoc* based on it yielding a large effect size, or otherwise conduct their analyses in ways that create or enhance the appearance of some relationship (Tincani & Travers, 2022). Specifically, researchers might simultaneously calculate several different effect size metrics on a given dataset, but only report the one that yields the greatest effect size without disclosing results of their other analyses. Or, given graphed data that reflect weak experimental control via visual inspection, researchers might add an effect size metric to bolster the appearance of experimental effect. Similarly, preregistration addresses practices such as hypothesizing after the results are known (HARKing; Kerr,), or changing research questions *post hoc* to conform to obtained data. Preregistration has been highlighted as a means of safeguarding against risks of researcher bias by emphasizing the importance of presenting a plan for testing study questions a priori. Publicly archiving such decisions beforehand provides an opportunity to avoid making ad hoc decisions when data are available and when the pressure to report robust experimental effects is at its strongest (e.g., before submitting for peer review).

Increasing Exposure of ABA Research

Clear benefits are available for SCED researchers who engage in open science practices. Empirical research available for disciplines where open data sharing is emphasized reveals that archiving raw study data in public repositories yields a higher rate of citation in comparison to studies that do not engage in such practices (Christensen et al., 2019; Colavizza et al., 2020; Drachen et al., 2016). Furthermore, increased transparency via the archiving of study preprints has been linked to larger research impact and researcher visibility, particularly for early career

researchers (see Sarabipour et al., 2019). For example, research reports published as preprints may yield more citations that those not published as preprints. To the extent that impact and visibility are valued by those who evaluate early career researchers' work (e.g., tenure review committees), open science practices can yield direct and tangible benefits to these researchers.

Empirical research on the impact of open science practices is largely positive, yet still emerging (Field et al., 2020; Fleming et al., 2024; Sarafoglou et al., 2022; Toth et al., 2021). The available data do not indicate the specific mechanism of increased citation or exposure; however, it is possible that (a) the existence of open data increases exposure of the research (e.g., repositories for study data and study materials each produce respective citations), in that other researchers are more likely to encounter the publication associated with the data; and (b) availability of open data encourages others to analyze it, which, in turn, facilitates secondary research questions and studies related to the original research, and thus citations (Piwowar et al., 2007; Wheeler et al., 2022). Regardless of the specific mechanism, greater visibility for SCED research (i.e., beyond SCED- and ABA-specific journals) would be a net positive for the field of behavior analysis.

Enhancing Research Collaborations

Increased research exposure provides additional benefits to researchers. For example, the open sharing of study methods (e.g., data collection strategies), analytic tools (e.g., source code), and raw data increases opportunities for others to review such elements and pursue research collaborations, facilitating replication (see Wang et al., 2022, for a relevant example). Furthermore, such practices can improve the efficiency of scientific work by removing the unnecessary duplication of researcher efforts (Ross & Krumholz, 2013). For example, different

research teams may conduct different analyses for the same dataset, minimizing the need for each team to run studies and collect data separately.

The field of ABA could benefit tremendously from increasing the number of collaborations within and across relevant domains of research (e.g., education, healthcare; Zhang et al., 2024). Furthermore, increased levels of transparency and engagement with other research domains could be useful in addressing novel clinical problems or determining new clinical applications. Finally, given their wide adoption across a variety of scientific disciplines, open science practices enhance the overall credibility of the ABA research approach against ongoing and persistent criticisms of ABA based on longstanding misconceptions of the field (see Leaf et al., 2022, for a discussion). Overall, there is much to gain from adding to the existing ABA research tradition and expanding existing collaborations in behavior analysis.

Preregistering ABA Study Protocols

Preregistration entails outlining a research protocol and specifying study methods and plans for analysis, which are then archived publicly in a repository before conducting the study (see Cook et al., 2018, for a review specific to education). Others can evaluate whether the published work ultimately kept consistent with the original study goals and procedures in the registry. Records within registries typically specify the research questions or guiding hypotheses, number of participants targeted or recruited, specific variables and their definition and measurement, and how the presence or absence of an effect would be determined (see Banks et al., 2019, for a report on frequent questions regarding such practices). Preregistration is similar to, but different from registered reports, a related open science practice in which manuscripts containing only the study's literature review or rationale, guiding research questions or hypotheses, and procedures are reviewed by a journal prior to the study being conducted

(Chambers & Tzavella, 2022). If accepted, the manuscript submitted initially as a registered report will be published by the journal if the authors adhere to their stated procedures when they conduct the study.

"Preregistration: A Plan, not a Prison" and Addressing Other Concerns

Open science practices like preregistration are increasing across various social science disciplines; however, some disciplines are adopting the practices more quickly than others (Christensen et al., 2020). Thus, it is reasonable to conclude that concerns about preregistration, as outlined in the following section, are not unique to ABA researchers. For example, researchers new to preregistration may have reservations about how it will impact their existing workflows and research processes. This is particularly relevant for ABA research given that SCED designs are useful in developing effective clinical interventions, as well as in answering specific research questions. As such, the following subsections address how and when preregistration is most pragmatic and beneficial to ABA researchers.

Flexibility and constraints on researcher freedom

The mantra "Preregistration: A Plan, not a prison" illustrates that the role of preregistration is to enhance the transparency of the research protocol and not to lock the research team to a set of procedures that could later become redundant or contraindicated by current circumstances (DeHaven, 2017). Applied behavior analysis researchers may be concerned that preregistration binds them to a protocol or plan that may become irrelevant or incompatible with providing optimally effective interventions for study participants. The central point of preregistration is to promote transparency, and deviations from a study protocol are consistent with this goal so long as they are accompanied by documentation and rationale for the decision (e.g., to minimize harm in the interest of participant safety, to enhance the effectiveness

of clinical interventions). Currently available preregistration venues (discussed below) allow changes to a protocol at any point throughout the research process to accommodate the need for such flexibility, along with timestamps accompanying the revisions.

