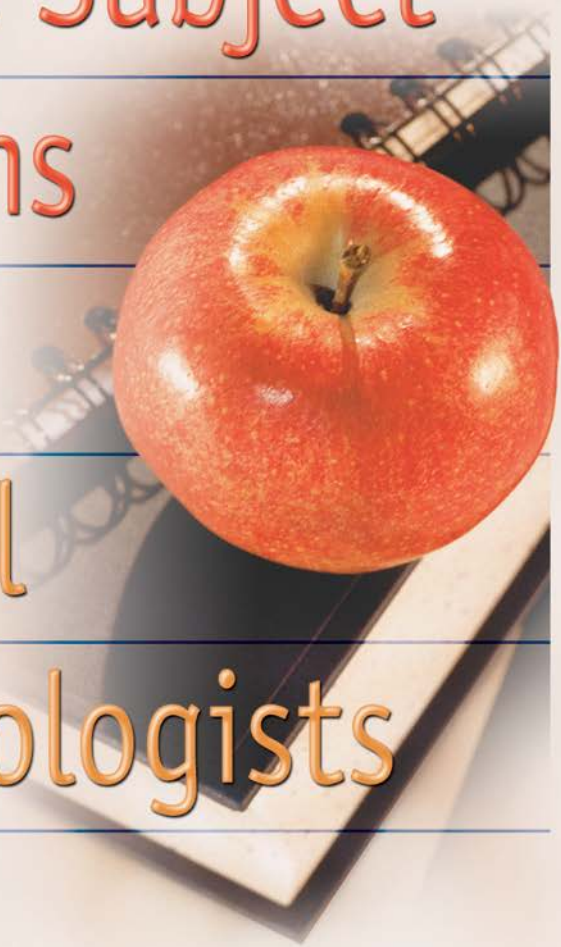
Single-Subject Designs for School Psychologists



Christopher H. Skinner, PhD • Editor

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Single-Subject Designs for School Psychologists, edited by Christopher H. Skinner, PhD (Vol. 20, No. 2, 2004). *"This book is exactly what is needed to promote evidence-based practice. IN THIS AGE OF ACCOUNTABILITY, IT SHOULD BE ON THE DESK OF EVERY SCHOOL PSYCHOLOGIST. The book splendidly achieves its goal—to illustrate how school psychologists can evaluate their interventions in a rigorous, scientific manner and yet do so in a way that is both feasible and practical for applied settings. Single-subject designs are ideally suited to the work of school psychologists and the topics covered in this book reflect the real-life problems confronting them. Excellently conceived and rigorously evaluated interventions are described for increasing reading and arithmetic fluency, reducing anxiety, increasing on-task behavior, and reducing transition time." (Jeff Sigafoos, PhD, Professor, Department of Special Education, The University of Texas at Austin)*

Computers in the Delivery of Special Education and Related Services: Developing Collaborative and Individualized Learning Environments, *edited by Louis J. Kruger, PsyD (Vol. 17, No. 1/2, 2002). *"An excellent compendium. . . . The topics selected cover a broad conceptual spectrum, yet provide specific and useful information for the practitioner. A valuable resource for professionals at all levels. I highly recommend it."* (*David G. Gotthelf, PhD, Director of Student Services, Lincoln-Sudbury Regional School District, Massachusetts*)

Inclusion Practices with Special Needs Students: Theory, Research, and Application, *edited by Steven I. Pfeiffer, PhD, ABPP, and Linda A. Reddy, PhD (Vol. 15, No. 1/2, 1999). *Provides a much needed and balanced perspective of the issues faced by educators committed to understanding how to best serve children with disabilities in schools.*

Emerging School-Based Approaches for Children with Emotional and Behavioral Problems: Research and Practice in Service Integration, *edited by Robert J. Illback, PsyD, and C. Michael Nelson, EdD (Vol. 10, No. 2, and Vol. 11, No. 1/2, 1996). *"A stimulating and valuable contribution to the topic." (Donald K. Routh, PhD, Professor of Psychology, University of Miami)*

