On Books

The Status of Developmental Science: A Review of *A Behavior Analytic View of Child Development* by Henry D. Schlinger, Jr.

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In the preface to *A Behavior Analytic View of Child Development*, Schlinger states that his purpose in writing the book was twofold: (a) to provide an introduction to behavior analysis, with a particular focus on behavior-analytic theory, and (b) to illustrate how behavior-analytic theory can be used to interpret the data produced by mainstream developmental psychology. Unfortunately, Schlinger's presentation of current developmental research and theory neglects significant material related to the topics he covers. This shortcoming of the book seriously detracts from his second stated purpose, that of applying behavior-analytic theory to developmental phenomena. He also misrepresents the extent to which critiques of reification and circularity as applied to cognitive theories are applicable to many contemporary developmental approaches. Because of these two features of the book, Schlinger misses major new themes in developmental psychology, in particular, an emphasis on contextualist approaches that are familiar to behavior analysts (e.g., Hayes, Hayes, Reese, & Sarbin, 1993; Marr, 1993; Morris, 1988) and an emphasis on variability and selectionist accounts of change.

Overview of the Book

The first three chapters consider the importance of a "foundation of well-established principles derived from a rigorous program of basic research" (p. 8). In the remaining seven chapters, Schlinger examines various developmental topics, including motor development, perceptual development, cognitive development, language development, the development of attachment relations, and the development of positive social behavior. He summarizes data generated by both behavior-analytic and non-behavior-analytic researchers, and for each topic gives interpretations of specific phenomena in both cognitive and behavior-analytic language.

For example, within the domain of motor development, Schlinger describes infant reflexes, rhythmical behaviors (e.g., stereotypical movements of the legs and feet), postural behaviors (e.g., sitting and standing), locomotor behaviors (crawling and walking), and manual behaviors (e.g., reaching and grasping), presenting approximate ages of onset, the role of neuromuscular maturation, the problems of gravity, stability, and equilibrium, the influence of experience, and the issue of voluntary control. He also discusses the importance of visual stimulus changes, movement relative to the external environment, the successful manipulation of objects, and proprioceptive feedback as ecological (unconditioned) reinforcers. Within the domain of memory, Schlinger describes visual recognition

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memory as it has been studied with habituation and paired-comparison (novelty preference and discrimination) procedures, and event memory studies that have used operant techniques for examining long-term remembering (including reactivation of "forgotten" events and contextual control over remembering). Within the domain of language development, Schlinger describes categorical speech perception in human infants, crying and other vocal prespeech behaviors, naming, extensions, grammar, the production of sentences, and rule-governed morphology. Oddly, given the title, the book covers only the infancy period of child development.

At the end of each chapter, Schlinger contrasts the cognitive and behavior-analytic explanations of the research in that domain. He defines cognitive theory as involving "the practice of studying observable behavioral relations and then either reifying them as hypothetical internal events or processes or inferring such events and processes as explanations of those relations" (p. x). For example, in the motor development chapter, he states that cognitivists conclude that changes in motor behavior occur through increasing "knowledge" (my quotes) about the environment. In contrast, he states that Skinnerian theory is "an organized collection of empirical facts (specifically functional relationships) and includes the formulation of principles (i.e., scientific laws) derived inductively from those facts using a minimum number of terms and concepts" (p. 32), and that "explanations in terms of hypothetical entities like knowledge or (spatial) understanding are unnecessary, not directly testable, and not parsimonious" (p. 93). A behavior-analytic explanation is simply that motor development occurs "because this is how [infants] normally find and get things they want" (p. 93). "Motor development is adaptive behavior that is important because it enables humans to survive in the external environment" (p. 94). Similarly, he gives examples of

cognitive explanations for remembering that refer to storage of information (p. 65) and "computer-like" scanning processes (p. 66). These involve hypothetical constructs and are unnecessary as explanations of the phenomena according to Schlinger, as he presents the traditional behavior-analytic criticisms of cognitive approaches involving the problems of reification and circularity.