Specifically, SCED studies sometimes accompany unplanned modifications to procedures and data analysis plans during or after a study (Ledford & Gast, 2018). For example, certain participants may or may not be included in the results of a study based on factors such as attrition or unstable responding, or response definitions may need to be expanded or revised in cases where previously unobserved but experimentally relevant responses emerge (e.g., extinction-induced variability). Such deviations are more the norm than the exception in applied research and preregistration does not hinder the researcher from making these changes before or after a study. Most important is that the research team provides updates to the preregistration to inform others of procedural and analytic changes made after the study was initiated.

Distinguishing exploratory versus confirmatory research

Researchers may be concerned that preregistration will stifle their team's aim to discover, innovate, and generate serendipitous findings (Banks et al., 2019). This concern is especially salient to ABA researchers given the exploratory nature of many SCED studies and the central role of serendipitous findings in the founding of our field (Skinner, 1956). For instance, a research team conducting a series of SCED studies across a group of participants may notice a particular pattern of responding consistent among a subset of them, which highlights previously undiscovered environment-behavior relationships. If these data yield important implications for clinical practice, the team may wish to share them through peer-reviewed publications.

The flexibility of SCED designs and range of contexts in which they are applied prompts a discussion about which ABA studies benefit most greatly from open science practices such as

preregistration. Applied behavior analysis research ranges from clinical applications that are almost entirely exploratory (i.e., little is or can be known a priori) to highly planned research endeavors where questions are specific and highly contextualized (e.g., confirming the superiority of a proposed treatment extension; Johnson & Cook, 2019). The risk of researcher bias and need for preregistration may be lower when researchers evaluate a novel intervention for a novel clinical problem that arises within a researcher-practitioner context. In contrast, the risk of researcher bias and need for preregistration may be higher when researchers execute a carefully planned study to replicate the effects of an intervention in which they have invested time and resources, for which they have firm hypotheses about the likely outcome. As such, our purpose is not to argue that all SCED research must be preregistered, or that journals, scholarly organizations, or other entities in our field should uniformly require such practices. Rather, we argue the practice of preregistration adds constructively to the ABA research tradition, especially for confirmatory research studies.

Study Preregistration: An Overview

The process of preregistering and managing a study protocol is essentially an added layer of documentation that takes place within the context of accepted domain-specific research norms and practices. Figure 1 provides an illustration of this process. Specifically, the act of preregistering a study takes place after a study plan is developed (e.g., after institutional review board approval of methods) and the protocol is updated, as necessary, up until the point that the study is accepted for publication. Steps in the process are discussed in greater detail in the sections below.

The Plan Development stage is essentially independent of preregistration and is the process through which a research team develops study goals and research questions, identifies

relevant populations and characteristics of the sample needed (e.g., participant type and sample size), delineates the outcomes of interest (e.g., response definitions), and articulates the strategy proposed to answer research questions (e.g., type of research design, means of drawing inferences).

The Plan Registration stage consists of (a) determining the team member responsible for submitting or managing the protocol and (b) archiving the protocol in a suitable repository. Most repositories provide flexibility in updating the study protocol, inclusive of deviations from the proposed plan as well as updating the status of the protocol (e.g., if a manuscript of the study is under review, if accepted for publication, if published). This stage is quite brief and takes place immediately prior to implementing the protocol.

The Plan Execution stage reflects the process of conducting research and the Reporting Results stage reflects domain-specific norms for reporting research. Preregistered research differs from non-preregistered research in that the work submitted for review lists the protocol identification and if or when deviations from the original protocol took place. As detailed in Figure 1, any deviations from the plan are documented as time-stamped updates to the protocol. Finally, following plan execution, the process finishes with sharing findings and referencing the protocol (i.e., Reporting Results). The research team should check the registry prior to submitting the manuscript for publication to verify that it reflects all methods and analysis plans executed during the study. The submitted manuscript should state the study was preregistered. If the venue uses a blinded editorial process, authors should remove potentially identifying information from the preregistration (e.g., authorship).

Selection Of Appropriate Study Registry

Increased adoption of and demand for open science support over the past decade has prompted a rise in the number and range of suitable repositories (Fleming et al., 2023). Table 2 includes several repositories. Many of the earliest repositories used to preregister protocols were crafted to accommodate the large-N group research designs often associated with high-impact and high-visibility research (e.g., randomized controlled trials). Early resources included the well-known ClinicalTrials platform hosted by the National Institutes of Health (NIH), and the International Clinical Trials Registry Platform (ICTRP) hosted by the World Health Organization. Grant-funded research by the NIH requires preregistration as a condition for research support.

More recently developed repositories provide a greater degree of flexibility to researchers, particularly regarding methodological details. Newer archiving platforms include the Open Science Framework (OSF) and the AsPredicted platforms, which each provide a flexible interface that is largely agnostic to research design or analytic approach. For ABA researchers specifically, the Registry of Efficacy and Effectiveness Studies (REES) repository provides a template with fields that are specific to the design and execution of SCEDs (e.g., information per phase, criteria for phase changes, varying conditions across phases). Given the focus on ABA researchers and the dedicated support for SCEDs provided via the REES template, the following section outlines the steps necessary to preregister a SCED protocol with this REES registry.

