A TRIBUTE TO SIDNEY W. BIJOU, PIONEER IN BEHAVIOR ANALYSIS AND CHILD DEVELOPMENT

KEY WORKS THAT HAVE TRANSFORMED BEHAVIOR ANALYSIS IN PRACTICE

Abstract

In clinical and educational settings, what constitutes best practice is often based on an integration of sound scientific theory and empirical research. The philosophy and methodology of behavior analysis have contributed immensely to the development of an effective technology that practitioners and educators alike can use to deliver services. However, it is important to remember that neither a science, nor the practical application of that science, can advance without the insight, dedication, and scientific endeavors of members of its field. Sidney W. Bijou represents one such researcher. With his application of the principles and methods associated with basic research with nonhuman animals to the study of clinically significant problems with children, Bijou became one of the founding fathers of applied behavior analysis. His contributions to the field span nearly 7 decades, the results of which continue to resonate today. Bijou produced numerous writings and engineered a multitude of studies in an attempt to gain a better understanding of child behavior and development. His seminal work in the field, particularly his work with individuals with developmental disabilities (DD), altered the direction of decades of research to follow and revolutionized educational and therapeutic arrangements.

The intent of this paper is not to chronicle Bijou's life history, nor is it to discuss the entirety of his work in the field. Rather, this paper serves to honor the memory of Bijou and to remind us all of the contributions he made to the practice of behavior analysis. Thus, the focus of this paper will be on what may be considered three of Bijou's most important works and how these works have influenced best practice in clinical and educational settings. Although many of the assumptions and findings summarized in what follows may seem obvious to the modern-day student of behavior analysis, we owe many of these assumptions to the pioneering research of Bijou. This paper will first describe Bijou's behavior analytic theory of child development and how such theory impacted the education of children with DD. Specific attention will be paid to “Programmed Instruction as an Approach to the Teaching of Reading, Writing, and Arithmetic to Retarded Children” (Bijou, Birnbrauer, Kidder, & Tague, 1966), one of Bijou's most cited research articles (Morris, 2008). The next section will turn to a discussion of Bijou's experimental analysis of the behavior of children and, in particular, his work on children's responding under various schedules of reinforcement and extinction (i.e., “Patterns of Reinforcement and Extinction in Young Children,” Bijou, 1957). Of emphasis in this section will be the links between this basic research paradigm (Bijou, 1957) and current therapeutic practice. We will conclude with a discussion of what many, including Bijou himself (Bijou, 2001), have considered to be one of Bijou's most influential works, namely, his seminal paper, “A Method to Integrate Descriptive and Experimental Field Studies at the Level of Data and Empirical Concepts” (Bijou, Peterson, & Ault, 1968). First, a brief history of Bijou's early educational and

professional career is warranted given that the intent of this paper is to draw a link from Bijou's theory and research to current best practices in the field of applied behavior analysis.

A Brief History

As a graduate student at the University of Iowa, Bijou expressed interest in the study of child development and behavioral psychology (Bijou, 1996). After receiving his doctorate, Bijou spent the next 7 years engaged in a variety of endeavors, working as a research psychologist, as an Assistant Professor and Director of the Clinical Psychology Program at Indiana University. He also served 3 years in the military. During the 1940s, 1950s, and 1960s, Bijou accepted an appointment as Associate Professor of psychology and Director of the Institute of Child Development at the University of Washington in Seattle. While at the University of Washington, and with the assistance of numerous collaborators, Bijou demonstrated that the methods used to study nonhuman organisms could be arranged to study the behavior of children both in the laboratory and in the natural environment. Moreover, Bijou extended his work to the assessment and treatment of behavior problems exhibited by children, both typically developing and those diagnosed with DD. These findings have in turn influenced how assessments and interventions are conducted today. That is, assessing and treating behavioral excesses and deficits in an individual's natural environment are now commonplace. In addition, his work at the University of Washington helped establish that basic operant principles could be used to train parents to treat the problem behavior of their own children (Bijou). This represents a truly noteworthy finding, particularly given the role parents can play in facilitating the generalization of treatment gains to the home (Matson, Mahan, & LoVullo, 2009). These early works have most certainly impacted practices employed by clinicians today, as evidenced by the continued application of behavior analytic principles and methods to the improvement of social skills, the treatment of behavior problems, and to educational practices, to name a few areas.