Critique of the Book

Schlinger's overview of a natural science perspective on developmental psychology, using behavior-analytic theory as an example, is well conceived and elaborated. He lays out the criteria for evaluating scientific theories, and highlights the importance of functional, as opposed to structural, accounts of human action. He acknowledges the utility of inference to explanations of human behavior when applied to potentially observable environmental events, while emphasizing the shortcomings of interpretation when applied to hypothetical entities that have no specified functional links to overt or covert behavior. He also examines the critical deficiencies inherent in correlational research and the use of age as a causal variable, two potential pitfalls in the search for explanations of developmental change.

Schlinger acknowledges that he primarily cites research produced by mainstream developmental psychologists and published in mainstream developmental journals (see, e.g., the section on visual-perceptual development, pp. 96–109, and the section on language development, pp. 151–175). In addition, when Schlinger gives examples of theoretical explanations of these current findings, as presented by the developmental scientists who produced them, he often states that these explanations are compatible with behavior-analytic ones (see, e.g., Harris, 1987, in the section on infant search behaviors). Critically, however, the majority of his examples of "bad"

cognitive explanations (e.g., R. W. Brown & Bellugi, 1964; Chomsky, 1959; L. B. Cohen & Gelber, 1975; Littenberg, Tulkin, & Kagan, 1971), and "good" behavior-analytic research (e.g., Brackbill, 1958; Gelfand, Hartmann, Cromer, Smith, & Page, 1975; Hart, Allen, Buel, Harris, & Wolf, 1964; Sheppard, 1969; Siqueland & DeLucia, 1969; Todd & Palmer, 1968) are at least 20 years old (notable exceptions are references to the continuing empirical contributions of Jacob Gewirtz, Martha Pelaez-Nogueras, Claire Poulson, and Carolyn Rovee-Collier). Thus, his review of current theory and research in developmental science is selective and his criticisms are often misdirected at historical, rather than contemporary, perspectives. The following paragraphs provide some examples.

With respect to significant omissions, Schlinger does not present empirical research that has revised earlier structuralist and maturationist views on development. For example, in the cognitive development chapter, he does not include a presentation of the work of Renee Baillargeon (e.g., Baillargeon, 1987, 1991; Baillargeon & DeVos, 1992; Baillargeon, Graber, Decops, & Black, 1990), which has had a major impact on Piagetian conceptualizations of infant search behaviors (pp. 142–149). Similarly, in the language development chapter, there is no presentation of current developmental approaches (for reviews of these approaches, see Locke, 1993; Nelson, 1996; Pinker, 1994; Tomasello, 1992) other than that of one researcher (E. Bates).

Schlinger also neglects neurophysiology, except for his coverage of visual perceptual development. The key distinction between developmental behavioral change and other kinds of behavior change is that *growth* (entailing significant morphological modifications) is a factor that interacts with learning. Recent trends in much of current psychological science (including some behavior analysis, e.g., Donahoe & Palm-

er, 1994) involve examination of the neurophysiological substrates of behaviors like complex learning, social behavior, verbal behavior, reasoning, and so on. These trends are prominent in developmental psychology (e.g., Carey & Gelman, 1991; Eckerman, Oehler, Hannan, & Molitor, 1995; Johnson, 1993; Spangler & Scheubeck, 1993; see Siegler, 1989, for discussion), in that developmentalists have always been concerned with the biology of the organism, particularly brain-behavior relations. For instance, developmental texts, books, and journals contain research on such topics as the regulation of physiological states (e.g., sleep-wake cycles: Thoman & Whitney, 1990; heart-rate variability: Porges, 1991; emotional reactivity: Fox, 1989). Additional examples of this type of research include studies on nutritional variation and its effect on both intrauterine and extrauterine brain growth (Super, Herrera, & Mora, 1990), brain changes in myelination patterns, dendritic density, and neuronal pruning (e.g., Diamond, 1990; Fox, 1991; Greenough, 1993), and frontal cortex development, inhibition, and early sensorimotor integration skills (Diamond, 1991).