Preregistration Using the REES Registry

The REES was developed by the Society for Research on Educational Effectiveness with the support of the Institute of Education Sciences. Studies that can be registered on REES include randomized control trial group designs, regression discontinuity designs, quasi-

experimental designs, and SCEDs. Although REES was designed to specifically accommodate impact studies in education and related fields, to our knowledge, it is the only registry that presently provides a preregistration template for SCED research. The REES platform provides an interactive website that allows SCED researchers to submit an initial registration and update their protocol as the study progresses and concludes. All updates or changes to the protocol are timestamped with the opportunity for researchers to provide a rationale for each change.

The first step to using the REES platform for study preregistration is to create a researcher profile. Notably, any team member of the research project can be designated as a study administrator and can make changes to the project at any time. Registry entries can be started and stopped at any time and a portable document format file can be saved, downloaded, and printed. Other designated roles include participation as a project collaborator. A designated project collaborator can view the entry but cannot make changes to the protocol directly. After creating a profile in REES, a registry can be submitted in Version 1.0. The sections of the registration include General Study Information, Description of Study, Research Questions, Study Design, Sample Characteristics, Outcomes (Selection), Outcomes (Input), Analysis Plan, and Additional Materials. Users can review example SCED preregistrations by visiting the REES website (https://sreereg.icpsr.umich.edu/sreereg/search/search), clicking the Design Category menu on the left, and checking the Single Case Design category. Considerations regarding the preregistration of SCED features are discussed in the following sections.

Design Considerations Unique to SCED Preregistration

Preregistration entails archiving study details common to most research methods; however, SCEDs present unique considerations that must be documented in the preregistration protocol (Johnson & Cook, 2019). Transparency and completeness in reporting are necessary to

ensure that each of the procedural and analytic details are adequately outlined in the registration and to prevent questionable research practices that are more exclusive to the SCED approach (Tincani & Travers, 2022).

Specification of baseline conditions

Most experimental studies include intervention and comparison conditions that can be outlined in the study registration. Single-case experimental design studies are unique in that control conditions are not simply business-as-usual comparisons lacking the intervention, but carefully controlled baseline conditions involving repeated measures of behavior to establish steady states of responding before intervention (Ledford & Gast, 2018; Sidman, 1960). Therefore, along with providing details of intervention conditions, study preregistrations should delineate key aspects of baseline conditions, detailing all relevant details of the baseline procedures before introducing the independent variables(s), along with any planned measures of baseline procedural fidelity per those procedures (Ledford & Gast, 2014).

Specification of data analyses

Single-case experimental design studies typically entail visual analyses of data to determine functional relationships between independent and dependent variables. Visual analysis is the staple of our field; however, in describing SCED analysis plans in the preregistration, it is insufficient to simply state that visual analyses will be used without specifying the dimensions of analyses on which experimental decisions will be made. For example, in the absence of clearly defined parameters, researchers could shift their criteria for baseline stability post hoc based on participant responding. Instead, research teams should delineate details of their visual analytic approach to convey how conclusions about experimental control will be determined, and how experimental decisions will be made. There is variation in visual analysis techniques used to

analyze SCED data; however, these details could include (a) criteria for baseline stability, (b) within-condition analyses to evaluate for level, trend and variability of data, (c) adjacent condition analyses to evaluate whether the application of a different condition coincided with changes in data patterns, (d) immediacy of change, and (e) degree of overlap between conditions (Barton et al., 2018). If data will be depicted in multiple visual formats, researchers should clearly outline which dependent measures will be depicted in line graphs, which will be depicted in other formats (e.g., histograms), and the rationale behind these decisions. If multiple dependent variables are measured, the primary dependent variable on which experimental decisions will be made should be identified.

Similarly, if quantitative or statistical techniques are employed in data analyses, these should be described in the registration. These descriptions should entail which analyses will be used and why, specifying as necessary how data collected in the study should meet known assumptions of each analysis technique (Manolov et al., 2021). If the data collected will not conform to the analytic assumptions of the selected techniques, then the plan should provide for the application of alternative techniques under these conditions.

Plans for excluding data

Selective reporting of data can have a substantial impact on the appearance of functional relationships. It is, therefore, incumbent on researchers to clearly outline their decision rules for including or excluding data during an experiment. Specifically, if data collected during a study could be excluded from reporting for any reason, these reasons should be specified in the registration. We propose that reasonable scenarios for excluding data include (a) attrition of study participants during baseline or following an insufficient period of exposure to an intervention that precludes the emergence of an experimental effect; (b) extraneous events that

occur during study sessions that impose unwanted variability on dependent measures (i.e., confounds); or (c) substantial variability of behavior between sessions that suggests the influence of extrinsic variables, known or unknown. Importantly, the research community may or may not have attained consensus on the conditions under which data should or should not be excluded within a particular research scenario. Most critical is that researchers disclose their decision rules publicly in the preregistration and published manuscript so that readers can make informed judgments as to whether their data inclusion and exclusion criteria are sound.

Checklist for Preregistering an SCED Study Protocol

Given features intrinsic to all study protocols in the social and behavioral sciences, coupled with unique components particular to SCED studies, Table 3 provides a checklist for research teams to follow when preregistering their SCED studies. The checklist is divided into seven main areas of study proposals: (a) research goals and questions, (b) recruitment and characterization of participants, (c) research design, (d) dependent measures, (e) experimental conditions, (f) social validity, and (g) analytic strategy. In sections that follow, we detail the information for the items on the checklist corresponding to these areas.

Research Goals and Questions

In this section, researchers overview the research questions and hypotheses guiding the investigation. Stating these components in the preregistration conveys the a priori goals guiding the study, the population targeted, and the basic features of the investigation (e.g., independent and dependent variables). If the dependent variables involve one or more response classes of behavior (e.g., manding), then all members of the class (e.g., speaking, using an augmentative device) should be listed.

