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## Journal of Contextual Behavioral Science

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## Editorial

# Technical, practical and analytic innovations in single case designs for contextual behavioral scientists<sup>☆</sup>



## 1. Introduction

Methods to observe, analyze and generate knowledge geared at fostering individual behavior change have been present in the field since the 1930s. B.F. Skinner and R.A. Fisher were pioneers in the analysis of individual data, both analytically and statistically. Fisher, among many other innovations, introduced the idea of randomization tests in a brief but consequential way (Fisher, 1935), since his work inspired a lineage of statisticians who persisted in developing analytic methods not dependent on population assumptions. Skinner on the other hand, created the field of behavior analysis (Skinner, 1938), and inspired several generations of behavioral scientists who in turn developed a variety of single case designs (SCDs) focused on the analysis of individuals' behavior over time.

Despite these initial efforts, mainstream psychology has put little emphasis in the development and enhancement of SCDs. Almost “by default” most researchers conceive and plan their studies in terms of summarizing responses from groups of individuals. Group designs, small, medium or large, have become the standard, sometimes because these methods are perceived as the only ones to produce experimental data, and other times because they are arguably the only methods to generate results that are generalizable to a larger population.

Among group designs, randomized controlled trials (the “gold standard”) are critically important, as they have generated a host of knowledge relevant to individuals and society. These trials are critical for science and can inform the population-level impact of certain interventions, which is difficult to address with other methods. However, they can also become a “giant with feet of clay.” Millions of dollars are spent on a single rigorously designed randomized controlled trial. If it fails, millions of dollars go to waste, and little there is that can be learned. Further, even when these trials are grounded in solid basic behavioral science research, interventions tested in the laboratory do not always translate into individuals' natural environment. Thus the question is not how do we discourage researchers from doing randomized controlled group trials, but instead how do we harness large group trials with durable and solid “feet.”

This special issue hopefully provides an answer. Recent innovations in data analysis and technology have opened up the field to unforeseen opportunities for research and practice. These

innovations have the potential to enhance SCDs and provide behavioral scientists and practitioners with the ability to (1) test their hypothesis experimentally, (2) examine the impact of new interventions on individual's natural environment, (3) enhance evidence-based practices. In other words, these methods provide researchers and practitioners with a solid ground to refine their research hypotheses and theory in a more agile manner (Riley, Glasgow, Etheredge, & Abernethy, 2013). Further, the importance of these low cost and high-speed methods comes at a time when both the public and research agencies demand rigorous data about the utility of a variety of emerging interventions (e.g., mHealth; Kumar et al., 2013).

## 2. This special issue

First, Pat Dugard, a mathematician and world expert in the use of randomization tests (e.g., Todman & Dugard, 2001), provides a historical overview of this statistical approach and makes the case for why it has taken so long for these methods to receive the attention they deserve by mainstream science (Dugard, 2014). Her provocative article challenges the statistical assumptions inherent in “classical” tests, and suggests that since randomization tests efficiently resolve the assumption of random sampling, they will soon become the new analytic standard for both for  $N=1$  and small group studies.

The following article by Mieke Heyvaert and Patrick Onghena provides the reader with a practical, concise and updated account on the use of this analytic method (Heyvaert & Onghena, 2014). The senior author of this paper, Patrick Onghena, has dedicated his career to the development of randomization tests (e.g., Edgington & Onghena, 2007). This article provides a state of the art account of this statistical method, includes numerous practical examples, and complements them with very useful video tutorials that walk the interested reader through the different steps needed to statistically analyze SCD data. Exciting is the fact that their examples and tutorials use open source non-proprietary software (R Core Team, 2013), which will ultimately benefit the public by facilitating the use of these analytic methods by a wider net of researchers (both young and more established). With a little bit of training and statistical knowledge, researchers interested in this method could follow Heyvaert and Onghena's excellent article and conduct their own single case experimental studies.

Third, Gareth Holman and Kelly Koerner contribute to this special issue by describing the critical importance of SCDs for the

<sup>☆</sup>Support for the writing of this editorial was provided by a grant from the National Institutes of Health (5T32MH082709-02).

evidence-based treatments movement as well as for the progressiveness of contextual behavioral science (Holman & Koerner, in press). Although their focus is not on the methodological rigor proposed by the articles described above, their insightful and evocative article describes the role that applied scientists have in participatory and collaborative research. Their article also highlights the many ways in which measurement-based care and SCDs can enhance clinical practice by informing clinical decisions, treatment successes and failures, and ultimately empowering front-line clinicians. Lastly, they provide the reader with clinical and practical guidelines for how to implement SCDs in clinical practice, such as measurement frequency, ethical considerations, client engagement, and the contributing role of new technologies.

Finally, Roger Vilardaga, Jonathan Bricker and Michael McDonnell discuss the implications of mobile technology to enhance the use of SCDs and further empower the study of individuals in their natural environment (Vilardaga, Bricker, & McDonnell, in press). Their paper argues that there is a special synergy between mobile technologies, randomization tests and SCDs, and discusses each one of its implications from a contextual behavioral science perspective. The authors argue that mobile technology can be an ideal platform to test hypotheses derived from Relational Frame Theory (Hayes, Barnes-Holmes, & Roche, 2001) they highlight the specific ways in which mobile technology and SCDs can improve the precision, scope and depth of contextual behavioral science, and in the last section of their paper they describe the analytic advantages of combining SCDs, mobile technology and randomization tests: enhanced experimentation, finer grain visual inspection and increased statistical power.

### 3. Future directions

We hope this special issue will empower contextual behavioral scientists with new tools and methods to pursue their specific areas of behavioral research and improve their practice. We still have a long way to understand human behavior in its natural context, but if these tools and methods contribute to strengthen

the methodological diversity of the contextual behavioral science community, this might put us on a solid path to exciting new findings and discoveries.

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