

Detection and Decision: The Theoretical Fundamentals

A review of



A Primer of Signal Detection Theory

by D. McNicol

Mahwah, NJ: Erlbaum, 2005. 240 pp. ISBN 0-8058-5323-5. \$29.95

Reviewed by

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Signal detection theory (SDT) was introduced to psychologists in the early 1960s. The fundamental concepts already existed, but the theory was not then part of mainstream experimental psychology. It rapidly became established as a tool for studying discriminative processes in perception, and approximately 10 years later D. McNicol (1972) published a short primer that provided a thorough but accessible introduction to the theory. McNicol's book, *Detection and Decision: The Theoretical Fundamentals*, long out of print, has now been reissued.

Few other theories have had such a broad impact on psychology as SDT. A tool that can distinguish perceptual sensitivity from response bias fills a need in almost every area of research, as evidenced by frequent use of the statistic d' to represent discriminative ability.

Extensions of SDT to recognition memory experiments were developed early on (see Wixted & Stretch, 2004, for a recent review). SDT has been used as the foundation for theories of judgment (e.g., Wallsten & González-Vallejo, 1994) and of group problem solving (Sorkin, Hays, & West, 2001). Applications are by no means limited to the study of basic psychological processes. SDT can illuminate topics ranging from diagnostic decisions made by clinical psychologists to forensic decisions made on the basis of lie detectors. And, because it was first developed to assist the analysis of radar images, SDT finds application well beyond the behavioral and social sciences (e.g., see Judy, Schaefer, Oestermann, & Greene, 1992, for a review of applications in medicine). The logic of the theory provides a useful critical thinking tool. SDT explains why we learn very little when told that, say, 75% of people telling a lie can be identified by using a lie detector. (We need to know the false alarm rate. If the lie detector falsely identifies 75% of honest people as liars, it clearly has no validity: $d' = 0$.)

McNicol's book provides a thorough introduction to the foundations, concepts, and methods of SDT, at a level that should be understandable by most undergraduates. It requires no background beyond basic statistics and elementary algebra. Each chapter contains several worked examples and includes practice problems, with answers.

The book begins with an introduction to the topic of statistical decisions. It uses the example of deciding whether a person is wearing shoes given that one knows his or her height—an example that is easy enough to follow, if not very engaging. The early chapters develop the standard Gaussian (normal distribution) model of binary decisions and its extension to rating tasks. Non-Gaussian approximations are then described. A later chapter covers threshold theory, which was probably taken more seriously as an alternative to SDT at the original time of publication, but which is still worth reviewing. Finally, the book provides a comparison with Thurstone's scaling methods. In every chapter McNicol provides detailed examples of the computational methods, so that a student who follows the text carefully will acquire a thorough understanding of each topic. For someone who wants to understand the central concepts, nothing is missing, and every chapter is useful.

But why reprint a book that was published 33 years ago? Someone of my age abhors the assumption that a book that old is of historical interest only. For the most part, the elements of the theory have not changed. If McNicol's book provided a good introduction to the topic when first published, why should it not do so now? Nevertheless, there are reasons to be puzzled. This is not a new edition; there has been no change in the original text. The only new material is a foreword by B. C. J. Moore, but an unfortunate printing error leads to the omission of some of the text—whether that text is a word, a line, or a whole page is not clear. We may never know why Moore is so pleased that the book is available once more.

There is a further concern for anyone planning to purchase the book or to use it for a class. The content is very similar to a recent book by Wickens (2002), which was reviewed in *Contemporary Psychology* by Lutfi (2004). Inevitably, a potential reader will be interested in a comparison of the two treatments.

The mathematical level of the two books is similar, although Wickens incorporates a few topics that require more than elementary algebra. Both provide a thorough coverage of the fundamentals. One advantage to McNicol's book is the chapter that explains the relationship of SDT to Thurstonian scaling theory. This helps to clarify the universality of the fundamental ideas and is not mentioned by Wickens.

However, Wickens's book covers several topics not found in McNicol's. It covers multidimensional versions of SDT, introduces methods for statistical testing, and discusses likelihood ratio interpretations of SDT at greater length. Perhaps most important, the more recent book provides plenty of references to computer programs.

The use of computers for data analysis has been a major change in psychological research since 1970. It is now possible to use methods that were previously impractical. For example, McNicol introduces the topic of maximum likelihood estimation, which in 1970 was a fresh development in SDT. However, it is computationally intensive and thus was beyond the reach of many investigators until the availability of high-speed computers. Now, one can easily find programs that perform the necessary calculations.

Neither McNicol nor Wickens provides as much information as I would like to see on applications of SDT beyond perception and psychophysics. This concerns me because the strength of SDT as a theory goes far beyond its psychophysical origins. In the first chapter McNicol lists several examples of applications of the theory, but his worked examples are all based on psychophysical topics. And the bibliography, of course, contains nothing published since 1970. At that time the number of applications outside perception was limited, but now there is hardly a topic in psychology for which one could not find a published example.

Psychologists of all kinds ought to be introduced to SDT. McNicol's book provides the necessary mathematical and conceptual foundation, but it will be unfortunate if readers assume that the theory is important only for the study of perception. Although the first chapter makes this point clear, I fear that nothing in the remainder of the book will encourage readers to think of the theory as a tool with many potential uses.

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