Recruitment And Characterization of Participants

Within the *Recruitment and Characterization of Participants* section, researchers must delineate their strategies for recruiting participants, including procedures for determining their eligibility or appropriateness for participation or intervention, along with plans for reporting attrition. Procedures for obtaining assent and consent from participants or others authorized to provide consent (e.g., parents), along with strategies for attaining participant assent, should be outlined. Any standardized testing or evaluation tools to confirm eligibility for participation, or to determine target behaviors or specific facets of an intervention (e.g., dosage), are also listed here. Importantly, a plan should be described for reporting if participants withdraw or drop from the study for any reason.

Research Design

The *Research Design* section allows researchers to detail the SCED design(s) used in their study (e.g., reversal, multiple baseline, alternating treatments), briefly overview the procedures applied in baseline and intervention conditions, describe the temporal dimensions of the study's conditions, state any risks of harm or criteria for termination or participant's withdrawal from the study, and include plans for reporting modifications to the research design. The temporal dimensions of baseline and intervention conditions should include details such as the duration of sessions, number of sessions per day/week, any anticipated gaps in sessions, and the anticipated duration of the study. This is critical information because graphs alone may not convey all key details about the temporal dimensions of a study, such as the amount of time elapsing between study sessions. Risks of harm would include any possible detrimental effects that would result in termination of the study for participants, along with other criteria for removing them from the study, such as patterns of responding within a particular condition.

Dependent Measures

In the *Dependent Measures* section, researchers outline the dependent measures used in the study, details of instruments or methods used to measure participant performances, steps taken to minimize the risk of bias from experimenters in dependent variable measurement, strategies for exploratory data analyses, and any criteria for excluding experimental data. Researchers should provide operational definitions of each dependent variable (e.g., academic engagement) along with a description of each measurement system (e.g., duration recording). The names and, if appropriate, psychometric properties of any standardized tools should be listed, along with the timing of their administration during the study. Steps taken to minimize risk of bias in measurement, such as blinding observers or interventionists, or randomizing the order in which data are collected from video recorded sessions, should also be described. Critically, any criteria for excluding data from a study, such as patterns of responding within conditions or insufficient exposure to intervention conditions, should be indicated. If journal editors, associate editors, or reviewers request that data be removed from the manuscript during the peer-review process, this information can be updated in the study registration.

Experimental Conditions

The Experimental Conditions section enables researchers to include more detailed information about baseline and intervention conditions. For example, if baselines involve "business as usual," the preregistration should detail what, exactly, occurs during these conditions. Specifically, details such as how participants will interact with teachers and interventionists or other students, any kinds of activities or other instructions presented, and any relevant aspects of the physical setting, should be described. Importantly, any aspects of baseline conditions that will be modified with the application of intervention(s) should be included. The

procedures for each experimental condition should be outlined with similar detail. Finally, strategies for documenting procedural fidelity of baseline and experimental conditions should be explained.

Social Validity

Within the *Social Validity* section, researchers describe procedures for socially validating independent and dependent variables of the study, as appropriate. For example, data collection to establish consumer preferences regarding aspects of the intervention (e.g., selection of treatment components, dosage) or intervention goals (e.g., topographies of target behaviors, levels of responding) should be detailed. In addition, procedures for documenting social validity of study outcomes must be described. Psychometric properties of any social validity assessments should be included, along with procedures for minimizing response bias and demand characteristics of assessments (e.g., anonymous survey completion, blinded data collection of continued intervention usage).

Analytical Strategy

As part of the *Analytical Strategy* section researchers must provide their plans for analysis of the study's data. Researchers should describe specific strategies for visual analysis of data, including usage of standardized approaches (e.g., Barton et al., 2018), structured visual analysis techniques, or both (e.g., Wolfe et al., 2019). If quantitative analytic plans are employed, including standardized effect size estimates, these should be detailed, including any data assumptions that must be met, and any alternative techniques that may be used based on conformity to analytic requirements.

Enhancing Contingencies For Preregistration

The preregistration checklist steps we describe involve outlining research procedures and analysis plans that should be established prior to conducting a study. Thus, beyond the steps of preregistering and updating the research plan we outline, the process should involve minimal response effort on the part of research teams. However, preregistration is a new practice for most ABA researchers and currently is not widely embraced by the ABA research community. Given the availability of multiple study registries at no cost to researchers, including one specific to SCED, we must conclude that lack of preregistering is likely a function of researchers (a) not being aware of the importance of preregistration; (b) having misconceptions or disagreements with preregistration and its potential benefits and drawbacks; (c) not understanding how to engage in the preregistration process; (d) weak contingencies of reinforcement supporting preregistration practices, or any combination of the above.

Our aim in writing this paper was to address the informational barriers to preregistration outlined in reasons a–c; however, reason d, weak contingencies of reinforcement supporting preregistration, is worth additional consideration with respect to the editorial process. When a study is preregistered and the authors disclose their preregistration in a manuscript submitted for publication, journal editors who process the manuscript can review the study registration, compare it to the submitted manuscript, and weigh it in their decision making process accordingly. The editors' ability to review the preregistration will be constrained by a number of factors, including the extensiveness of the submitted manuscript, study, and registered protocol; a thorough review of the registration may not be feasible in all cases. Similarly, journal reviewers will not be able to review preregistrations whose authorship is redacted in the

manuscript because of blind review; however, they will at least know the manuscript was preregistered and can factor this into their editorial decision-making.

