Book Review

A Volume in Honor of Kenneth MacCorquodale: A Review of *Analysis and Integration of Behavioral Units*

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Early in the fall of 1985, I received a brochure announcing a conference to be held at the University of Minnesota in honor of Kenneth MacCorquodale. The list of speakers was diverse and interesting, and the focus of the conference was on units of behavior as an issue in behavior analysis. Given my interest in the topic and the fact that my home is only a day's drive from Minneapolis, I gave serious consideration to attending. In the end, the effort involved in rescheduling classes and a stiff conference fee combined to keep me home. All of us who did not attend can now read what we did not hear, for written essays based on those talks have been compiled in a volume edited by the conference organizers, Travis Thompson and Michael Zeiler.

My reading of this volume made me regret that I was too lazy and too cheap to make the trip. In part, I feel it is important to honor the people whose work we value while they can still appreciate it (MacCorquodale died in February, 1986 as the book went to press), but mostly I think this conference must have been an occasion filled with great conversation on many conceptual issues in behavior analysis. The speakers and the topics discussed should have provided an occasion for reconsideration of many assumptions underlying the work each of us does as a behavior analyst. Something

exciting seems to happen when a critical mass of behavioral intellectuals is assembled, and this volume has the slight glow of such an occasion.

CONTENTS OF THE VOLUME

Following a warm tribute to MacCorquodale by Travis Thompson, a series of essays frame the general issue; they progress from smaller to larger units of analysis. Commentaries on the general questions of unit definition and reductionism are provided by Zeiler and by Paolo Meazzini and Carlo Ricci as introductions to the topic; Peter Harzem offers strategies for using language to identify behavior patterns. Phil Hineline offers a clear example of the impact of unit selections in adjunctive behavior, and he offers a strategy for identifying the most useful definition. Don Baer offers strategic counsel for selecting units of human behavior in natural settings, and also describes an analysis of the verbal behavior of the person writing a unit definition.

Four essays then describe specialized areas of behavior analysis, making reference to their implications for a discussion of basic units of behavior. Zeiler integrates a wide range of research on temporally extended sequences of behavior, and Peter Dews gives a historical perspective on a range of findings in behavioral pharmacology. These essays relate to the theme of units primarily by providing examples of units of behavior that show very orderly interactions with experimental variables, the most commonly reiterated criterion for proper unit definition. Jack Marr describes a search for units in the verbal behavior of math-

Analysis and Integration of Behavior Units was edited by Travis Thompson and Michael Zeiler, and is available from Lawrence Erlbaum Associates (1986, 367 pp., \$32.50). I am grateful to Ed Morris and Renee Michael for helpful comments on earlier drafts of this review. Requests for reprints should be sent to Daniel Bernstein, 209 Burnett Hall, University of Nebraska, Lincoln, NE 68588-0308.

ematicians, and Roger Schnaitter expands the topic of a taxonomy of behavior into a comparison of contemporary behavioral and mentalistic psychologies.

Charles Catania and Dan Cerrutti offer an empirical demonstration of the combination of molecular units into larger structured patterns; their work is an example of using basic units of behavior to build complex structures instead of just searching for basic units. Murray Sidman also writes about building from basic units to more complex behavior, and his essay provides integrative insight into his research program in stimulus control. The final section of the book is devoted to discussion of units of the largest order, with aggregation of behavioral units over time and even across individuals. David Lubinski and Travis Thompson examine criteria for clustering individual units into patterns that resemble traits while maintaining clear behavioral referents. Paul Meehl also presents clusters of behavior patterns and defends their role as orderly units, and finally John Falk notes patterns of repetitive activity that suggest orderly units in a cultural context.

