The Single Case Experiment: A Design Study on Steroids?

“No one asks how to motivate a baby. A baby naturally explores everything it can get at, unless restraining forces have already been at work. And this tendency doesn't die out, it's wiped out.”

Do you recognize this quote? It may surprise some readers to learn that this statement was made by B.F. Skinner (1948). Given the intense vilification of behavioral theory among some educational researchers, too few researchers today adequately, let alone deeply, understand behaviorism, Skinner’s contributions, and the considerable impact behavioral theory can have on teaching and learning when used thoughtfully and in concert with other theories. Similarly, few know that one reason Skinner became involved in research on learning among children was a visit to his daughter’s math class. He left with several concerns, including noting that some students struggled and failed to complete problems, whereas others finished quickly but really didn't learn anything new. This was one of the experiences that led Skinner (1972) later to conclude “A failure is not always a mistake, it may simply be the best one can do under the circumstances. The real mistake is to stop trying” (p. 153). Concern about the negative impact too much failure can have on learners, something now well established in educational psychology research, was one driving force for his work.

Among the many legacies behavioral researchers have given and continue to give the field is single subject design, now known as single case design, or single case intervention research design and analysis (these names, however, are misleading, as single case research typically involves multiple participants, with the performance of each single participant closely examined for cause and effect). The Institute of Education Sciences, which was instrumental in the new name for this approach, has developed guidelines as well as professional training for researchers, including a 2015 Single-Case Design Summer Training Institute. Although current legislation requires scientific evidence for educational practices, too few educational researchers, including educational psychologists, understand this method and the advantages it has for causal analyses in teaching and learning (Plavnick & Ferreri, 2013). On the other hand, most of us are familiar with the design study (Brown, 1992). As an intervention researcher, I deeply respect the concept of the design study and the contribution this research method has made to our field. Iterative, intervention, and theory-oriented design studies have made important contributions to the development of effective approaches to teaching and learning, allowing researchers to look not only at what works, but “how, when, and why it works” (Cobb et al., 2003, p. 13). Complex learning ecologies and how they influence teaching and learning can be examined. Design studies, however, are typically not experimental studies.

Single case design studies also clearly and strongly allow researchers to address complex learning ecologies; examine how, when, and why an intervention or approach to instruction or development works; and closely investigate individual differences associated with participants (Plavnick & Ferreri, 2013). They are, in addition, experimental studies that when done well have high internal validity and a clear path to external validity. This is one reason why I refer to single case design studies as “design studies on steroids.” As with any form of research, doing single case studies well is demanding and requires deep understanding and careful management. Here, I share only a few key characteristics and one example. As with all experimental research, investigators conducting single case studies use experimental manipulation to isolate the effects of independent variables on one or more observable and measurable dependent variables. As Plavnick and Ferreri noted, however, “An important benefit of SCED [Single Case Experimental Design] for the application of practices or interventions … is that the design allows for individual differences associated with participants: a feature noticeably missing from comparisons of outcomes between groups of participants” (p. 550). Further, this experimental research design also allows researchers to fine tune an intervention in important ways to meet student needs while...
maintaining the focus on cause and effect. These are additional reasons I refer to single case studies as “design studies on steroids.”

Finally, innovative, talented researchers have conducted single case studies to provide initial validation of an intervention and to substantiate cause and effect before engaging in group experimental studies (Plavnick & Ferreri, 2013). Others have combined single case design and experimental or qualitative methods within a single study or in a line of studies (cf. McKeown, 2012; Graham, Harris, & Zito, 2005). An example is the single case study our research team conducted last year, and how that study led to the randomized controlled trial (RCT) we are conducting this year. Last year, we worked with three small groups of 4th and 5th grade students. Each group consisted of three students (one student moved before the end of the study); each student scored below the 25th percentile on a normed writing test but, was able to write complete sentences. Using the self-regulated strategy development instructional approach, we taught these students the writing and self-regulation strategies, genre knowledge, and genre craft needed to write powerful persuasive essays using source text and their own ideas (see Harris, Graham, Chambers, & Houston, 2014 for details of the intervention; research paper in progress).

Requiring students in these grades to write persuasively from source text is unusual, yet required by the Common Core State Standards. Thus, we revised existing strategies and crafted a new combination of these strategies for younger students. There are multiple forms of design within single case research; for this study, we used the multiple baseline across participants design. This design allows researchers to look for a causal effect of an independent variable by demonstrating a change in responding when, and only when, the intervention is sequentially applied to different participants (singly or in groups). Control of potential confounds, as in all experimental research, must be carefully addressed. A minimum of three replications (three “baselines”) showing clear cause and effect on one or more dependent variables in a single study is a typical standard for evidence of an intervention’s effectiveness (Kazdin, 2011).

As can be seen in the figure, in approximately 10 hours of instructional time spread over 35-minute lessons held four times a week, these struggling 9-10 year old writers made impressive gains on one of the independent variables in our study, a score reflecting use of elements of persuasive writing and source text content (we also looked at holistic quality and interviewed students regarding attitudes toward writing and social validity of the intervention). This instruction is a beginning, not an ending, but following the guidelines for interpretation of single case design data, cause and effect was established for these students (cf. Kazdin, 2011). Further, we were able to fine tune the strategies instruction as we worked with students to the point where we were ready to run an RCT this year. In the RCT, our dependent measures also include student genre knowledge and student self-efficacy for writing. While this RCT will help provide external validity for this instruction, so will replications of our single case study.
There are no panaceas in teaching and learning, or in research on teaching and learning. Here, I argue only that single case design is a powerful, yet underutilized, experimental research method in education and encourage far greater use of this method among educational psychologists. It is typically more affordable than other experimental methods; allows initial validation of an intervention and sets up replication studies; addresses individual student needs and characteristics and allows researchers to address complex learning ecologies; allows examination of how, when, and why an intervention or approach to instruction or development works; and can add to the scientific evidence needed to determine if an approach is evidence-based. If you aren’t using it already, why not add it to your repertoire?

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References