Advocates have lobbied for journals to establish policies that support open science practices, including preregistration (Nosek & Lindsay, 2018). These policies range from journal editors encouraging preregistration in their editorial policies, providing links to authors for suitable registries to journals requiring authors to preregister studies submitted for publication, and recognizing authors for meeting specific preregistration requirements (Nosek et al., 2015). Major academic publishers, including Wiley, Inc., which publishes the *Journal of Applied Behavior Analysis*, encourage open science practices such as open data sharing (Wiley Author Services, n.d.). Collectively, we encourage editors of journals publishing ABA research to consider adopting similar strategies to enhance contingencies for preregistering, along with other open science practices. Similarly, faculty in graduate degree programs can model and reinforce preregistration with their students, including using preregistration templates as a guide in formulating student research proposals.

Caveats

We have argued for the benefits of preregistration and hope that ABA researchers and the ABA research community will consider embracing preregistration as part of their SCED research practices. We have outlined unique considerations for preregistering ABA studies; however, we must also acknowledge caveats within the process. Preregistration is intended to enhance the ABA tradition of research transparency and prevent some of the most salient, if infrequent, questionable research practices. However, preregistration is not a panacea, nor is it intended to prevent all questionable research practices from occurring in SCED. For example, researchers may deviate from prespecified procedural and analysis plans, vaguely specify components of a

study protocol, or omit critical details from the preregistration that render detection of questionable research practices impossible.

The matching law tells us that relative response allocation in a choice situation varies according to the relative rates of reinforcement (Herrnstein, 1970; McDowell, 2013; Podlesnik et al., 2021). Consequently, as preregistration reduces questionable research practices in certain situations where reinforcement for them becomes less available, it may increase them in other situations where reinforcement remains available. Therefore, we strongly encourage researchers to employ preregistration in concert with other open science practices aimed at enhancing transparency and preventing questionable research practices, such as providing citations to raw data they have made accessible in public repositories (Nosek et al., 2015). Moreover, we encourage future research to evaluate the purported benefits of preregistration of SCED research, specifically. These could include studies that examine whether preregistered SCED studies are more frequently read or cited by other researchers, or whether preregistered studies exhibit more quality indicators relative to non-preregistered studies (e.g., van den Akker et al., 2023).

Finally, open sciences practices, including preregistration and open data sharing, may increase the probability that different research teams will generate conflicting findings. For example, a research team attempting to replicate a registered protocol may produce different results than the original investigators, or two different research teams may analyze the same dataset but arrive at different conclusions from the data. The possibility of other research teams reporting conflicting findings may concern researchers who are considering whether to engage in open science practices. Importantly, conflicting findings can result from any systematic replication attempt, whether related to open science practices or not (Sidman, 1960). Moreover, the critical appraisal and replacement of current findings with new ones is an intrinsic feature of

science necessary for advancements in scientific knowledge (Popper, 2005). Investigators who report conflicting findings facilitated by open science practices should be held to the same standards of transparency and rigor as the original investigators.

Conclusion

Preregistration is a widely adopted open science practice that is new to ABA researchers working within the SCED framework. We hope the rationale and benefits of preregistration described in this paper, coupled with our overview of the process and unique considerations for SCED methods, will encourage ABA researchers to preregister their studies. Although preregistration is not without response cost to researchers and research teams, we argue the potential benefits of preregistration outweigh the costs. Potential benefits include methodologically rigorous studies, greater exposure for reregistered research, and credibility conferred to the ABA research enterprise, generally. We hope that journal editors, and other leaders within the field of ABA, will consider adopting policies and practices that enhance contingencies for preregistration, along with other open science practices.

CONFLICT OF INTEREST

We have no known conflict of interest to disclose.

ORCID

Art Dowdy https://orcid.org/0000-0001-6466-6774

Shawn P. Gilroy https://orcid.org/0000-0002-1097-8366

Matt Tincani https://orcid.org/0000-0003-4829-6907

REFERENCES

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis*, *1*(1), 91–97. https://doi.org/10.1901/jaba.1968.1-91

Banks, G. C., Field, J. G., Oswald, F. L., O'Boyle, E. H., Landis, R. S., Rupp, D. E., & Rogelberg, S. G. (2019). Answers to 18 questions about open science practices. *Journal of Business and Psychology*, *34*(3), 257–270. https://doi.org/10.1007/s10869-018-9547-8

Barton, E. E., Lloyd, B. P., Spriggs, A. D., & Gast, D. L. (2018). Visual analysis of graphic data. In J. L. Ledford & D. L. Gast (Eds.), *Single Case Research Methodology* (3rd ed., pp. 179–214). Routledge.

Bosnjak, M., Fiebach, C. J., Mellor, D., Mueller, S., O'Connor, D. B., Oswald, F. L., & Sokol, R. I. (2022). A template for preregistration of quantitative research in psychology: Report of the joint psychological societies preregistration task force. *American Psychologist*, *77*(4), 602–615. https://doi.org/10.1037/amp0000879

Chambers, C. D., & Tzavella, L. (2022). The past, present and future of Registered Reports. *Nature Human Behaviour*, *6*(1), 29–42. https://doi.org/10.1038/s41562-021-01193-7

Christensen, G., Dafoe, A., Miguel, E., Moore, D. A., & Rose, A. K. (2019). A study of the impact of data sharing on article citations using journal policies as a natural experiment. *PLOS ONE*, *14*(12), Article e0225883. https://doi.org/10.1371/journal.pone.0225883

Christensen, G., Wang, Z., Levy Paluck, E., Swanson, N., Birke, D., Miguel, E., & Littman, R. (2020). *Open science practices are on the rise: The state of social science (3S) survey*. Center for Effective Global Action. https://escholarship.org/content/qt0hx0207r/qt0hx0207r.pdf

Clark, C. J., Honeycutt, N., & Jussim, L. (2022). Replicability and the psychology of science. In W. O'Donohue, A. Masuda, & S. Lilienfeld (Eds.). *Avoiding questionable research practices in applied psychology* (pp. 45–71). Springer Nature. https://doi.org/10.1007/978-3-031-04968-2_3

Colavizza, G., Hrynaszkiewicz, I., Staden, I., Whitaker, K., & McGillivray, B. (2020). The citation advantage of linking publications to research data. *PLOS ONE*, *15*(4), Article e0230416. https://doi.org/10.1371/journal.pone.0230416

Cooper, J. O., Heron, T. E., & Heward, W. L. (2020). *Applied behavior analysis* (3rd ed.). Pearson.