MAJOR THEMES OF THE ESSAYS

Defining Behavioral Units

This volume touches on many diverse behavioral domains and on many different research procedures, but the primary focus of most essays concerns defining behavioral units. Author after author asserts that the most important criterion of success for any attempted definition is the order found between behavior measured with the proposed units and features of the environment, usually in the form of experimental operations. Not coincidentally, virtually every author addressing this point cites B. F. Skinner's (1935) paper on the generic nature of stimuli and responses, a work that appears to be the common source of this widely held view. Referring to that article, Zeiler notes,

In a paper that has become so well integrated in the way experimental psychologists think about responses that it is rarely cited, Skinner . . . proposed that a response unit was the generic class of behav-

ior that showed orderly effects of an experimental variable. A fundamental unit is what is left when the irrelevant properties . . . have been stripped away. (p. 82)

Although the operant research tradition appears inevitably to lead to key pecks or lever presses as the units of behavior, it is the generic nature of Skinner's proposal that suggests application to units at a molar as well as a molecular level of analysis. In the molar arena, Baer's essay offers a very interesting account of the development of unit definitions for categories of "problem" behavior that would be typical in applied behavior analysis. He identifies sources of natural feedback within an intervention system that drive unit definitions toward matches with the variables being used to alter the target behavior. As Baer notes, this feedback system so successfully assures internal consistency that it is necessary to look outside the system for "social validity" to make sure the overall goals are being met. Meehl proposes a similar feedback strategy in sorting through different possible clusters of behavioral patterns in search of orderly, useful indices of individual differences.

Perhaps the most intriguing molar analysis is Lubinski and Thompson's exploration of aggregation of basic response units into clusters that might function like the traditional notion of a trait. They propose the use of extended baseline samples of behavior to estimate local patterns in response probability, attempting to account ultimately for transitions across response probabilities. This essay makes a good complement to their recent article on molecular analysis (Thompson & Lubinski, 1986), and it offers a way of addressing patterns that emerge across smaller units. The proposed analysis makes contact with the usual meaning of trait in noting that the relative occurrence of specific topographies within a response class (trait) cannot be predicted, leaving only more abstract units available for analysis.

In the molecular arena, Hineline describes research in which inter-event intervals are varied to determine maximum levels of adjunctive behavior. When

food is presented using periodic, response-independent schedules, the interval between periodic presentations can influence the amount of adjunctive drinking, pecking, or biting. Hineline adjusted the periodic interval with an interactive procedure similar to titration to home in on the duration that produced maximum responding, yielding units of interaction between behavior and environment. He explicitly notes that this strategy need not be applied to any particular level of analysis, and applies the notion to temporally extended patterns of behavior. As would be expected from examination of Skinner's initial statement, most behavior analysts recognize that orderly units will be discovered at many different levels of analysis and with samples including long and short time intervals.

Throughout the book, examples are presented of orderly relations discovered at molar and molecular levels, and over brief and extended time periods. The common strategy is reliance on finding order in environmental interaction rather than reliance on formal analysis. It is apparent from reading this book that Skinner's (1935) paper should be on every student's "must read" list, and readers who have not already done so will gain a valuable perspective on this volume by reading that Skinner article first. A more accessible variation on the basic theme is also available in Catania's (1973) paper on the concept of the operant.

Synthesis and Integration

A secondary focus in this volume is discussion of the integration of simple units into more complex behavioral episodes. Zeiler makes clear in his historical introduction to the area that integration will be essential in developing the utility of any analysis of units. The importance of units as building blocks is most apparent in the context of attempts to construct or synthesize complex behavior-environment interactions. After drawing a parallel between the cell in biology and the operant in psychology, Zeiler argues that the next step is to find the rules that

generate larger structures. Two excellent examples of that kind of work are presented in this volume, both of which follow familiar themes but still add new insights.

First, Catania and Cerrutti carried out a procedure first proposed as a thought experiment by Catania (1980) in a discussion of autoclitic processes. They demonstrate that a pigeon can keep three dimensions of responding conditionally discriminated on three dimensions of stimulus control, and they document a variety of training histories that brought about varying levels of this performance. The procedure is a clear example of the kind of work Catania (1983) called behavior synthesis, and it is an essential component of a complete study of the interaction between behavior and the environment. In one sense, this procedure is parallel to Epstein's (1981) simulations in that patterns typical of verbal behavior (structure and productivity) have been produced in a pigeon.