Relatedly, evolutionary theory, evolutionary biology, comparative psychology, and ethology have historically (e.g., Ainsworth, 1973; J. M. Baldwin, 1895; Lorenz, 1935/1970; for reviews, see Gottlieb, 1983; Hinde, 1983; Sameroff, 1983) and currently (e.g., Bjorklund, 1997; Oyama, 1989; Plotkin, 1994; Povinelli & Eddy, 1996; Sameroff & Suomi, 1996; Suomi, 1991; Tomasello, Savage-Rumbaugh, & Kruger, 1993) had a major influence on developmental science. That is, phylogenetic and ontogenetic selectionist accounts of change have had a prominent role (even in Piaget's theory, as Schlinger notes in the section on sensorimotor intelligence) and continue to do so. The importance of species-specific principles of behavior to developmental psychology cannot be understated, and these principles are at least as im-

portant as principles generalized across animals that have evolved in different environmental niches (Harrison, 1994; Lamb & Campos, 1982). Schlinger gives little attention in the book to these issues.

Finally, even though he acknowledges that not all of the important variables in human development can be manipulated ethically (see his discussion on p. 30), Schlinger neglects the many attempts by developmental psychologists to capitalize on "natural experiments" in order to examine functional relations by using correlational and quasiexperimental research designs. For example, Spitz (1965) looked at the development of infants raised in orphanages in eastern Europe to examine possible functional relations between lack of adult play and interaction and a variety of social and emotional behaviors. Similarly, children with various disabilities, like blindness or deafness, have been compared to nondisabled children to examine possible functional relations between differential visual and auditory environmental experiences and the development of verbal behavior (e.g., Goldin-Meadow & Mylander, 1984; Landau & Gleitman, 1985; Petitto & Marentette, 1991). As advanced medical technology has significantly increased the viability of preterm infants, infancy researchers have been at the forefront of examining functional relations between early exposure to the extrauterine environment and behavioral development (e.g., Achenbach, Phares, Howell, Rauh, & Nurcombe, 1990; DiPietro & Porges, 1991; Korner, 1996; Landry & Chapieski, 1988). Furthermore, developmental textbooks emphasize the idea that correlation does not imply causation, and that it is critical to continually examine the possibility of additional variables that might underlie observed relations. Students are taught that attempts to eliminate these possibilities are the direct impetus for much of developmental research.

It is also the case that by omitting areas of research and theory, current developmental science is misrepresent-

ed by Schlinger. For example, in the chapter on memory, Schlinger's major criticism of developmental research is that it ignores potential functional relations that may control behavior. Many studies published in the past 15 years on infant remembering have examined just that, but these are not presented by Schlinger. For example, a prominent, current, and frequently cited book is entitled *Knowing and Remembering in Young Children* (edited by Fivush & Hudson, 1990). (Note that the title is not *Knowledge and Memory in Young Children*.) Chapters in this book include "Remembering What Happened Next: Very Young Children's Recall of Event Sequences," "The Social and Functional Context of Children's Remembering," and "Remembering, Forgetting, and Childhood Amnesia." Although developmentalists continue to use terms like *knowledge* and *memory* in developmental writing (e.g., chapters in the Fivush and Hudson book include "Autobiographical Memory Across the Preschool Years: Toward Reconceptualizing Childhood Amnesia" and "Children's Concerns and Memory: Issues of Ecological Validity in the Study of Children's Eyewitness Testimony"), a functionalist, contextualist, cultural learning perspective is emphasized by using the gerund form of the verb. The empirical and theoretical work reported in this book approaches the study of development changes in "memory" (translate as "remembering behaviors") as ongoing activities that are embedded in and affected by larger social and cognitive tasks. The focus of this research is on examining environmental influences through both correlational and experimental methodologies designed to discover potential determining factors, eliminate spurious relations as causal factors, and examine interactions among factors.

