A SEQUENTIAL THEORY OF PSYCHOLOGICAL DISCRIMINATION*

S. W. Link**
AND
R. A. Heath

McMASTER UNIVERSITY
HAMILTON, ONTARIO
CANADA

A theory of discrimination which assumes that subjects compare psychological values evoked by a stimulus to a subjective referent is proposed. Momentary differences between psychological values for the stimulus and the referent are accumulated over time until one or the other of two response thresholds is first exceeded. The theory is analyzed as a random walk bounded between two absorbing barriers. A general solution to response conditioned expected response times is computed and the important role played by the moment generating function (mgf) for increments to the random walk is examined. From considerations of the mgf it is shown that unlike other random walk models [Stone, 1960; Laming, 1968] the present theory does not imply that response conditioned mean correct and error times must be equal. For two fixed stimuli and a fixed referent it is shown that by controlling values of response thresholds, subjects can produce Receiver Operating Characteristics similar or identical to those predicted by Signal Detection Theory, High Threshold Theory, or Low Threshold Theory.

Introduction

The purpose of this paper is to describe a time dependent decision process for relative judgments. The term relative judgment denotes a mental comparison between a subjective referent and a psychological (or psychophysical) value evoked by a peripheral stimulus, each defined on commensurate psychological (or psychophysical) continua. It will be assumed that the process of comparison consists of adding together, over small units of time, the differences between two such psychological values. When the summed differences exceed a subject controlled criterion, a decision occurs. Our aim is to describe the time course of this process of comparison and produce predictions relating response probability and response time.

A major assumption of Relative Judgment Theory (RJT) is that there

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exists a subjective referent which is based upon a subject's experience. In this regard a subjective referent has a status in RJT similar to the status of the adaptation level in Helson's [1959] adaptation-level theory. In our view stimuli not only serve to establish the referent but also act as probes of the referent that has been established. Thus the referent for a particular experimental task may depend heavily on the nature of the experimental task.

For example, when two stimuli to be compared are presented successively the memory of the first stimulus may act as a referent against which the second stimulus is compared. The adoption of the memory of the first stimulus as a referent may be optimal when values of both the first and the second stimulus vary from trial to trial. However, if the first of the two stimuli is fixed and only the second stimulus allowed to vary then performance may be improved by basing the referent upon knowledge of both the fixed standard and the comparison stimuli presented on proceeding trials.

When only one of two stimuli is presented during an experimental trial a classification of the stimulus presented may depend upon a referent that is based upon a blend or mixture of the psychological representations of the two stimuli. The referent must then depend upon prior exposure to the two stimuli, and, furthermore may be shaped or emphasized by the number of previous exposures to each stimulus. With novel stimuli many practice trials may be required before a referent is sufficiently well defined to allow discrimination to be exhibited. On the other hand previous exposure to the stimuli may produce a well established referent prior to the subject’s exposure to the experimental task.

These examples are meant to convey our interpretation of a "mental" standard against which the subject compares a presented stimulus. The mental standard may depend upon previous exposure to the stimuli employed in the experiment and may be modified through repeated exposure to the stimuli. The mental standard is, therefore, on the stimulus side of a discrimination process and is the psychological yardstick or referent against which other stimuli can be compared. A judgment concerning a feature of a stimulus is relative to the referent utilized by the subject performing the judgment.

The simplest case of relative judgment will be developed. In particular it will be assumed that only two responses are available to the experimental subject and that one response must be made by the subject on any experimental trial. These two responses may be associated with various discriminative responses such as Same-Different, Larger-Smaller, Blue or Green, or in general a binary discrimination. Thus a restriction on the present theory is not the number of stimuli but rather the number of responses. However, to demonstrate the major relationships among components of the relative judgment process the examples given below will assume a two stimulus-two response discrimination procedure.

We will assume that the psychological values representing either a