A Theory of Child Development: “Programmed Instruction as an Approach to the Teaching of Reading, Writing, and Arithmetic to Retarded Children” (Bijou, Birnbrauer, Kidder, & Tague, 1966)

Bijou's interest in child development continued during his time at the University of Washington. However, Bijou reported that he felt there was a pressing need for a systematic and empirical theory of child development that would be compatible with and draw upon the research conducted at the University of Washington (Bijou, 1996). That is, he sought to present a theory of development from a behavior analytic perspective. In collaboration with Donald M. Baer, Bijou wrote and published a multi-volume work on child development (Bijou & Baer, 1961; Bijou & Baer, 1965; Bijou, 1976). Bijou and Baer presented a theory in which the principles of behavioral psychology were extended to the understanding of human psychological development. “Psychological development” was described in terms of the progressive changes of an organism's behavior as a consequence of the continuous interaction between the developing, biologically changing individual and his or her environment (Bijou & Baer, 1961). Briefly, Bijou and Baer (1961) suggested that an understanding of child development required an analysis of (a) the developing child as a source of responses (respondent and operant), (b) the child's environment (internal and external), and (c) the continuous and reciprocal interaction between the child and the environment. In addition, their analysis of child development stressed that scientific study

be limited to observable, measurable instances of behavior and environmental events. This theory of child development served as the theoretical basis for the application of behavioral principles to the education of children.

Armed with his behavioral view of child development, Bijou became convinced that the most effective technology for teaching young children with DD would involve the application of operant principles to the educational context (Bijou, 1996). To bring about a desired behavior change of a learner, the learning *environment* could be systematically programmed, or arranged and rearranged, until that change was observed (Bijou et al., 1966). Bijou established an experimental classroom at the Rainier State School to demonstrate that operant principles could be effectively applied to an educational context and to develop a program of instruction for teaching academic and social skills (e.g., reading and writing, waiting, hand raising). Over the course of 3 years, 27 children diagnosed with DD, between 6 and 14 years of age, participated. The physical structure of the classroom was arranged so as to allow each child to work independently and at his or her own pace. A motivational system was developed to promote academic and adaptive social behavior. Tokens (i.e., marks entered into a booklet), exchangeable for a variety of back-up reinforcers, were delivered for following instruction, completing assignments, working independently, and engaging in other appropriate classroom related behavior. Continuous attention and reinforcement were initially delivered to strengthen prerequisite academic and social behavior. As children mastered certain tasks, independent study was initiated and task completion was reinforced (rather than reinforcing every correct response), thereby thinning the schedule of reinforcement. The duration, difficulty, and number of tasks to be completed prior to receiving reinforcers were then gradually increased (the practical implications of this will be discussed in the following section on patterns of reinforcement).

A program of instruction and instructional materials were developed for each of the core academic areas (reading, writing, and arithmetic). To expedite learning, attempts were made to limit errors (e.g., through the use of discrimination programs), appropriate or prerequisite responses were shaped (e.g., holding pencils), and positive reinforcement was employed. The program of instruction was developed such that the materials were conducive to independent study, advancement to more difficult materials was contingent on predetermined criteria (e.g., if error rates were low, more advanced materials would be presented), and the initial academic materials provided to each child was based on his or her current level of competence. At the time, the implementation of these procedures in a classroom environment was revolutionary. Given the success of the program, others soon followed suit and classrooms modeled after the Rainier experimental classroom were developed across the country (e.g., in Los Angeles public schools; Bijou, 1996). The reading program developed at the Rainier school was eventually purchased by Edmark and is still in use today. This line of research has unquestionably set the stage for what are now commonly used practices in special education (e.g., errorless learning, direct instruction, differential reinforcement, shaping).