Educational Outcomes for Students with Disabilities, *edited by James E. Ysseldyke, PhD, and Martha L. Thurlow (Vol. 9, No. 2, 1995). *"Clearly directed at teaching staff, psychologists, and other educationists but has relevance to all who work with children and young people with disabilities in schools of further education. . . . A useful book." (Physiotherapy)*

Promoting Student Success Through Group Interventions, *edited by Joseph E. Zins, EdD, and Maurice J. Elias, PhD (Vol. 8, No. 1, 1994). *"Contains clear, concise, and practical descriptions of a variety of group interventions designed to promote students' success in school and life." (Social Work with Groups Newsletter)*

Promoting Success with At-Risk Students: Emerging Perspectives and Practical Approaches, *edited by Louis J. Kruger, PsyD (Vol. 5, No. 3/4, 1990). *"Essential to professionals interested in new developments in the education of at-risk students, guidelines for implementation of approaches, and the prevention of student crises and discipline problems." (Virginia Child Protection Newsletter)*

Leadership and Supervision in Special Services: Promising Ideas and Practices, *edited by Leonard C. Burrello, EdD, and David E. Greenburg, EdD (Vol. 4, No. 1/2, 1988). *A rich source of ideas for administrative personnel involved in the delivery of special educational programs and services to children with handicapping conditions.*

School-Based Affective and Social Interventions, *edited by Susan G. Forman, PhD (Vol. 3, No. 3/4, 1988). *"Provides a valuable starting point for the psychologist, counselor, or other special service provider, special educator, regular classroom teacher, nurse, vice-principal, or other administrator who is willing to get involved in the struggle to help children and adolescents feel good about themselves and get along better in this world." (Journal of Pediatric Nursing)*

Facilitating Cognitive Development: International Perspectives, Programs, and Practices, *edited by Milton S. Schwebel and Charles A. Maher, PsyD (Vol. 3, No. 1/2, 1986). *Experts discuss the vital aspects of programs and services that will facilitate cognitive development in children and adolescents.*

Emerging Perspectives on Assessment of Exceptional Children, *edited by Randy Elliot Bennett, EdD, and Charles A. Maher, PsyD (Vol. 2, No. 2/3, 1986). *"Contains a number of innovative and promising approaches to the topic of assessment. It is an important addition to the rapidly changing field of special education and should be read by any individual who is interested in the assessment of exceptional children." (Journal of Psychological Assessment)*

Health Promotion in the Schools: Innovative Approaches to Facilitating Physical and Emotional Well-Being, *edited by Joseph E. Zins, Donald I. Wagner, and Charles A. Maher, PsyD (Vol. 1, No. 3, 1985). *"Examines new approaches to promoting physical and emotional well-being in the schools. . . . A good introduction to new-style health education." (Curriculum Review)*

Microcomputers and Exceptional Children, *edited by Randy Elliot Bennett, EdD, and Charles A. Maher, PsyD (Vol. 1, No. 1, 1984). *"This volume provides both the experienced and novice micro buff with a solid overview of the potential and real uses of the technology with exceptional students." (Alex Thomas, PhD, Port Clinton, Ohio)*

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Single-Subject Designs for School Psychologists

CONTENTS

ABOUT THE EDITOR

Christopher H. Skinner received his PhD in School Psychology from Lehigh University in 1989. He is Professor and Coordinator of School Psychology Programs at The University of Tennessee. His research interests include prevention and remediation of children's academic and social problems, applied experimental research, behavioral assessment, and applied behavioral analysis. He is currently serving as co-editor of *Journal of Behavioral Education*. Along with his students and colleagues, Dr. Skinner has contributed to the empirical validation of intervention process by conducting and publishing experiments using single-subject design methodologies (i.e., withdrawal designs, multiple baseline designs, alternating treatment designs, and change criterion designs) to evaluate and compare the effects of applied interventions.

Single-Subject Designs: Procedures that Allow School Psychologists to Contribute to the Intervention Evaluation and Validation Process

Christopher H. Skinner

University of Tennessee

Like many undergraduate psychology students, I received training in traditional social science research (i.e., group-design and analysis procedures) and was required to conduct a scientific study using such procedures. I conducted an experiment in a laboratory setting where I manipulated tones and measured the effects on time perception of undergraduate students. The laboratory setting made it easy to control confounding variables, and technical equipment allowed for precise manipulation of the independent variable and measurement of the dependent variable. This experience was invaluable in that it allowed *me*, the researcher, to gain experience in the scientific process of evaluating cause-and-effect relationships. However, the same cannot be said for the undergraduate students who served as subjects for my experiment.

