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A cybernetic theory for EEG biofeedback

Kip Errett Patterson
Mental Health Clinic, Fourth Medical Group,
Seymour Johnson Air Force Base, North Carolina, USA

Abstract

Purpose – The purpose of this paper is to present a theory that applies Miller *et al.*'s (1960) Test-Operate-Test-Exit (TOTE) concept to the psychophysiology involved in electroencephalographic (EEG) biofeedback (BFB).

Design/methodology/approach – Six components are presented, namely, the teleological brain, attractors as the "test" in TOTEs, EEG production, positive and negative feedback, synaptogenesis and designated actor, and then integrated into a theoretical structure. Comparisons with the previous conceptualizations are discussed, and finally, suggestions for practical application and needed research are offered.

Findings – Previous theories neglected significant variables and promoted unverified conceptualizations. These issues are redressed with a psychophysiological, cybernetic theory.

Research limitations/implications – The pursuit of substantive research needed to verify the theory would improve the scientific foundations for EEG BFB.

Practical implications – This theory shifts the designated actor in BFB to the participant's brain, away from the BFB provider. EEG BFB is thus viewed as a means for neuronominalization driven by the brain's attractor systems instead of as an intrusive intervention.

Social implications – The theory proposes a much more participant-centric process than previous modes, which also promotes self-determination. The research validation needed for the theory could produce wider EEG BFB acceptance and application.

Originality/value – The theory is a complete departure from previous conceptualizations. It is the first instance of TOTE application to psychophysiological processes, and it is the first fully cybernetic conceptualization of EEG BFB.

Keywords Theory, Biocybernetics, Biofeedback, EEG, Neurofeedback

Paper type Conceptual paper

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Introduction

Cybernetics, as a discipline, should play a dominant role in the study of any area of psychology. For living systems, cybernetics offers a scientific discipline that examines how systems control their own outcomes, maintain their own integrity and modify/adapt themselves during their teleological behavior. The critical feature of any application of cybernetic concepts is the analysis of "feedback loops" in which the output of a system becomes an iterative input which allows the system to update its status *vis-à-vis* the results of its output. A cybernetic system is, essentially, conceptualized as self-correcting.

Unfortunately, mainstream psychology tends to ignore cybernetic principles and to remain infatuated with agricultural statistics as a means of verifying "cause-effect", strictly linear variable relationships. A PubMed (US National Institute of Health searchable database

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