At the time, the implementation of these procedures in a classroom environment was revolutionary.

Perhaps the most important outcome of the work at the Rainier State School was the principles, or guidelines, proposed for developing an effective educational environment (Bijou et al., 1966). These guidelines have served to inform practices that are commonly

used today in educational and clinical contexts. In terms of developing an effective motivational system, Bijou et al. proposed that tokens be used because they are inexpensive and easy to deliver, their delivery does not interfere with ongoing academic behavior, the instructor can manipulate the delivery and exchange schedules, and they can be exchanged for highly individualized reinforcers. In addition, Bijou et al. discussed three important components of a token system that continue to direct the design and administration of token systems in current practice. First, tokens should be delivered in close temporal proximity to the behavior targeted for reinforcement. Second, thinning the schedule of token delivery will increase resistance to extinction. Third, providing tokens in close temporal proximity to social stimuli (e.g., praise) may result in those social stimuli becoming conditioned reinforcers.

Bijou et al. (1966) also addressed what may be one of the greatest challenges a teacher or practitioner faces. Namely, how do you teach children adaptive behavior when they engage in competing, disruptive behavior? Bijou and colleagues outlined a method of differentially reinforcing successive approximations to the targeted, appropriate response (i.e., shaping appropriate responses). Importantly, Bijou noted that the contingencies must be meaningful to the child and that the teacher must define and discriminate between the progression of responses involved. Although shaping of appropriate behavior was not new to the field of behavior analysis, Bijou and his colleagues at the Rainier State School were among the first to recognize that shaping procedures could be used in educational contexts to strengthen appropriate academic behavior. This procedure continues to be used today to teach children adaptive (e.g., Lerman, Kelley, Vorndran, Kuhn, & LaRue, 2002), academic (Athens, Vollmer, & St. Peter Pipkin, 2007), and social skills (Hall, Maynes, & Reiss, 2009). Furthermore, Bijou suggested the use of negative punishment, or time-out from reinforcement, to decrease inappropriate behavior. In their guidelines, Bijou et al. discussed the importance of ensuring that the environment from which the child would be removed is highly reinforcing. If not, Bijou et al. acknowledged that time-out might function to strengthen, not weaken, disruptive behavior. Bijou and colleagues also discussed pairing a verbal warning with the time-out procedure. In doing so, the verbal warning itself may function as a conditioned aversive stimulus (Vorndran & Lerman, 2006), thereby becoming an effective punisher on its own.

Finally, Bijou et al. (1966) presented several important considerations for developing programmed instructional materials. Because learning is defined by changes in one's behavior, it is exceedingly important to observe and measure the behavior of interest. This point was stressed in several of his published works (e.g., Bijou, 1970, 1973, 1977) and continues to be a primary method of assessing behavior change in both educational contexts and in the treatment of behavior problems. In addition, Bijou suggested that programs should be initiated at a level that ensures successful completion of the materials, with advancement to more complex programs on the basis of the child's observed responding. Bijou et al. made several more specific recommendations with regards to developing academic programs. For example, the authors suggested that discrimination training should precede more complex programmed instruction, acquisition training should follow stimulus-fading procedures, and shaping procedures should precede motor skills training. These recommendations were valuable as they suggested a method by which teachers could arrange educational programs to facilitate children's acquisition of skills from the very onset of training.