Thus, Schlinger misrepresents developmental psychology with his repeatedly stated contention that "the reification of structures" and the "forms" of behavior are central to the

majority of developmental accounts. In another example, he cites the developmental presentation of the finding that infants can point to or look at a telephone when the parent says "telephone" (i.e., detect the relation between the word and the object, or understand to what the word refers) prior to being able to say the word *telephone*. In this example, Schlinger claims that this "understanding" on the part of infants is a hypothetical entity being used as a causal, functional explanation in the development of language (p. vii). He is wrong. Developmental psychologists are not giving an *explanation* in this example, they are *describing* an observable phenomenon, namely, that in the course of most children's language development, comprehension behaviors generally precede production behaviors (Pinker, 1994). This description is recognized as requiring explanation in terms of possible controlling variables, hence, empirical examination of functional relations between comprehending behaviors and environmental events and their connection to human biology (e.g., Aitchison, 1996; D. A. Baldwin, 1993; E. Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979; Golinkoff & Hirsh-Pasek, 1995; Miller & Johnson-Laird, 1976; see also Ribes, 1996; Wilkinson, Dube, & McIlvane, 1996; special section of the *Journal of the Experimental Analysis of Behavior (JEAB)*, Vol. 65, pp. 185–353, for discussions of listening).

Similarly, in Schlinger's discussion of "voluntary" behavior (begun in the chapter on motor development), he states that one way to define *voluntary* is "intentional, not accidental." *Intentional* is defined as the control of behavior by contingencies of reinforcement. Schlinger prefers this definition over one that involves the notion of free will. He further states that when most developmental researchers describe motor behaviors as voluntary and less advanced motor behaviors as reflexive, "they are implying that the infant has no choice over reflexive behavior but has a choice over later mo-

tor behavior" (p. 91). The notion that the two types of behavior are controlled by different variables (reflexes by evolutionary history and advanced motor behavior by ontogenetic history) is presented as the "correct" behavior-analytic explanation. "Both are caused; neither is a result of free will" (p. 91). I have never seen a developmental scientific report or discussion of free will as a causal mechanism. (Free will should not be confused with the biologically based concepts of self-organization and self-regulation that are used by developmentalists to explain behavior change, see, e.g., Edelman, 1987; Gibson, 1988; Goldfield, 1995; Thelen, Kelso, & Fogel, 1987.) Intentional action, or "choosing," is goal-directed behavior that emerges from current environmental conditions and the history (both phylogenetic and ontogenetic) of the organism. Developmentalists speak of intentional action as adaptive means-ends behavior whose environmental antecedents and consequences are often temporally delayed and physically displaced (e.g., Bruner, 1990; Siegler, 1996; Tomasello & Call, 1997). If given a choice between Schlinger's two definitions of *voluntary*, most developmentalists too would pick "intentional, not accidental," and their definition of *intentional* would not give causal status to free will.

To summarize, while Schlinger provides a nice introduction to behavior analysis, his limited presentation of current empirical and theoretical work in developmental psychology and his misrepresentation of the extent to which aspects of the traditional cognitive-behavioral debate apply to contemporary developmental science make it difficult to begin the task of integrating the study of development with behavior-analytic theory and method. It is therefore somewhat ironic that a clear theme throughout the book is Schlinger's concern about the inadequate presentation of behavior analysis in developmental textbooks. Why should this be? Most scientists recog-

nize that undergraduate textbooks give at least incomplete, if not inadequate, treatments of the best current research and theory in their field, so possibly this is not a problem specific to developmental psychology. But Schlinger also may be accurately noting a feature of advanced textbooks and the research presented in developmental journals, and this makes the problem more serious. My view is that these inadequate presentations may be partially a result of books like the one Schlinger has written (see also Bijou, 1995, which includes no references to developmental research in its treatment of child development). Anyone engaged in the practice of developmental science would be unlikely to incorporate a theory and methodology into their work that states that what they do is limited in scope, is unable to produce empirically testable hypotheses, and has little external validity or utility (pp. 9–13) (Reese, 1998). The following section is a brief summary of contemporary developmental science presented to illustrate how at least one developmentally trained psychologist has seen beyond a simplistic, stereotyped version of behavior analysis. She hopes that some behavior analysts will see beyond Schlinger's presentation of developmental science.