Cook, B. G., Lloyd, J. W., Mellor, D., Nosek, B. A., & Therrien, W. J. (2018). Promoting open science to increase the trustworthiness of evidence in special education. *Exceptional Children*, *85*(1), 104–118. https://doi.org/10.1177/0014402918793138

DeHaven, A. (2017, May 23). *Preregistration: A plan, not a prison*. Center for Open Science. https://www.cos.io/blog/preregistration-plan-not-prison

Dowdy, A., Peltier, C., Tincani, M., Schneider, W. J., Hantula, D. A., & Travers, J. C. (2021). Meta-analyses and effect sizes in applied behavior analysis: A review and discussion. *Journal of Applied Behavior Analysis*, *54*(4), 1317–1340. https://doi.org/10.1002/jaba.862

Dowdy, A., Tincani, M., & Schneider, W. J. (2020). Evaluation of publication bias in response interruption and redirection: A meta-analysis. *Journal of Applied Behavior Analysis*, *53*(4), 2151–2171. https://doi.org/10.1002/jaba.724

Doyen, S., Klein, O., Pichon, C.-L., & Cleeremans, A. (2012). Behavioral priming: It's all in the mind, but whose mind? *PLOS ONE*, *7*(1), Article e29081. https://doi.org/10.1371/journal.pone.0029081

Drachen, T. M., Ellegaard, O., Larsen, A. V., & Dorch, S. B. F. (2016). Sharing data increases citations. *LIBER Quarterly: The Journal of the Association of European Research Libraries*, *26*(2), Article 2. https://doi.org/10.18352/lq.10149

Field, S. M., Wagenmakers, E.-J., Kiers, H. A. L., Hoekstra, R., Ernst, A. F., & Van Ravenzwaaij, D. (2020). The effect of preregistration on trust in empirical research findings: Results of a registered report. *Royal Society Open Science*, *7*(4), Article 181351. https://doi.org/10.1098/rsos.181351

Fleming, J. I., McLucas, A. S., & Cook, B. G. (2023). Review of four preregistration registries for special education researchers. *Remedial and Special Education*, *44*(6), 495–505. https://doi.org/10.1177/07419325231160293

Fleming, J. I., Wilson, S. E., Espinas, D., Van Dijk, W., & Cook, B. G. (2024). Special education researchers' knowledge, attitudes, and reported use of open science practices. *Remedial and Special Education*, 1-12. https://doi.org/10.1177/07419325241237268

Gilroy, S. P., & Kaplan, B. A. (2019). Furthering open science in behavior analysis: An introduction and tutorial for using GitHub in research. *Perspectives on Behavior Science*, *42*(3), 565–581. https://doi.org/10.1007/s40614-019-00202-5

Herrnstein, R. J. (1970). On the law of effect. *Journal of the Experimental Analysis of Behavior*, *13*(2), 243–266. https://doi.org/10.1901/jeab.1970.13-243

Johnson, A. H., & Cook, B. G. (2019). Preregistration in single-case design research. *Exceptional Children*, *86*(1), 95–112. https://doi.org/10.1177/0014402919868529

Kerr, N. L. (1988). HARKing: Hypothesizing after the results are known. *Personality and Social Psychology Review*, *2*(3), 196–217. https://doi.org/10.1207/s15327957pspr0203_4

Kratochwill, T. R., Horner, R. H., Levin, J. R., Machalicek, W., Ferron, J., & Johnson, A. (2023). Single-case intervention research design standards: Additional proposed upgrades and future directions. *Journal of School Psychology*, *97*, 192–216. https://doi.org/10.1016/j.jsp.2022.12.002

Leaf, J. B., Cihon, J. H., Leaf, R., McEachin, J., Liu, N., Russell, N., Unumb, L., Shapiro, S., & Khosrowshahi, D. (2022). Concerns about ABA-based intervention: An evaluation and recommendations. *Journal of Autism and Developmental Disorders*, *52*(6), 2838–2853. https://doi.org/10.1007/s10803-021-05137-y

Ledford, J. R., & Gast, D. L. (2014). Measuring procedural fidelity in behavioural research. *Neuropsychological Rehabilitation*, *24*(3–4), 332–348. https://doi.org/10.1080/09602011.2013.861352

Ledford, J. R., & Gast, D. L. (Eds.). (2018). *Single Case Research Methodology* (3rd edition). Routledge.