Over the next several decades, Bijou published many more influential writings concerning the application of behavioral principles to the education of children with DD. In these writings, he continued to espouse the importance of the recommendations that resulted from his seminal work at the University of Washington and at the Rainier State School (e.g., Bijou, 1970, 1973, 1977). The years in which Bijou flourished as a prominent researcher in the field of developmental psychology were also fruitful years for his work in the field of behavior analysis. Bijou produced some of his most influential works as director of the Institute of Child Development (1948–1965) at the University of Washington. During this time, Bijou sought to synthesize his interests in experimental analyses of nonhuman behavior with functional analyses of child behavior. It is at this point in Bijou's career that his work on response patterns of children under periods of reinforcement and extinction flourished.

"Patterns of Reinforcement and Extinction in Young Children" (Bijou, 1957)

Over half a century ago, Bijou extended work typically conducted with nonhuman animals to young children. One of these remarkable works investigated reinforcement patterns and provided one of the very first accounts of child behavior under periods of extinction. Although Bijou conducted several studies on reinforcement schedules with children, one paper is particularly important to practitioners in the field of behavior analysis. The 1957 paper, "Patterns of Reinforcement and Extinction in Young Children," focused on the study of intermittent and continuous reinforcement. Two groups of preschool-aged children participated in both experiments of this study. For one group, responding (i.e., putting a rubber ball in a wooden box) was reinforced with access to a small toy on a continuous schedule. For the second group, children were required to emit the same response to receive a small toy on what may have approximated a variable-ratio (VR) 5 schedule. For both groups, a 3.5 min period of extinction followed 30 responses. The results of both studies showed that children in the intermittent reinforcement group responded at much higher rates during extinction than those in the continuous reinforcement group.

The finding that behavior patterns observed in laboratory settings with nonhuman animals under intermittent reinforcement schedules mirrored those observed with children in community settings was of notable importance for practitioners for several reasons. First, intermittent reinforcement is practical for practitioners because, by definition, each response is not reinforced. Second, intermittent reinforcement is more economical as less reinforcers needed to be purchased. Third, high rates of desirable behaviors can be maintained with fewer reinforcers under intermittent reinforcement schedules. Behavior reinforced under intermittent reinforcement schedules also may be more representative of what occurs in the natural environment (Worsdell, Iwata, Hanley, Thompson, & Kahng, 2000). This influential paper not only aided practitioners by making reinforcer deliveries more practical, but also greatly aided the clients they served. Bijou's studies on patterns of reinforcement with children are undoubtedly amongst some of the greatest contributions to the field, as evidenced by current research on practices such as error correction (e.g., Worsdell et al., 2005), punishment of problem behavior (e.g., Lerman, Iwata, Shore, & DeLeon, 1997), extinction of problem behavior (e.g., Lerman, Iwata, Shore, & Kahng, 1996), functional communication training (e.g., Worsdell et al., 2000), and delayed reinforcement (e.g., Freeland & Noell, 1999), to name a few areas of research informed by Bijou's work.

Descriptive Analysis: “A Method to Integrate Descriptive and Experimental Field Studies at the Level of Data and Empirical Concepts” (Bijou, Peterson, & Ault, 1968)

After a one-year post-doctoral fellowship under B. F. Skinner at Harvard University, Bijou returned to the University of Washington in 1962 and continued his work with operant principles as applied to young children with DD. Three years later, Bijou left the University of Washington and was appointed to Full Professor at the University of Illinois in both the psychology and education departments. He also served as Director of the Child Behavior Laboratory and was the inaugural Editor of the *Journal of Experimental Child Psychology*, as well as a member of multiple committees devoted to the advancement of behavior analysis and treatment for children with autism (Morris, 2008). While at the University of Illinois, Bijou produced what may be his most powerful work.

