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SI: ADVANCED QUANTITATIVE TECHNIQUES FOR SINGLE CASE EXPERIMENTAL DESIGN

Introduction to the Special Section: Translating Advanced Quantitative Techniques for Single-Case Experimental Design Data

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Abstract

The articles in this special section offer strategies to single-case experimental design (SCED) researchers to interpret their outcomes, communicate their results, and compare the results using common, quantitative results. Advancing quantitative methods applied to SCED data will facilitate communication with scientists and other professionals that do not typically interpret graphed data of the dependent variable. Horner and Ferron aptly note that innovative statistical procedures are improving the precision and credibility of SCED research as disseminate our findings to an increasingly diverse audience. This special section promotes the translation of these quantitative methods to encourage their adoption in research using single case experimental designs.

Keywords single case designs · experimental · effect size · quantitative

There has been increased interest in extending advanced quantitative techniques to support visual inspection of graphically depicted data within single-case experimental designs (SCEDs). Recent advances in quantitative methods have expanded the options available for aggregating data from SCEDs as emphasis shifts from demonstrating strong internal to external validity of treatment outcomes. The extensions to quantitative techniques have included but are not limited to randomization techniques (Onghena et al., 2019; Weaver & Lloyd, 2019); new and revised approaches to calculating effect sizes for intervention outcomes (Parker et al., 2011; Pustejovsky, 2018; Tarlow, 2017); and ultimately the meta-analysis of

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SCED data (Kratochwill & Levin, 2014; Shadish et al., 2014). However, there has been great variability in procedures across applications of advanced quantitative techniques to SCED data, which may be one reason these procedures have not been well-adopted by single-case design researchers even when attempting to communicate with other professionals that are most familiar with interpreting treatment outcomes via statistical analyses. The purpose of this special section is to provide an outlet for quantitative and SCED researchers to expound upon the possible applications and implications of using various advanced quantitative techniques to aggregate and analyze SCED data. Indeed, Horner and Ferron note in their discussion article commenting on the articles in this special section that there are growing efforts from methodologists and SCED researchers to disseminate professional standards for applying SCEDs (Kratochwill & Levin, 2014; Tate et al., 2016), and the need for continued advancement of techniques for analysis and interpretation of SCED studies (Manolov & Moeyaert, 2017; Pustejovsky et al., 2014; Riley-Tillman et al., 2020). Horner and Ferron provide an overview and summary of the articles published in this special section, which we will not reiterate here. Instead, we will briefly introduce these articles.

This special section of *Perspectives on Behavior Science* is a timely contribution to the fields of quantitative psychology and behavior analysis. Articles that provide guidelines, direction, and step-by-step procedures with applied examples for SCED researchers are presented. Cox et al. provide one such authentic application utilizing clinical data evaluating psychotropic medication reductions in a program for adolescents with severe problem behavior. Mason et al. examine the use of Cochran's *Q* test of stimulus overselectivity within the verbal repertoire of children with autism. This special section also includes the input of applied behavior analysts demonstrating the application of advanced quantitative techniques and technological applications to SCED data. For instance, Aydin and Yassikaya examine the validity and reliability of a data extraction software (PlotDigitizer Software Program) as a technological application for graphically depicted SCED data. This special section continues the discussion of how the field of behavior analysis can create guidelines for delineating strengths and weaknesses across various techniques for conducting rigorous meta-analyses of SCED data. Next, Falligant et al. examine the relative performance of advanced quantitative methods and supplemental interpretative aids compared to visual inspection of graphed data and clinical decisions related to changing phases within SCEDs. Kranak and Hall examine the implementation of automated nonparametric statistical analysis on functional analysis data specifically with guidance for SCED practitioners and researchers interpreting functional analysis outcomes.

In view of the purpose of this special section, the range of articles exhibit the intellectual creativity present within this emerging and evolving field of quantitative advancements and applications to SCED data. Manolov et al. provide an examination for the a priori justification for effect size measures in SCEDs. In another article by Manolov et al., they examine quantitative techniques and graphical representations for interpreting results from alternating treatment designs. Also, in this special section, Moeyaert et al. examine the power of hierarchical linear modeling to explain variability in intervention effectiveness for SCEDs. Related to this, Carlin

and Costello examine influence measures of effect size with respect to potential Type I errors.

In the final theme of this special section, there are several articles that address the large variation in procedures used to conduct a meta-analysis of treatment effects from SCED data. These articles represent substantial advantages over historical efforts to estimate treatment effect size such and as the average PND (percent of nonoverlapping data) value across SCED studies. Yet, meta-analytic studies that extract raw data and apply advanced quantitative techniques such as hierarchical linear modeling are far more rigorous than averaging a problematic single measure of effect size such as PND. Basic guidelines as to what constitutes best practice in the meta-analysis of SCEDs as well as essential practices are needed if we continue to apply quantitative advancements to SCED data. Dowdy et al. examine strategies for detecting publication bias in the meta-analysis of published SCED treatment analyses. In addition, articles in this special section continue to demonstrate how quantitative methods enhance and complement initial visual inspection of graphed SCED data by extending data simulation techniques from group design data to SCED data. Additional research is needed on the utility of procedures for comparing the performance of different effect size measures for treatment and other possible applications of simulations such as Monte Carlo techniques and others that simulate data based on observed data. In this special section, Friedel et al. discuss Monte Carlo analyses for SCEDs as an untapped resource for increasing the sample size of data points within SCEDs via simulations.

The articles in this special section offers a crosswalk or a clear, direct translation as to how SCED researchers should interpret and compare outcomes from various quantitative methods. In sum, we hope that this special section promotes the translation of quantitative methods to encourage their adoption by research teams using SCEDs. Advancing quantitative methods applied to SCED data will likely facilitate communication with scientists and other professionals that do not typically interpret graphed data of the dependent variable. Horner and Ferron aptly note that innovative statistical procedures are improving the precision and credibility of SCED research as disseminate our findings to an increasingly diverse audience.

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Declarations

Conflicts of Interests None of the authors have any potential conflicts of interests.

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