Second, Sidman describes extensive synthesis of complex units out of simple relational units, and extends the conceptual analysis into future relations not yet attempted. Using Skinner's (1935) generic response argument as a guideline for evaluating any proposed operant unit, Sidman expands the three-term contingency to five terms or more. He considers difficult problems in language recognition by proposing computer systems that would "learn" from experience with contingencies to recognize complex linguistic ideas. Sidman cites Findley's (1962, 1966) work with complex response chains as a beginning example and then describes structures of equivalent stimulus relations that he and his colleagues have built from simple training units.

It is discouraging to have only two preliminary empirical examples of synthesis in a book devoted to the utility of behavior units as fundamental to an empirical account of behavior, but both Catania and Cerrutti's synthesis and Sidman's exploration of equivalence classes are very promising and demonstrate a new direction that experimental analysts can pursue. Given the excite-

ment that Sidman's work has generated in the behavioral community in the last several years, there should soon be much more synthesis to report.

TOPICS NOT FULLY DEVELOPED

Two topics relevant to the issue of units could have received more attention from the authors or editors.

Complete Discussion of Reductionism

First, this volume certainly addresses the issue of reductionism (and reductivism), most explicitly in the essay by Meazzini and Ricci, but the topic is not really given a complete treatment. Most authors note or imply that both molar and molecular behavior analysis are appropriate, but they do not acknowledge that both of those positions are within one end of any continuum that includes all of psychology. Since most behavior analysts share the authors' acceptance of the value of analytic reductionism, it makes sense not to dwell on the topic. It would not hurt, however, to recognize that the struggles over unit definition described in this volume do not address the concerns of those psychologists who challenge the utility of reductionism as a research strategy.

When challenges to reductionist research are mentioned at all, they are given very brief consideration. For example, Meazzini and Ricci dismiss two aspects of the holistic position in a particularly cavalier fashion, contributing to the illusion that the topic of reductionism had been broadly covered. They note that a holistic position asserts (among several things) that "parts can not be understood, if they are detached from the whole" and "parts are closely and dynamically interlocked" (p. 28). In discussing the holist perspective, they state that these two assertions "can easily be accepted by all scientists, irrespective of their epistemological and methodological leanings" (p. 28). Many psychologists would find those two assertions inconsistent with most of the research practices in behavior analysis (or synthesis), and glib acceptance of these statements does not re-

spond adequately to the criticism implicit in them.

Zeiler and others support analytic reductionism by drawing a strong parallel between progress in biology based on cells and progress in psychology based on operants, but a critical perspective on this assertion is not integrated into the book. A discussion of reductionist assumptions would seem especially appropriate in the context of Catania and Cerrutti's synthesis of linguistic structures. Savage-Rumbaugh (1984) questioned the validity of Epstein's (1981) pigeon simulations, even while using Skinner's approach to the acquisition of verbal behavior. In a similar vein, someone should address whether Catania and Cerrutti's demonstration, important and elegant though it is, constitutes a simplified version of the same behavior-environment interactions that produce complex structures in human verbal behavior. Catania and Cerrutti recognize this issue, but the volume includes no extended treatment of the question.

On a broader scale, challenges to the most sweeping reductionist assumptions also come from within a behavioral perspective, but these are not addressed in any essays. For example, Lowe's (1979, 1983, 1985) research has legitimately questioned the assumption of a single, continuous line of reduction to simple elements that connects human schedule performance with nonhuman schedule performance. Nonhuman subjects respond to fixed intervals in the familiar scalloped pattern, whereas adult human subjects respond more uniformly and at very high or very low rates. Lowe has also demonstrated that nonverbal human infants respond in a scalloped pattern, while verbal children aged 5 years and older respond in the uniform pattern typical of adult humans. Lowe and colleagues have argued that these phenomena can be understood through analysis of verbal behavior, and Lowe (1983) asserted that behavior analysts have relied too much on data from nonhuman subjects. The discussions of reductionism should have included some response to this challenge from within behavior analysis.