Manolov, R., Moeyaert, M., & Fingerhut, J. E. (2022). A priori justification for effect measures in single-case experimental designs. *Perspectives on Behavior Science*, *45*(1), 153–186. https://doi.org/10.1007/s40614-021-00282-2

McDowell, J. J (2013). On the theoretical and empirical status of the matching law and matching theory. *Psychological Bulletin*, *139*(5), 1000–1028. https://doi.org/10.1037/a0029924

Nosek, B. A., Alter, G., Banks, G. C., Borsboom, D., Bowman, S. D., Breckler, S. J., Buck, S., Chambers, C. D., Chin, G., Christensen, G., Contestabile, M., Dafoe, A., Eich, E., Freese, J., Glennerster, R., Goroff, D., Green, D. P., Hesse, B., Humphreys, M., … Yarkoni, T. (2015). Promoting an open research culture: Author guidelines for journals could help to promote transparency, openness, and reproducibility. *Science*, *348*(6242), 1422–1425. https://doi.org/10.1126/science.aab2374

Nosek, B. A., Ebersole, C. R., DeHaven, A. C., & Mellor, D. T. (2018). The preregistration revolution. *Proceedings of the National Academy of Sciences*, *115*(11), 2600–2606. https://doi.org/10.1073/pnas.1708274114

Nosek, B. A., Hardwicke, T. E., Moshontz, H., Allard, A., Corker, K. S., Dreber, A., Fidler, F., Hilgard, J., Kline Struhl, M., Nuijten, M. B., Rohrer, J. M., Romero, F., Scheel, A. M., Scherer, L. D., Schönbrodt, F. D., & Vazire, S. (2022). Replicability, robustness, and reproducibility in psychological science. *Annual Review of Psychology*, *73*, 719–748. https://doi.org/10.1146/annurev-psych-020821-114157

Nosek, B. A., & Lindsay, D. S. (2018). Preregistration becoming the norm in psychological science. *APS Observer*, *31*. https://www.psychologicalscience.org/observer/preregistration-becoming-the-norm-in-psychological-science

Open Science Collaboration. (2015). Estimating the reproducibility of psychological science. *Science*, *349*(6251), Article aac4716. https://doi.org/10.1126/science.aac4716

Peters, M. A. (2014). Open science, philosophy and peer review. *Educational Philosophy and Theory*, *46*(3), 215–219. https://doi.org/10.1080/00131857.2013.781296

Piwowar, H. A., Day, R. S., & Fridsma, D. B. (2007). Sharing detailed research data is associated with increased citation rate. *PLOS ONE*, *2*(3), Article e308. https://doi.org/10.1371/journal.pone.0000308

Podlesnik, C., Jimenez-Gomez, C., & Kelley, M. (2021). Matching and behavioral momentum: Quantifying choice and persistence. In W. W. Fisher, C. C. Piazza, & H. S. Roane (Eds.), *Handbook of applied behavior analysis* (2nd ed., pp. 94–114). Guilford.

Popper, K. (2005). *The logic of scientific discovery*. Routledge.

Rosenthal, R. (1979). The file drawer problem and tolerance for null results. *Psychological Bulletin*, *86*(3), 638–641. https://doi.org/10.1037/0033-2909.86.3.638

Ross, J. S., & Krumholz, H. M. (2013). Ushering in a new era of open science through data sharing: The wall must come down. *JAMA*, *309*(13), 1355–1356. https://doi.org/10.1001/jama.2013.1299

Sarabipour, S., Debat, H. J., Emmott, E., Burgess, S. J., Schwessinger, B., & Hensel, Z. (2019). On the value of preprints: An early career researcher perspective. *PLoS Biology*, *17*(2), Article e3000151. https://doi.org/10.1371/journal.pbio.3000151

Sarafoglou, A., Kovacs, M., Bakos, B., Wagenmakers, E.-J., & Aczel, B. (2022). A survey on how preregistration affects the research workflow: Better science but more work. *Royal Society Open Science*, *9*(7), Article 211997. https://doi.org/10.1098/rsos.211997

Shadish, W. R., Zelinsky, N. A. M., Vevea, J. L., & Kratochwill, T. R. (2016). A survey of publication practices of single-case design researchers when treatments have small or large effects. *Journal of Applied Behavior Analysis*, *49*(3), 656–673. https://doi.org/10.1002/jaba.308

Sidman, M. (1960). *Tactics of scientific research*. Basic Books, Incorporated.

Simonsohn, U., Simmons, J., & Nelson, L. (2023, June 17). *Data Falsificada (Part 1): "Clusterfake."* Data Colada. https://datacolada.org/109

Skinner, B. F. (1956). A case history in scientific method. *American Psychologist*, *11*(5), 221–233. https://doi.org/10.1037/h0047662

Tanious, R., & Onghena, P. (2021). A systematic review of applied single-case research published between 2016 and 2018: Study designs, randomization, data aspects, and data analysis. *Behavior Research Methods*, *53*(4), 1371–1384. https://doi.org/10.3758/s13428-020-01502-4

Tincani, M., & Travers, J. (2019). Replication research, publication bias, and applied behavior analysis. *Perspectives on Behavior Science*, *42*(1), 59–75. https://doi.org/10.1007/s40614-019-00191-5

Tincani, M., & Travers, J. (2022). Questionable research practices in single-case experimental designs: Examples and possible solutions. In W. O'Donohue, A. Masuda, & S. Lilienfeld (Eds.), *Avoiding questionable research practices in applied psychology* (pp. 269–285). Springer Nature. https://doi.org/10.1007/978-3-031-04968-2_12

Toth, A. A., Banks, G. C., Mellor, D., O'Boyle, E. H., Dickson, A., Davis, D. J., DeHaven, A., Bochantin, J., & Borns, J. (2021). Study preregistration: An evaluation of a method for transparent reporting. *Journal of Business and Psychology*, *36*(4), 553–571. https://doi.org/10.1007/s10869-020-09695-3