Contemporary Developmental Science

Contemporary developmental science, both theory and research, involves the experimental and quasiexperimental analysis of "behavioral changes that are observed over time in the life of an individual largely as a function of his or her interaction with objective, environmental events" (this is Schlinger's definition of a behavior-analytic approach to development, p. viii) (see Spiker, 1989, for a similar argument regarding whether current cognitive theory is behavior analytic or mentalistic). Table 1 lists the contents of a recent volume of *Child Development*, the flagship journal of the Society for Research in Child Develop-

ment, to provide support for this position.

Developmental science (which is distinct from, although linked to, cognitive science) is currently dominated by contextual approaches to the study of learning and maturation (see R. Cohen & Siegel, 1991, and Lockman & Hazen, 1989, for recent overviews of contextualism and development, and Wertsch, 1985, 1991, for historical background). Performance, not competence, is the focus of developmental psychology today (Sophian, 1997). Contextual approaches, like behavior-analytic ones, have had longstanding concerns with Piagetian (e.g., Flavell, 1992; Gelman, 1969; Karmiloff-Smith, 1992; Klahr, Fay, & Dunbar, 1993; Lipsett, 1981; Siegel & Brainerd, 1978) and information-processing accounts of developmental change (e.g., A. L. Brown & DeLoache, 1978; Paris, 1978). Although research in the Piagetian and information-processing traditions yielded many excellent descriptions of behavior, neither provides an adequate research methodology or theory of development (Flavell, Miller, & Miller, 1993), an opinion that has made its way into the three best selling undergraduate lifespan developmental textbooks (Berger, 1998; Papalia & Olds, 1998; Santrock, 1995). In fact, the criticisms of structuralist cognitive theories marshaled by Schlinger have been made by developmentalists (e.g., Case, 1992; Gibson, 1988; Karmiloff-Smith, 1992; Leslie, 1988; Mandler, 1988; Willatts, 1994).

For example, Schlinger's critique of stage theories (p. 24) is fully elaborated in current perspectives on developmental change that emphasize variability and selectionism (see Siegler, 1996, for discussion). Similarly, information-processing approaches have been criticized for not considering individual differences in past experience with environmental factors (Bjorklund & Zeman, 1982; Chi, 1978; Chi & Ceci, 1987). In addition, cross-cultural and socio-cultural developmental research has highlighted the importance of dif-

TABLE 1

Articles from a recent issue of *Child Development* (Vol. 68, No. 3, June 1997)

Authors	Title
Westergaard, Champous, and Soumi	Hand preferences in infant rhesus macaques (<i>Macaca mulatta</i>)
Zeskind and Barr	Acoustic characteristics of naturally occurring cries of infants with "colic"
Johnson and Solomon	Why dogs have puppies and cats have kittens: The role of birth in young children's understanding of biological origins
Morford and Goldin-Meadow	From here and now to there and then: The development of displaced reference in homesign and English
Taylor and Carlson	The relation between individual differences in fantasy and theory of mind
Belsky, Domitrovich, and Crnic	Temperament and parenting antecedents of individual differences in three-year-old boys' pride and shame reactions
Rubin, Hastings, Stewart, Henderson, and Chen	The consistency and concomitants of inhibition: Some of the children, all of the time
Helwig	The role of agent and social context in judgments of freedom of speech and religion
Fonzi, Schneider, Tani, and Tomada	Predicting children's friendship status from their dyadic interaction in structured situations of potential conflict
Glasgow, Dornbusch, Troyer, Steinberg, and Ritter	Parenting styles, adolescents' attributions, and educational outcomes in nine heterogeneous high schools
Bigler, Jones, and Lobliner	Social categorization and the formation of intergroup attitudes in children
Farver and Shin	Social pretend play in Korean- and Anglo-American preschoolers
Miller, Wiley, Fung, and Liang	Personal storytelling as a medium of socialization in Chinese and American families