“Psychology, like the other natural sciences, depends for its advancement upon both descriptive accounts and functional analyses of its primary data” (Bijou et al., 1968, p. 175). Descriptive analyses are critical for practitioners as these analyses can help determine potential environmental variables that may maintain an individual's behavior. Experimental analyses may be difficult to implement in community settings due to time constraints and lack of practitioner experience. Recognizing the utility of descriptive analyses, Bijou et al. produced a guide that detailed a method by which practitioners could perform such analyses. In the seminal article, entitled “A Method to Integrate Descriptive and Experimental Field Studies at the Level of Data and Empirical Concepts,” Bijou et al. produced a paper that would undoubtedly have a significant impact on the practice of applied behavior analysis. Bijou could not have been more accurate when he said that this article was one of his publications that had “the greatest impact on psychologists and students” (Bijou, 2001, p. 117). Bijou's work on descriptive analysis helped guide practitioners to identify possible interactions between behavior and environmental events and served as the cornerstone in the field for how to conduct descriptive analyses of behavior. Notably, Bijou et al. offered an alternative to a more traditional psychological assessment of child behavior and development. The researchers suggested that scientists look beyond theoretical concepts of child behavior (e.g., permissive mothers as a cause for child problem behavior) and seek explanations for child behavior based on empirical evidence and observable events. As this influential article provided practitioners a large framework from which they may study child behavior, the following will detail what Bijou contributed to the field, especially to practitioners working with individuals with behavior problems.

Bijou advocated for a science in which conclusions about the causes of behavior were based on the continuous and reciprocal interactions between behavior and environmental events, rather than on hypothetical constructs (Bijou et al., 1968). This position was of critical importance for practitioners, as behavior was not viewed as a constant but rather as something that was malleable, that could be changed by way of manipulating environmental events.

Descriptive analysis begins with identifying not only the behavior of interest but also the physical and social setting in which behavior occurs. Bijou et al. (1968) pointed out that identifying the setting prior to data collection is critical as changes in the setting may alter behavior. Such changes may be minimally intrusive to the study (e.g., phone ringing), and others may warrant postponing data collection (e.g., absence of individuals common in the

child's environment). Further, Bijou emphasized that only *observable* events should be recorded, rather than hypothesized intentions or feelings, which was a critical message for practitioners. At the time, the field of psychology lacked an emphasis on empirical accounts of behavior. By merely advocating that practitioners analyze behavior based on environmental interactions and not hypothetical constructs, the practice of applied behavior analysis was wholly advanced by the third page of Bijou's paper.

One of the greatest contributions of Bijou et al. (1968) to the practice of applied behavior analysis was the introduction of a method of conducting anecdotal observations (i.e., “A-B-C recording”). During anecdotal observations, practitioners provide running narratives of an observed event over a specific period of time. The narratives are then broken down into descriptions of the antecedents, behaviors, and consequences that occurred during the observation period. This method differs from the running narratives that were proposed by Barker and Wright (1955). Bijou and colleagues suggested the importance of transforming the narratives into specific environmental events because running narratives are less amenable to analyses of environmental interactions. Anecdotal observations, as proposed by Bijou and colleagues, are useful because they provide information not only about the occurrence of the target behavior, but the context in which they occur. By providing a comprehensive account of the environmental events surrounding the individual being observed, a practitioner is better prepared to draw conclusions as to the potential environmental events that evoke and maintain problem behavior. The information derived from these observations influence the direction of future assessments as well as treatment decisions. However, what is most noteworthy about this paper is that it introduced the notion of transforming narrative recordings into quantifiable events. Prior to its publication, practitioners had few tools to rely on to assess behavior. In addition, thorough examples provided by Bijou et al. further aided practitioners by serving as a model.

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The suggestion of developing observational codes also made a mark on the field, making data collection easier for practitioners and allowing for the simultaneous observation of multiple behaviors and participants. Bijou et al. (1968) suggested the development of observational codes to represent each target behavior (i.e., “specific observational codes”). General observational codes were also suggested, and these codes could represent several responses (e.g., tantrum recorded when a combination of self-injury and crying occurs). In addition, the shorthand described allowed practitioners to tailor their recordings to their individual clients and, most importantly, provided a viable and efficient method to record behavior.

