Chapter 55
Cultivating Chan with Calibration

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ABSTRACT

Chan is a superior mental training methodology derived from Buddhism and absorbed the wisdom of religious practitioners, philosophers, and scholars around Eastern Asia through thousands of years. As the primary way of Chan, meditation has clear effects in bringing practitioners' mind into a tranquil state and promoting both the mental and the physical health. The effect of Chan is measurable. The authors propose to establish a Chan science by applying modern experimental sciences to various models. In particular, machine learning methods have been used to classify brain states using electroencephalogram (EEG) data. The experimental results show potential in building brain state models for calibrating the routine of meditation. Through these studies, the authors believe they will be able to make Chan a beneficial practice to promote human's life in modern society.

INTRODUCTION

Chan (Zen), originated as a methodology of spiritual meditation, has played an important role in the history of Eastern countries. In recent centuries, with the fusion of various cultures in modern society, Chan has drawn the attention of various ethnic groups for its focus on practice and direct effect on human's lifestyles and health conditions. Chan itself has shown its religion neutral nature in the modern society. The objective of this article is to introduce Chan without any religious biases and discuss its effect on human's health system, and propose a "Chan science," i.e., using scientific methods to measure the effectiveness of Chan practice and, therefore, develop a system to guide Chan practice.

Although Chan is not a typical scientific topic, it is clearly a philosophy that impacts human's view about the essence of science and relates scientific study to the contemplation of its performer --- human. In recent years, term "life science" has been used to denote studies related to the understanding of human's nature and seeking ways to harmonize human's life with the environments. Therefore, applying Chan methodology to health sciences is important. It will help clarify misunderstandings about Chan around the world. For the historical reason, Chan is regarded as a religious practice of a sect of Buddhists and its philosophy concords with Buddhism only. As a matter of fact, Chan is the result of a reflection on various philosophies including Buddhism and Taoism (Taoism is a system of Chinese philosophy) and became a practice-oriented life philosophy (Nan 1993). It is independent of any religions and customizable to any religious and cultural ground. For example, Confucianism adopted Chan and became a system that includes not only ethical teachings but spiritual exercises.

Renowned scientist and philosopher Galvani was the first person to discover electrical activity in living organism in the 18th century (Kropotov 2009). Later, the electrophysiologist Hans Berger successfully recorded electrical activity from the human brain using electroencephalography (EEG), which measures voltage oscillations due to ions flow in the neurons of the brain. Today, EEG is one of the popular non-invasive techniques to record brain activity in clinical and research settings, and there is a wide range of applications for the analysis and interpretation of these measurements. The development of EEG devices, for example, EPOC from Emotiv (www.emotiv.com) and NeuroSky (www.neurosky.com), and increasing interest in EEG data analysis is evident. EEG data carries an immense potential in its usability in various areas including human-computer interaction, psychology, and neurological sciences. Therefore, it is a valuable endeavor to design an application that applies various analytical techniques to EEG data and predicts the state of the brain from which the data was acquired.

There are five major waves recorded by EEG devices (Table 1). Beta waves are linked with the mechanism of consciousness while alpha waves are associated with disengagement (Larsen 2011). Theta waves are often related to motionless but alert (Sławińska, & Kasicki, 1998), and finally, Delta waves are associated with sleeping. There are numerous studies aimed to decipher the complex relationship among consciousness of the brain, the underlying pattern of its activity, and the generation of waves, using mathematical models and computing technology. Yang et al. (2010) have proposed some novel feature extraction method using harmonic wavelet transform and bispectrum for EEG signals to be used in brain-computer interface (BCI) system to classify left and right-hand motor imagery. The experimental results have shown that the separation of the classes extracted by proposed method achieved recognition accuracy of 90%. Similarly, in a different study, the spectrum analysis of brain waves using specific music stimulus has been successfully completed utilizing various statistical models (Zhuang et al., 2009). The research group found that the upper alpha wave was entrained under the special brainwave stimulus. This study showed the positive correlation between upper alpha wave generation and memory formation in the brain.

The EEG is also being used to develop innovative systems in healthcare and biomedical research. The recent study has been reported to discover links between emotional states of patients and their brain activity using machine learning algorithms (Yuvaraj et al., 2014). The research analyzed EEG data collected during various emotional states from 40 Parkinson disease patients and healthy subjects using bispectrum feature and concluded that the higher frequency bands such as alpha, beta and gamma played an important role in determining emotional states compared to lower frequency bands, delta, and theta. In a different study, Direito and the group have designed a model to identify the different states of the epileptic brain using topographic mapping relative to delta, theta, alpha, beta and gamma frequency (Direito

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