UNESCO (2021). UNESCO Recommendation on Open Science. https://doi.org/10.54677/MNMH8546

van den Akker, O. R., van Assen, M. A., Bakker, M., Elsherif, M., Wong, T. K., & Wicherts, J. M. (2023). Preregistration in practice: A comparison of preregistered and non-preregistered studies in psychology. *Behavior Research Methods*, 1-10. https://doi.org/10.3758/s13428-023-02277-0

Vicente-Saez, R., & Martinez-Fuentes, C. (2018). Open Science now: A systematic literature review for an integrated definition. *Journal of Business Research*, *88*, 428–436. https://doi.org/10.1016/j.jbusres.2017.12.043

Wang, H., Gainey, M., Campbell, P., Young, S., & Behrman, K. (2022). Implementation and assessment of an end-to-end Open Science & Data Collaborations program. *F1000Research*, *11*, Article 501. https://doi.org/10.12688/f1000research.110355.2

Wheeler, J., Pham, N.-M., Arlitsch, K., & Shanks, J. D. (2022). Impact factions: Assessing the citation impact of different types of open access repositories. *Scientometrics*, *127*(8), 4977–5003. https://doi.org/10.1007/s11192-022-04467-7

Wiley Author Services. (n.d.). Open Data. Wiley Publishing. Retrieved March 25, 2024, from https://authorservices.wiley.com/open-research/open-data/index.html

Wolfe, K., Barton, E. E., & Meadan, H. (2019). Systematic protocols for the visual analysis of single-case research data. *Behavior Analysis in Practice*, *12*(2), 491–502. https://doi.org/10.1007/s40617-019-00336-7

Young, M. E. (2018). A place for statistics in behavior analysis. *Behavior Analysis: Research and Practice*, *18*(2), 193–202. https://doi.org/10.1037/bar0000099

Zhang, Y., Wang, Y., Du, H., & Havlin, S. (2024). Delayed citation impact of interdisciplinary research. *Journal of Informetrics*, *18*(1), Article 101468. https://doi.org/10.1016/j.joi.2023.101468

Zwanenburg, A. (2019). Radiomics in nuclear medicine: Robustness, reproducibility, standardization, and how to avoid data analysis traps and replication crisis. *European Journal of Nuclear Medicine and Molecular Imaging*, *46*(13), 2638–2655. https://doi.org/10.1007/s00259-019-04391-8

TABLE 1 Transparency and openness promotion guidelines and descriptions

Guideline	Description
Citation	Support for citing open data sets, materials, syntax as distinct units thereby reinforcing open practices.
Replication	Publishing of replication studies as a means of reinforcing the practice of study replication.
Data Sharing	Providing source data for later research synthesis or analytical replication.
Analytical Methods	Support for replicating and/or extending the analyses conducted for a published study.
Materials Archiving	Specific materials (e.g., study questions, framing) are archived to support replication in the future.
Designs	Expectations regarding a standard for sufficiently robust/rigorous methodological designs.
Preregistration (Studies)	Study questions and methods are pre-specified to communicate a priori study plans (e.g., sample size).
Preregistration (Analysis)	Analytical strategies are outlined at the outset to distinguish between primary and exploratory research.

TABLE 2 Repository options for single case researchers

Name	Location	Support for Single Case Design?
Registry of Efficacy and Effectiveness Studies (REES)	https://sreereg.icpsr.umich.edu/sreereg/	Yes
Open Science Framework (OSF)	https://osf.io/	No
AsPredicted	https://aspredicted.org/	No
ClinicalTrials.gov	https://clinicaltrials.gov/	No
WHO Registry Network	https://www.who.int/clinical-trials-registry-platform/network	No

Note: WHO = World Health Organization.

TABLE 3 Checklist for preregistering an SCED study protocol

Area		Yes	N/A
1. Research Goals and Questions	a. State primary and secondary (if applicable) research questions and/or hypotheses.	___	___
	b. Operationalize the independent and dependent variable(s).	___	___
	c. Describe the target population.	___	___
	d. State plans for reporting modifications to research questions/hypotheses.	___	___
2. Recruitment and Characterization of Participants	a. Indicate number of participants.	___	___
	b. Describe methods for recruitment and informed consent/assent.	___	___
	c. State procedures for characterizing populations (e.g., testing for specific skill needs, diagnostic evaluations).	___	___
	d. Provide plan for reporting attrition.	___	___
3. Research Design	a. State single case design(s) used in investigation.	___	___
	b. Briefly state baseline and intervention conditions.	___	___
	c. Describe temporal dimensions of baseline and intervention conditions.	___	___
	d. Document any risks of harm, and criteria for participants' termination/withdrawal from the study.	___	___
	e. State plan for reporting modifications to research design.	___	___
4. Dependent measures	a. Provide operationalization and measurement system for each dependent variable.	___	___

		b. If using established tools, list them and their psychometric properties, if any, including the timing and sequence of administration.	___	___
		c. Describe steps taken to address risks of bias.	___	___
		d. Describe any exploratory data analyses.	___	___
		e. Report criteria for excluding experimental data.	___	___
5.	Experimental Conditions	a. Describe procedures for baseline condition(s).	___	___
		b. Describe procedures for experimental condition(s).	___	___
		c. Report procedural (i.e., baseline and intervention) fidelity measures.	___	___
6.	Social Validity	a. State any procedures for socially validating independent and dependent variables.	___	___
7.	Analytical Strategy	a. Describe how functional relations will be determined through visual analysis.	___	___
		b. Report any quantitative analysis plans, including how data assumptions will be evaluated, and possible alternative strategies.	___	___

FIGURE 1 Workflow for preregistering study and updating study protocol. DV = dependent variable; IV = independent variable; ID = identification.