In discussing the importance of reliability, Bijou and colleagues (1968) stressed the significance of properly training observers. Training tips included orientation to observation tools, orientation to the code being used, pre-observation recording using videotapes, and ways in which to behave while observing. Further, the paper suggested methods by which to calculate reliability (i.e., interobserver agreement [IOA]) and recommended specific methods to use based on the type of data collected by observers. The method one selects to calculate IOA is undoubtedly dependent on the data because some methods may artificially inflate agreement scores, depending on the type of data collection employed and the frequency of

the behavior (Cooper, Heron, & Heward, 2007). Given the importance of data analysis in developing and assessing treatment outcomes, it is of the utmost importance that the data we analyze are accurate representations of what we are observing (i.e., show evidence of internal validity). Further, Bijou and colleagues stressed the importance of graphing data regularly, especially given the role that data play in aiding day-to-day decision-making. Practitioners also benefited from the paper's discussion of *how* to plot the data based on the type of data collected (e.g., graphs using discrete points versus cumulative records). The breadth of the discussion on data collection and reliability provided practitioners with a sound basis from which to collect accurate data.

Bijou's 1968 paper truly appeared to be written for the practitioner, as evidenced by the fact that the authors did not just describe how to conduct descriptive studies, but they also applied the instruction to examples that practitioners would typically encounter in their day-to-day work. This paper could serve as a training tool, a prescription for practitioners who aim to assess and treat behavioral excesses and deficits.

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Conclusions

The impact of Bijou's efforts concerning the education of individuals with DD and the treatment of behavior problems has been considerable. Although the use of behavior analytic tools in clinical and educational environments is common practice today, Bijou's unprecedented work helped to establish that these principles could in fact be applied to individuals with DD and in educational contexts. His work was also important in establishing a set of principles or guidelines that practitioners and educators could use to develop effective learning environments. Many of these recommendations are still used in educational contexts today. Without question, Bijou's work on descriptive analyses and schedules of reinforcement are of vital importance to our field.

Bijou often adopted the practice of briefly recapping the important points he described in a given paper, usually in a numbered format, in his concluding remarks. As a tribute to Bijou, the final remarks regarding his contributions to practice will follow suit. The contributions his works have had with regard to best practice may comprise two main areas of improvements for children:

1. Academic and social skills
    a. Bijou suggested that understanding child development depends on observations of the child's environment; this view influenced practitioners, especially those working in educational settings, to arrange and rearrange the learning environment until change was observed.
    b. The experimental classroom he developed at the Rainer State School has been replicated across the country to teach academic and social skills more effectively.
    c. Bijou advocated for programmed instruction, individualized instruction specifically tailored to each child's needs; he suggested that practitioners attend to antecedent, consequent, and setting events to modify the learning environment.

d. By stressing the role of supports, Bijou highlighted the importance of involving parents and school aides in the education of children, a practice that remains today.

2. Problem behavior

    a. Bijou's early work revealed that operant principles derived from basic research with nonhuman animals could be used to treat behavior problems with children and to train parents to conduct treatments in the child's natural environment.

    b. Bijou's (1957) description of children's responding under intermittent schedules of reinforcement suggested viable methods to reinforce desirable behavior and suggested a practical method for practitioners to generalize treatment gains to the natural environment.

    c. Bijou's work on descriptive analysis and the introduction of anecdotal recording provided practitioners a framework by which they could develop hypotheses regarding the variables maintaining problem behavior, thus guiding further assessments and treatment decisions.

The current article highlights just some of Bijou's major contributions to the field of behavior analysis and to practices currently employed by its practitioners. Many of the procedures practitioners and educators use on a daily basis with their clients and students were shaped by Bijou's life work (e.g., the use of parents in assessment and treatment, programmed instruction, intermittent reinforcement, A-B-C recording). Bijou's influences on best practice are numerous. Without a doubt, the lives of individuals with and without disabilities have been profoundly improved over the last 70 years as a result of Bijou's contributions to our field.

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