Chapter 15
Realtime BioSensing System Assessing Subconscious Responses of Engagement: An Evaluation Study

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ABSTRACT

Inferences of physiological responses are seen increasingly in dynamically adaptive environments, towards personalization, learning, and interactive instructional design. In search of conclusive interpretations, scientists consider bio-sensing and physiological metrics in addition to formal assessment methodologies. Devices developed for laboratory use impose limitations that yield them prohibitively unsuitable for wider use due to their strong dependence on electrodes and kinetic restrictions. Additionally, synchronisation, diverse format and frequencies of data produced by assorted equipment, contribute to precision concerns. The development cited in this chapter circumvents the above constraints by using a proprietary real-time system. An algorithm assessing coinciding excitation of two important physiological quantities is used to evaluate classifiers indicative to focused attention and engagement. Experiments and interpretations are delineated, exposing system accuracy and potential to assist in substantiating propositions towards improved learning performance and adaptive personalisation.

INTRODUCTION

The concept analysed in this chapter, involves an implementation assessing the effectiveness of simultaneous excitation of two physiological signals when used to deduce states of engagement and focusing involvement of a learner. An unobtrusive proprietary system has been used as a tool for assessing validity and accuracy of a modelling algorithm deducing psychosomatic condition from their corresponding

DOI: 10.4018/978-1-5225-3940-7.ch015

physiological expressions. Classifiers produced by the system in real time can be effectively provided as inputs to dynamically adaptive learning environments.

Scientific studies assessing learning efficiency rely predominantly on toolsets employing formal psychological assessment of emotional and affective disposition (McCrickard & Chewar, 2006, Groth-Marnat, 2009). The above toolsets help to deduce relationships between pre-designed teaching scenarios and learning scores which are then used to optimise educational content. Typically, pre-validated self-reporting questionnaires, interviewing sessions and personality assessments, form the initial collection of data (Costa & McRay, 1992). Subsequently, datasets are examined in relation to selected hypothesis and studied further in order to deduce conclusive statistical interpretations. Although formal methodologies enjoy a high degree of credibility in the scientific community, one can argue that particularly when assessing learning aptitudes, feedback taken from learners present largely their subjective judgment. Disparity errors introduced by the differences between actual psychosomatic conditions and corresponding responses obtained from individuals require additional consideration. Recent studies have also demonstrated that incidental emotional and affective states of a learner influence their perspective judgement (Damasio, 2006), an influencing factor particularly difficult to estimate by formal methods. As humans do not have clear perception of their emotional or affective state, its particular constituents and their specific intensity (Salovey & Mayer, 1990), subjective evaluations can be biased and error prone, particularly in estimates of combinations of emotions that produce similar affective conditions (Ochsner & Gross, 2005). Studies in evolutionary biology and psychology present a number of theories of emotions, emphasizing analogies either with propositional judgments or with perception, making choice of relevant methodologies for learner assessment even more intricate. Different ontologies of emotion express various concerns disputing rational and cognitive contribution towards emotional and affective formation, reducing in some cases the credibility of early studies based on those earlier assumptions.

Ambiguities in definition of emotion and affect as mentioned above limit the collective acceptance of several studies. Also, a concession when using formal assessment becomes more obvious if results and vital conclusions need to be drawn immediately. Cross-validation and intelligent analysis of hand written records can be cumbersome when conclusive data need to be readily available as they happen (i.e. in real-time assessment). The above limitations have forced scientists to seek established foundations for new universally accepted data classifiers.

Digital Technologies have introduced a credible alternative to formal psychological assessment and self-reporting methodologies with regards to learning and personalisation. Biosensing and physiological data acquisition present a new approach to deduce inner expressions of emotional and affective disposition. Major advantages of biosensing over formal assessment methods proving invaluable when studying psychosomatic condition are:

- Impartiality of measurements
- Real-time processing capabilities
- Learners cannot affect in any way the quality of data.

Evaluation of physiological expressions used as indicators of emotional and affective reactions has been investigated in numerous studies (Picard, 2003; Fairclough, Moores, Ewing, & Roberts, 2009).

Typical system configurations for assessing affect, cognitive engagement or brain activity using physiological measurements essentially borrow functionality from medical devices designed for use strictly in laboratory settings and therefore their usage in commonplace environments proves difficult.