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While I cannot be certain, I would venture that none of my participants ever engaged in any life experiences that were enhanced because of their participation in this study. Even had I targeted a useful or functional behavior, the participants would have derived little benefit from the study as the goal was not to evaluate the effects of an intervention design to enhance their skills or ability in estimating time.

THE STUDIES IN THIS VOLUME

The articles contained in this volume include empirical case studies and experiments where researchers implemented procedures designed to control confounding variables. There are several common threads across all the studies. First, each study involved the implementation of an intervention designed to target useful or functional behaviors. Second, in all the studies, the participants' behavior improved. Thus, these studies differ from my undergraduate study in that the participants in these studies benefited from their participation. Third, each intervention was based on previous applied and theoretical research. Thus, each study demonstrated the application of the scientist-practitioner or data-based problem-solving model. In all studies, researchers used within-subject repeated measures of behavior which allowed for frequent evaluation of behavior change. Finally, all studies have both strengths and weaknesses related to drawing cause-and-effect conclusions.

In the first two studies (Campbell & Skinner, and Sharp & Skinner) school psychology students serving as consultants worked with teachers who asked for assistance. In both studies, a behavioral consultation model of service delivery was used which involved the collection of baseline and intervention phase data (Bergan, 1977; Bergan & Kratochwill, 1990). In both studies, class-wide behavior, as opposed to the behavior of individual students (single-subjects), served as the primary dependent variable. Campbell and Skinner worked with a sixth-grade teacher to reduce the amount of time the class spent transitioning from one room to another. The intervention, the Timely Transitions Game (TTG), included (a) an interdependent group-oriented reinforcement program with randomly selected criteria, (b) public posting, and (c) explicit timing. Results showed large, immediate, and sustained decreases in transition times following the implementation of the intervention. These data suggest that the presenting problem was solved.

In the second study, Sharp and Skinner worked with a teacher who was concerned that students in her class were not reading during sustained silent reading time and were not passing comprehension quizzes based on their reading. The practitioners developed an intervention by combining paired-readings with two interdependent group contingencies. In many ways this study was similar to Campbell and Skinner's study in that (a) the intervention was class-wide, (b) researchers constructed the interventions by applying previous applied and theoretical research, (c) an empirical case-study (i.e., A-B design) was used, and (d) the class-wide data suggested an immediate and sustained change in target behaviors. Although the primary dependent variable was class-wide (i.e., the number of reading comprehension quizzes passed each week by the entire class), the practitioners also collected data on each student's behavior. These results confirmed one concern with analysis of group data–practitioners may not be able to determine which students benefit from a class-wide intervention unless individual student analysis is conducted (Michael, 1974). Individual student analysis suggested that the intervention was not very effective for four of the students, indicating the need for alternative or additional intervention procedures for these students.

Although data from these consultation cases suggest that the class target behaviors improved following the implementation of the interventions, there are several problems associated with both studies that prevent one from concluding that the intervention caused these changes. In both studies, the practitioners did not collect interobserver agreement data and the treatment integrity data that was collected was suspect (i.e., either indirect or non-systematic collection of treatment integrity). Thus, the quality of both the dependent and independent variable is suspect (Gresham, Gansle, & Noell, 1993). Perhaps the most serious problem is related to the design. Both studies involved an empirical case study (A-B design), which provided only one demonstration of experimental control. Therefore, neither study allowed the practitioners to rule out other variables (i.e., threats to internal validity including history and testing–see Campbell & Stanley, 1963) which may have caused the measured changes. Campbell and Skinner intended to use a brief withdrawal phase (i.e., A-B-A-B design) which could have provided for three demonstrations of experimental control. However, the teacher declined to withdraw the intervention, as she did not want to do anything that may cause transition times to return to pre-intervention (e.g., baseline) levels.

