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Mind and Measurement

Review by John H. Flowers

Daniel Algom (ed.), *Psychophysical Approaches to Cognition*

Amsterdam: North-Holland, 1992. 627 pp. ISBN 0-444-88978-7. \$157.00 (df. 275,-)

Daniel Algom, professor of psychology at Bar-Ilan University (Ramat-Gan Israel), is recipient of a grant from the United States-Israel Binational Science Foundation (1990-1993) and from the Israel National Academy of Science (1993-1996). Algom is author of *Perception and Psychophysics: An Historically Oriented Introduction to Some Representative Problems and Issues in the History of Psychology* (both in Hebrew).

John H. Flowers, professor of psychology at the University of Nebraska-Lincoln, is author, with C. Gargin, of the chapter "Creativity and Perception" in J. A. Glover, R. R. Ronning, and C. R. Reynolds (eds.) *Handbook of Creativity: Assessment, Research, and Theory*, author of the chapter "Voluntary and Involuntary Shifts of Spatial Attention During Visual Search" in D. Brogan and K. Caw (Eds.) *Visual Search 2*, and editor of *Nebraska Symposium on Motivation: Cognitive Processes* (Vol. 28).

A salient theme that emerges from almost any academic review of the history of psychological science is the tendency for certain research traditions and paradigms to develop independently, with relatively little crosstalk. Such has been the case with the classical psychophysical tradition and the much younger subdiscipline of laboratory cognitive psychology. The present edited volume (part of the "Advances in Psychology" series from North-Holland) contains 10 chapters, each of which addresses some aspect of the historical, existing, or future potential relationships between psychophysics and cognition. Given the diversity of research and theoretical interests among the 12 contributors to this volume, it is not surprising that the chapters differ in the relative emphasis they place on historical and philosophical analysis, advancement of theory, and review of empirical research. However, it is clear from the editor's remarks in the Preface that these chapters were indeed intended as "self-contained" (p. v) units, albeit within the broad theme of integrating psychophysical theories and methods within the domain of cognition.

Although the volume title implies that the primary theme will be to examine applications of psychophysical

techniques to the study of cognition, the first three chapters are somewhat more concerned with the cognitive nature of psychophysical judgment itself. Anderson's chapter, titled "Integration Psychophysics and Cognition," is aimed at advancing both a theoretical perspective and methodological approach—information integration theory and functional measurement. This comprehensive, eight-section chapter provides a sufficiently detailed development of both theory and methods that readers not previously familiar with Anderson's perspective and approach will find informative and thought provoking. Anderson provides clear descriptions of empirical applications involving a diverse set of research problems and settings, ranging from sensory evaluation (e.g., brightness judgment) to the more cognitive topics of memory psychophysics and attributions of causality. Because a major function of a volume such as this should be to stimulate creative thinking within a subject area, it is very useful to present examples of limitations of an approach and to discuss unresolved problems. This chapter accomplishes both these goals as well.

Marks's chapter, titled "'What Thin Partitions Sense From Thought Divide': Toward a New Cognitive Psychophys-

ics," is even more directly aimed at cognitive influences on psychophysics *per se* than is Anderson's chapter. After tracing the roots of modern thinking about perception and psychophysical measurement from ancient Greek philosophy to the present, Marks presents an excellent overview of research on context effects in psychophysical judgment, concluding with a strong plea for a pluralistic and cognitively based approach to psychophysics.

Ward's chapter, titled "Mind in Psychophysics," continues the theme that psychophysical judgment is best viewed in a pluralistic, cognitive framework. However, the theme is developed largely through a critical analysis of modern multidisciplinary views of the role of the mind (e.g., Minsky, Bechtel, and Dennett, to name a few), rather than from issues presented from empirical data. As such, Ward's chapter nicely complements the previous chapter by Marks. As with Marks's chapter, however, Ward's chapter is more concerned with the cognitive nature of psychophysics than with the application of psychophysical theory or procedures to the assessment of cognitive structure or representation.

With the exception of the final chapter, which returns to issues concerning sensory evaluation, the re-

maining chapters each address a theme that links a psychophysical approach with the study of cognitive representations. Galanter's contribution, "Intentionalism—An Expressive Theory," is concerned with psychophysical analysis of choice behavior. This chapter develops and provides examples of a general scaling procedure, *modulus estimation*, that is proposed as a tool for assessing utility based on equivalence matching with previously psychophysically scaled material. Galanter's contribution is, nevertheless, as much theoretical as it is oriented toward proposing a general measurement tool, because it is presented in the context of a general motivational theory of expressive behavior. From a more empirical standpoint, however, some intriguing suggestions are made about the application of the modulus estimation tools to the investigation of how utilities of individual components of a decision path are combined or integrated to determine overall utility of that path.

