Psychophysiological predictors of task engagement and distress

Stephen H. Fairclough & Louise Venables
School of Psychology
Liverpool John Moores University
UK

Abstract

Biocybernetic systems utilise real-time changes in psychophysiology in order to adapt aspects of computer control and functionality, e.g. adaptive automation. This approach to system design is based upon an assumption that psychophysiological variations represent implicit fluctuations in the subjective state of the operator, e.g. mood, motivation, cognitions. A study was performed to investigate the convergent validity between psychophysiological measurement and changes in the subjective status of the individual. Thirty-five participants performed a demanding version of the Multi Attribute Test Battery (MATB) over four consecutive twenty-minute blocks. A range of psychophysiological data were collected (EEG, ECG, SCL, EOG, respiratory rate) and correlated with changes in subjective state as measured by the Dundee Stress State Questionnaire (DSSQ). The DSSQ was analysed in terms of three subjective meta-factors: Task Engagement, Distress and Worry. Multiple regression analyses revealed that psychophysiology predicted a significant proportion of the variance for both Task Engagement and Distress but not for the Worry meta-factor. The consequences for the development of biocybernetic systems are discussed.

Introduction

Biocybernetic systems utilise real-time changes in psychophysiology as an adaptive control input to a computer system. For example, a biocybernetic loop may control the provision of automation within an aviation environment (Byrne & Parasuraman, 1996). This loop diagnoses the psychological status of the human operator based on psychophysiological activity and relays a control signal to initiate or relinquish system automation (Pope, Bogart, & Bartolome, 1995). The affective computing concept (Picard, 1997) represents an example of the same principle where psychophysiological monitoring/diagnosis enables computer software to respond to the subjective state of the user. The concept of biocybernetic control enables a wide range of applications (Allanson & Fairclough, 2004), from adaptive automation (Scerbo et al., 2001) to health-monitoring (Gerasimov, Selker, & Bender, 2002) and biofeedback training tools (Pope & Palsson, 2001).

In D. de Waard, K.A. Brookhuis, R. van Egmond, and Th. Boersema (Eds.) (2005), *Human Factors in Design, Safety, and Management* (pp. 349 - 362). Maastricht, the Netherlands: Shaker Publishing.