In the third study, Rickards-Schlichting, Kehle, and Bray evaluated the effects of a self-modeling intervention on behavioral symptoms of speech anxiety in six high school students. Although they reported using an A-B-A design, because no data were collected during the intervention phase, the researchers had only pre-intervention data and post-intervention data. Thus, the strengths and weaknesses of this study may be better understood by conceptualizing it as a series of replicated, concurrent A-B designs. In this experiment, after baseline (i.e., A-phase) data were collected, all six students were exposed to the intervention for five sessions (distributed over a 3-week period). Then, one month later, follow-up (i.e., B-phase) data were collected. Results showed large changes in behavioral symptoms of speech anxiety across all students.

As similar changes in behavior were seen across all participants, researchers provided six replications of treatment effects. However, the changes occurred over the same time (over a 7-week period), with students from the same school, after each had been assessed five times. Thus, it is possible that all recorded changes may have been caused by some confounding variable(s). While the authors suggest that these changes were immediate and/or dramatic, it is important to note that the intervention phase lasted 3 weeks, and changes were measured one month after the last intervention session. Thus, there were no procedures in place to assess for immediate or dramatic change. Therefore, it is possible that threats to internal validity (i.e., history, maturation, testing) account for these changes. For example, other experiences and instruction at their school over the course of the 7-week period may have caused these changes. Although these limitations are serious threats to internal validity, this series of simultaneous A-B empirical case studies has applied value. Specifically, as the researchers' introduction reveals, previous studies had already been conducted that provided empirical evidence for the effectiveness of the self-modeling intervention. This study does provide additional evidence supporting these previous investigations. Also, because the data suggest that this procedure was effective across six additional students, the study enhances the research base related to the external validity of the self-modeling intervention.

The fourth, study by Trolinder, Choi, and Proctor, differs from the previous three in that the researchers attempt to apply single-subject design procedures in order to control for threats to internal validity and more clearly establish a cause-and-effect relationship between their treatment, delayed directive praise, and increases in the on-task behavior of two children. Specifically, the researchers used a withdrawal de-

sign (i.e., A-B-A-B phases). With this design, baseline data is collected (A-phase), and then a treatment is implemented (B-phase). Comparisons across these phases allow for the first demonstration of treatment effectiveness. Next, the treatment is withdrawn and experimental conditions are returned to baseline conditions. Comparisons across the first B-phase and second A-phase (withdrawal phase) allows for the second demonstration of experimental control. Finally, provided the data from the second A-phase return to previous baseline levels, then the re-implementation of treatment allows for the third demonstration of experimental control.

A withdrawal design is powerful but has several limitations (Barlow & Hersen, 1984). First, as the Campbell and Skinner study showed, practitioners may not be willing to withdraw effective treatments. Second, when interventions alter target behaviors that are likely to be reinforced in natural environments (e.g., classrooms), those behaviors may not regress (i.e., return to baseline levels) when the intervention is withdrawn. From an applied perspective, this is positive and suggests that the intervention resulted in changes in behavior that are sustained long after the treatment is withdrawn. This may be what Rickards-Schlichting et al. found with their B-phase data which was collected one month after treatment. Regardless, when researchers employ A-B-A-B withdrawal designs and the behaviors improve during the initial treatment phase but fail to regress after the treatment is withdrawn, researchers are left with only one demonstration of experimental control (similar to Campbell & Skinner, and Sharp & Skinner). Thus, although Trolinder et al. attempted to implement an experimental design, because the data did not reverse, one cannot rule out the possibility that other confounding variables (i.e., threats to internal validity) accounted for the measured changes in behavior.

Practitioners often develop creative or novel interventions that they use to address presenting problems. However, in many instances, their data does not allow for cause-and-effect conclusions. Yet, these studies may contribute to the development and empirical validation of interventions as others can conduct follow-up studies which more clearly establish a causal relationship between the intervention and behavior change. This process is demonstrated in the Yarbrough, Skinner, Lee, and Lemmons study.