Conceptual Contributions of Applied Behavior Analysis

The second underdeveloped topic in this volume is the contribution of applied behavior analysis to theoretical conceptions of behavioral units. Lubinski and Thompson (among others) discuss patterns of covariation as possible indicators of response class boundaries, making several suggestions about covariation patterns that could suggest clustering of units. In this discussion (and a similar one by Baer), no mention is made of previous conceptual analysis by Sajwaj, Twardosz, and Burke (1972) or by Bijou and Baer (1967) that suggested criteria for combining specific topographies into molar response classes. These authors raised many of the same conceptual questions that are found in this volume, but in the context of applied behavior analysis.

In a similar vein, this volume might have included more reports on integration of units or behavior synthesis, especially given the central role Zeiler proposes for integrating and building with behavioral blocks. My casual reading of the applied behavior analysis literature suggests that there are many examples of synthesis, often done under the rubric of verbal training. Research by Wheeler and Sulzer (1970), Lutzker and Sherman (1974), and Clark and Sherman (1975) documented successful strategies for combining simple operants into complex structures through behavioral procedures. None of this applied behavior synthesis is offered as an example of successful behavioral integration. It is worth noting in this context that Sidman's exciting conceptual work on integration and synthesis has taken place within an applied context.

CONTEXTS FOR EVALUATION

The success of this volume can be evaluated from several different frames of reference. First, one could ask if this book makes a contribution to the conceptual analysis of behavioral units, the topic of its title. On the whole, I believe the answer is yes, even though several of the

essays make only minimal attempts on their first and last pages to relate their main points to the stated topic. The work relevant to behavioral units is of such high quality that the volume makes a clear contribution to that aspect of our field. The presence of less directly relevant material is not a problem, in large measure because those essays are also of very high quality. The best thing about a conference is that interesting and active scientists talk about what they are currently doing and thinking; picking only people who will cover what the organizers want would probably limit the overall quality. As a volume based on conference presentations, the finished product exceeds my expectations for thematic coherence.

Given that the volume is somewhat eclectic, it could be evaluated as a potential source book for a personal library or a graduate course. In that context, I think the book's success is mixed. As a source of reading for personal scholarly growth, the essays outside the mainstream of the conference make good reading. Harzem's warnings about ordinary language use, Marr's account of mathematical verbal behavior, and Schnaitter's summary of his current thinking about mentalism are all highly readable and scholarly. Dews' review of behavioral pharmacology offers a historical perspective to the area that would be valuable to someone who wanted an overview, and Zeiler's essay on extended temporal patterns is both complete and intellectually stimulating. This is a volume that has many fine essays that would interest behavior analysts, and for that reason, I think it would be a good volume for an individual to own or find in the library.

Taken as a whole, however, this book would be less useful as a primary source for a graduate course. My impression is that most graduate courses are more focused than the range of these essays, and I would be unlikely to build a course around this book. Many individual essays focus on very specialized topics and would be highly appropriate for a particular course, but the volume is not sufficiently coherent that it would likely fit an entire course.

Finally, one could evaluate this volume as a publication honoring a fine senior scholar in the field of the experimental analysis of behavior. Although the book is not formally a *Festschrift* for MacCorquodale, the main function of the conference was to provide an occasion for people to express their appreciation of his career. Travis Thompson's foreword describes the interactions with colleagues and students that led people to admire MacCorquodale as a scholar and teacher, and it is easy to understand how experimental analysis could flourish in the environment depicted. The majority of the essays in the book, however, do not cite any of MacCorquodale's writing. Those authors who do make explicit citation mostly refer to only two articles (MacCorquodale, 1969; MacCorquodale & Meehl, 1948). The book succeeds in honoring Kenneth MacCorquodale despite the absence of citation because the scholarship found in the volume is the same high quality work that he did and that he engendered in those who worked and studied with him. Given Thompson's description of the kind of scholar and teacher MacCorquodale was, I would guess that he enjoyed these examples of behavior analysis presented in his honor.

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