

# Chapter 21

## A Study of Biofeedback in a Gaming Environment

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### ABSTRACT

*This chapter reports on a study of biofeedback in a gaming environment incorporating the acquisition and analysis of physiological data sets in tandem with other behavioral and self-report data sets. Preliminary results presented here provide some groundwork toward subsequent study in this area, as more comprehensive and detailed treatments will require further research. The main contribution and focus of this chapter concerns our experiences in applying methods not typically available to educational researchers. Our results are promising, though they cannot be taken to be definitive. Further developments and applications of these methods will lead to more detailed investigations as to what people may learn or gain from biofeedback in gaming environments, along with interdependencies of biofeedback and gaming pertaining to affect, motivation, behavior and cognition, and perhaps especially, to learning anxiety.*

### INTRODUCTION

This chapter reports on a collaboration between the *SAGE for Learning* project and *ENGRAM/ME*. *ENGRAM/ME* (Educational Neuroscience Group for Research into Affect and Mentation / in Mathematics Education, [www.engrammetron.net](http://www.engrammetron.net)) is a diverse collection of researchers with a special but

not restricted emphasis in mathematics education, concerned with augmenting educational research with methods and results from psychophysiology and cognitive neuroscience (Campbell, with the ENL Group, 2007). The central hub for *ENGRAM/ME* activities is the *ENGRAMMETRON*, the second author's state-of-the-art educational neuroscience laboratory in the Faculty of Education at Simon Fraser University, where the research reported herein was conducted.

DOI: 10.4018/978-1-61520-731-2.ch021

This study observed, recorded, and analyzed participants' experiences playing a biofeedback-based video game called *Journey to Wild Divine*®. The virtual nature of this game invites players into an interactive realm of seemingly endless possibilities. This interactive gaming environment, consisting of graphics and music, entices and affects changes in players' energy levels by encouraging alterations in their breathing rates and levels of relaxation, thereby determining their progression through the game. We hope that this preliminary study will inform future research that can unveil novel educational implications leading to interesting new ways to improve teaching and learning.

## **BACKGROUND**

Biofeedback has been studied for more than 40 years, and has well-established utility. Many of its clinical applications have been identified for quite some time. Biofeedback training has been broadly used as a treatment for addiction, attention-deficit hyperactivity disorder (ADHD), autism, and epilepsy. At present, there are more than 1,500 professionals practicing biofeedback training in hundreds of mental fitness centers in North America. According to the Biofeedback Certification Institute of America (BCIA) ([www.bcia.org](http://www.bcia.org)), there are currently more than 1,000 practitioners with BCIA certification in the U.S. and about 33 in Canada.

### **Why Learn Biofeedback?**

Biofeedback is based on direct, immediate feedback to the person about the state of some aspect of his/her body, such as heart rate, respiration rate, or temperature. According to Whitehouse and Turner (2007), biofeedback typically involves the use of electronic equipment to monitor peoples' internal physiological states and provide them with feedback that consequently helps them learn to

influence those states, "to activate, balance, release or recover from them" (para. 2). Biofeedback presenting some aspect of an individual's brain behavior to that individual in real time, using methods such as electroencephalography (EEG), is commonly referred to as neurofeedback. (Note that although we recorded participants' EEG, neurofeedback was not a part of this study because they were not presented with these data).

Biofeedback training has been proven to have a powerful, positive effect on one's emotional and physical condition through many medical interventions and educational training programs (e.g., see Larsen, 2006). A noted example is the "New York Program," which demonstrated that a biofeedback program can have a significant positive effect on school and community. This effect has been referred to as "The Ripple Effect" (Biofeedback Consultants, 2008; see also, Imel, Baldwin, Bonus, & MacCoon, 2008).

Research has also shown that biofeedback training can be an appropriate and efficacious treatment for children with ADHD (Fuchs, Birbaumer, Lutzenberger, Gruzelier & Kaiser, 2003; Lubar, Swartwood, Swartwood, & O'Donnell, 1995; Warnes & Allen, 2005). Some researchers have further confirmed that biofeedback is an effective way to control anxiety and panic (Plotkin & Rice, 1981; Rice, Blanchard, & Purcell, 1993; Townsend, House, & Addario, 1975) because biofeedback can often be helpful "in stabilizing a nervous system so that it no longer makes excursions into panic" (EEG Spectrum International Inc., 2007, para. 3). Research also suggests that skills people have developed through biofeedback training can be transferred to daily life after they have developed habitual behaviors, and that they feel comfortable with their new response patterns.

So, why learn biofeedback? Research and accepted practice in this area have shown that biofeedback can provide advantages for people in improving self-control and performance in daily life. Measuring effectiveness is a non-trivial

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