Yarbrough et al. used an intervention package similar, although not identical to, the TTG employed by Campbell and Skinner. Additionally, Yarbrough et al. used scientific procedures to evaluate the effects of the intervention (i.e., TTG) on student transition times. A multi-phase with-

drawal design was used which allowed for five within-class demonstrations of experimental control. Furthermore, direct observation data were collected which suggested that both experimental procedures (treatment and withdrawal phase sessions) and data collection procedures were implemented as described. With five within-group demonstrations of experimental control, their results suggested the TTG did, in fact, cause reductions in transition times. Thus, although the Campbell and Skinner study provided poor evidence of a cause-and-effect relationship, it did have heuristic value (Malone, 1990), in that this empirical case study caused Yarbrough et al. to conduct an experiment on the TTG which provided much more valid evidence that the TTG caused decreases in transition times.

The next two studies are both variations of the multiple-baseline design. The first study by Winn, Skinner, Allin, and Hawkins is actually three separate behavioral consultation cases. However, because the practitioners (teachers and consultants) employed similar intervention strategies and dependent variables, these cases could be combined. Additionally, by coincidence, the practitioners used a different number of baseline sessions across each case. Thus, the three non-concurrent cases could be combined to form a non-concurrent, multiple-baseline, across-subjects design (Watson & Workman, 1981). This design provided for three replications of experimental control, across three subjects, in three different classrooms, at three different times. As this design controlled for most threats to internal validity, the results support the conclusion that the self-managed intervention strategy did cause the changes in student writing behavior.

The final study, by McCallum, Skinner, and Hutchins provides the only example of single-subject design research in this volume that included only one subject. In this study, researchers used a multiple-probe design to evaluate the effects of the tape-problems intervention on student mathematics fact fluency. The multiple-probe design is similar to a multiple-baseline design, except that assessment-only baseline sessions are not run as frequently. This is done to minimize testing effects, including the possibility that the students become frustrated by constantly being assessed on tasks that are not being targeted with the intervention (Cuvo, 1979). In the McCallum et al. study, staggered (as opposed to concurrent, see Rickards-Schlichting et al.) replications were performed across tasks (as opposed to across subjects, see Winn et al.). Staggering the treatment across sets of problems (tasks) served both an experimental and applied purpose. From an experimental perspective, staggering the intervention across sets of items

allowed for three non-concurrent, within-subjects demonstrations of experimental control (Hayes, 1985). These procedures control for several confounding variables, including testing and history effects. From an applied perspective, it would have been overwhelming to target over 60 different facts simultaneously. Thus, targeting only 21 or 22 facts at a time likely increased the probability of the intervention being effective and the student experiencing success.

SUMMARY

None of the researchers who conducted the first three studies in this volume (Campbell & Skinner; Rickards-Schlichting et al.; Sharp & Skinner) used traditional experimental design procedures to control for threats to internal validity. Although Trolinder et al. attempted to use design elements (e.g., treatment withdrawal) to establish experimental control, this strategy was unsuccessful. Thus, none of the first four studies allow us to rule out a plethora of confounding variables that may have caused the change in behavior. This prevents us from concluding that the intervention caused desired behavior change. However, in each of the first four studies, the participants' lives appeared to be improved. Room-to-room transitions were made more efficient, allowing more time for teaching and learning (Campbell & Skinner). Students began reading during sustained silent-reading time and passed more comprehension tests (Sharp & Skinner). Such behaviors are likely to enhance reading skills. High school students improved their public speaking skills and reported feeling more confident and less anxious when speaking in public (Rickards-Schlichting et al.). Finally, two students who often failed to sustain their attention were now engaging in high rates of on-task behavior (Trolinder et al.). Such behaviors can enhance learning and decrease inappropriate behaviors across settings and tasks (Lentz, 1988). Thus, despite limitations in establishing cause-and-effect relationships, the evidence collected suggests that the participants in these studies were all better off for having participated.

Additionally, the four studies which failed to control for threats to internal validity do have value. The heuristic value of the Campbell and Skinner study is confirmed by the Yarbrough et al. study. Currently, researchers are conducting an additional study designed to empirically validate the results of the Sharp and Skinner study. The Trolinder et al. study suggests that delayed praise may enhance maintenance of behavior change, perhaps more than immediate praise. This provides a clear