ferential experience in many areas of development (e.g., Bronfenbrenner & Ceci, 1994; Cole & Scribner, 1974; Elder, Eccles, Ardelt, & Lord, 1995; Okagaki & Sternberg, 1991; Rogoff, 1990; Tudge, Putnam, & Valsiner, 1996) and emphasized cultural learning (e.g., Montgomery, 1997; Tomasello, Kruger, & Ratner, 1993; see also Glenn, 1991; Glenn & Malagodi, 1991; Lamal, 1991; Malagodi, 1986; Mattaini, 1996; for discussions of culture by behavior analysts that are compatible with the developmental perspective). Developmental change is increasingly seen by many developmental psychologists as tied to more "fluent" behav-

ior derived from large amounts of practice and as the strengthening of behavioral probabilities over time (see Siegler, 1996; Siegler & Crowley, 1991).

The emphasis on contextualism is also in accord with a new metatheory, dynamic systems, that currently is having a major influence on mainstream developmental science (Cairns, Elder, & Costello, 1996) as well as on theory in other natural science domains, including behavior analysis (see Marr, 1996, and Novak, 1997, for an introduction to possible links between developmental psychology and behavior analysis through application of dynamic systems theory, and the special issue

of *JEAB*, May 1992, on behavior dynamics). Dynamic systems theory describes changes in complex unstable systems. It has as core features an acceptance of determination without predictability (through an integration of local variability, global regularity, and novelty) and, most critically, the notion that stimulus control is not restrained to momentary cause (see Rachlin, 1994). The application of a dynamic systems perspective to developmental theory and research (e.g., Fogel & Thelen, 1987; Kelso, 1995; Molenaar & Newell, 1997; Smith & Thelen, 1994; Thelen & Smith, 1993; van Geert, 1994) is compatible with the longstanding developmental methodologies of examining individual differences and conducting longitudinal analyses (e.g., J. E. Bates & Wachs, 1994; Columbo & Fagen, 1990). As just one example of the impact of this perspective, a presentation of contemporary analyses of the development of motor behavior is incomplete without describing the use of dynamic systems metatheory to generate research questions, experimental methodology, and interpretation (e.g., Goldfield, 1995; Swinnen, Heuer, Massion, & Caesar, 1994; Thelen, 1995; Thelen et al., 1993). Applications to infant perception (Butterworth, 1993), cognition (van Geert, 1993), language development (E. Bates & Carnevale, 1993; Tucker & Hirsh-Pasek, 1993), and emotional (Wolff, 1993) and social behavior (Eckerman, 1993) are also being explored.

In conclusion, over the past 20 years, the field of infant learning and growth has exploded as new techniques for measuring infant behaviors have been discovered, driven by developmental psychologists asking questions and developing hypotheses and new methodologies inspired by previous work. In considering explanations (not descriptions) of change, the determinants of behavior are being sought in the biology and history of the organism as well as in the current environment. The inclusion in this review

of developmental journal citations from the past 15 years, and examples of the contents of a recent developmental journal, will, I hope, encourage readers of *The Behavior Analyst* who are interested in developmental science to explore the field. (Readers are also directed to the following advanced textbooks in infant development: Bornstein & Lamb, 1992; Bower, 1989; Fogel, 1991; Mehler & Dupoux, 1994.)

The onus is also on developmentalists to familiarize themselves with the experimental analysis of behavior. Many current topics in behavior analysis, such as decision making (e.g., Fantino, 1998), behavioral momentum (e.g., Nevin, 1992), complex stimulus control (e.g., Honig & Fetterman, 1992), establishing operations (Michael, 1993), contingencies as discriminative stimuli (special section on contingency learning in *The Behavior Analyst*, Fall 1997), and stimulus equivalence (Sidman, 1994), to name just a few, would be of great interest to developmental scientists, were it not for the continued separation of the two fields with respect to journal space and conference attendance. Schlinger's book is a well-written account of the behavioral-cognitive debate from a historical perspective. It fails, however, to provide a firm basis for advancing and integrating theory and research in behavior analysis and developmental science due to its lack of attention to much of the work that has occurred in the last two decades.

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