The next chapter, by Melara, is an extremely well-presented discourse on a central concept of perceptual and cognitive structure—similarity. Many widely used scaling and measurement procedures for assessing either perceptual or representational structures make implicit assumptions about similarity, such as its relationship to performance and the metric by which stimulus differences along separate dimensions are integrated to produce psychological distances among stimuli or concepts. Melara provides a concise, thoughtful, and readable historical analysis of how similarity has been treated historically, moving from Fechnerian psychophysics through the contributions of Thurstone, Attneave, Torgerson, Shepard, Kruskal, and others. This historical analysis leads to the presentation of a personal view about the concept of similarity that sets forth a presumably testable (but as yet not rigorously tested) model concerning integration of stimulus dimensions. The speculative theme with which the chapter concludes is to its credit; it should stimulate new thinking and research on a very fundamental issue in perception and cognition.

Baird and Hubbard address the topic of mental imagery and the ex-

tent to which psychophysical assessments traditionally applied in the perceptual domain (to actual observed stimuli) can be applied to assessment of the structure of imagined stimuli or events. Both the Baird and Hubbard chapter and the following chapter by Algom, titled "Memory Psychophysics," recognize that, although the study of memory and imagery have evolved from research traditions somewhat isolated from that of sensory psychophysics and have thus developed different approaches and tools to make inferences about mental structure, each discipline can clearly benefit from the sharing of research tools. Such an approach can be particularly useful in determining the degree of structural equivalence between perceptual and remembered (or mentally created) representations of stimuli.

The chapter on pain research by Rollman provides an interesting overview of how an extremely important quality of human experience (but one that is exceedingly difficult to measure or even define in a noncircular manner) can be systematically explored by psychophysical methods. Pain is both experienced and remembered and is controlled by both sensory and contextual events. Rollman provides an excellent layout of issues concerning the separation of sensory versus cognitive and emotional components providing many useful illustrations of the confounds and ambiguities inherent in previous laboratory work on this topic. Despite the shortcomings of much of this reviewed research, Rollman concludes with the strong view that in assessment of pain for either clinical, diagnostic, or research purposes, behavioral (i.e., psychophysical) responses encompassing "numbers, words, and matches" (p. 564) constitute a superior approach to that provided by purely physiological measures.

The final chapter of the volume by Gescheider, Bolanowski, and Verillo is more focused on methodological issues inherent in measuring sensory magnitude than on the interface with more cognitive issues. Although Norman, Marks, and Ward, each in their own way, stress the unavoidable and perhaps inseparable cognitive component to sensory measurement, this fi-

nal chapter returns to the perspective that measuring sensory magnitude *per se* is of value and that, given appropriate measurement procedures, it can be adequately accomplished with a minimum of contextual biases that could cause comparisons between experiments and settings to be uninterpretable. In my view, it would have been better to place this chapter after those of Marks and Ward, because it does address the general issue of context effects. As currently placed, however, this chapter is somewhat difficult to integrate with the themes of the immediately preceding chapters.

Other than the minor chapter placement issue mentioned above, my only other criticism is to question whether the volume title adequately encompasses the breadth of the contents. As indicated earlier, the initial chapters of the volume are deeply concerned with the fact that psychophysical judgment is by nature a cognitive task—even when applied to sensory evaluation. The application of cognitive principles to produce a better understanding of sensory judgment, as well to improve psychophysical measurement techniques, is such an important theme in several chapters that it would have been nice to have it reflected in the volume title.

In summary, I believe this volume will stimulate new research ideas, provide readers with some unique historical and philosophical perspectives, and raise important basic theoretical issues about both measurement and cognitive structure. Additionally, several of the chapters provide useful topical reviews (e.g., Baird and Hubbard on imagery, Algom on memory psychophysics, and Rollman on pain). The volume makes a compelling case that cognitive effects are an important component of psychophysical judgment even within the sensory realm and that psychophysical techniques can and should be used to tell us more about aspects of cognition. Whether the latter message will be heard by those cognitive psychologists who, according to Algom, view sensory psychology as "the last bastion of fixed mechanistic (i.e., psychologically trivial) properties, best left to those unprepared or uninterested enough to deal with real psychology" (p. 10), remains to be seen.