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The Effect of Bio/ Neurofeedback Training on Visual Selective Attention in Elite Taekwondo

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ABSTRACT

Background: The use of peripheral biofeedback is growing rapidly in sport psychology. **Objective:** The purpose of this study was The Effect of Bio/Neurofeedback (BNFK) on Visual Selective Attention of Iran Taekwondo National Team. Therefore 16 elite males were divided to experimental and control groups purposefully and systematically (according to federation physical test), with a minimum of three years experience at the international level or overseas competition. The test (as pre-tests and post-tests) to assess selective attention included: Integrated Visual and Auditory Continuous Performance Test (IVA-Advanced). Athletes received 45 minutes of a Heart Rate Variability (HRV) and Respiration Biofeedback Training (BFB) and also Neuro feedback Training (NFB) in every session (15 session), that included increasing in total HRV and decreasing the rate of respiration. Also the procedure of the research involved NFB training with these protocols: (1) to train the skill of focus, and relaxation skills. (2) For the aim of decreasing Theta power/ Beta power, Busy Brain ratio, and Intensity waves. The t-test was applied for data analysis and the result was: there is a significant difference between the pretest and posttest scores of the experimental and control group in Visual Selective Attention ($t_{(7.69)} = 3.71, p < 0.05$). It can thus be concluded that BNFK training increases Attention in order to improve self-regulation of elites' Arousal.

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INTRODUCTION

The last few decades have seen a substantial increase in the employment of sport psychology and specialized sport enhancement consultants by individuals athletes and Olympic and professional teams. This trend is filtering down to college, high school, and youth sports as well. This is because athletes and coaches know the mind shapes the outcome for almost all of physical activity and sport behavior. Your mind tells your body what movements to make to properly execute a skill, and your body tells your mind what is experiencing during the execution of that skill. Prior to the computer age, athletes and the sport psychology consultants who train them had to make guesses about what was going on in the body during a great performance (Vietta, 2011). Therefore, the use of peripheral biofeedback is growing rapidly in sport psychology. The aim is to lower competition stress and anxiety and to promote optimal attention and performance. To date applied sport psychologists spend much of their time encouraging athletes to develop psychological skills that will enhance their performance (Krane and Williams, 2006). These skills and strategies enable athletes to develop self-awareness and self-regulation of arousal (Crews *et al.*, 2001).

The main purpose of all of these psychological skills or strategies is to enable an athlete to perform exceptionally well in the stressful environment of national, international and Olympic level competition (Crews *et al.*, 2001).

To achieve appropriate arousal levels, Biofeedback is often mentioned as a useful means for facilitating the learning of self-regulation by competitive athletes (Blumenstein *et al.*, 2002; Collins and McPherson 2006; Ravizza, 2006). Biofeedback can be a powerful tool for physiological and psychological change, increasing individual awareness and control over the body, reducing habitual stress, improving arousal regulation (Blumenstein *et al.*, 2002). The most common biofeedback modalities used in sport are heart rate variability (HRV), respiration, temperature, EMG, EDR, and EEG. These biofeedback modalities reveal the subtle and dramatic changes in the autonomic nervous system (ANS) (Vietta, 2011; Davis and Sime, 2005).

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The biofeedback modalities are: Muscle contraction and relaxation is measured by electromyography (EMG). Temperature change is assessed via fingertip thermometers. Skin resistance influenced by sweat is evaluated by electro dermal assessments (EDR). Cardiovascular activity is measured via heart rate, heart rhythm, and blood pressure. Respiration is analyzed by the depth and rate of breathing, and brain wave activity is measured by electroencephalography (EEG) (Vietta, 2011). Electroencephalographic (EEG) feedback, usually called neurofeedback (NFB), is a technique that involves a brain-computer interface that monitors the electrical activity of the brain and gives virtually instantaneous feedback to the athletes concerning his/her brain activity. The activation patterns in various brain regions at any given moment determine how a person performs in a specific task (Vietta, 2011).

Literature review:

Attention has always been a topic of major interest to psychologist and motor behavior researchers. Early research and theorizing began in the 19th century (Crews *et al.*, 2001); and interest in the topic remains high today. William James (1890), one of the most renowned experimental psychologists wrote: Attention is the taking possession by the mind, in clear and vivid form, of one out what seem several simultaneously possible objects or trains of thought. There are many different ways to view the concept of attention. One of these is the notion that attention is limited: we can attend to only one thing at a time, or think only one thought at a time. In terms of motor behavior, we seem strongly limited in the number of things we can do at a given time, as if some "capacity" would be exceeded if too much activity were attempted. Another important feature is that attention is selective: we can concentrate on one thing or on something else (Zaichkowsky and Baltzell, 2001). In addition to the capacity limits of attention, the selection of performance – related information in the environment is also important to the study of attention as it relates to the learning and performance of motor skills. This area of study is commonly referred to as selective attention. Of particular interest to researchers has been *visual selective attention* to environmental information that influences the preparation and/or the performance of an action (Magill, 2011). Some ways to operate the nation of attention are Attention and Consciousness, Attention as Effort or Arousal, and as a Capacity or Resource. Attention as arousal is based on the idea that when people perform attention – demanding tasks such as diving in competitive swimming, they are expending mental *effort* that is revealed in various physiological measures. Therefore, it is useful to consider attention as reflected by various physiological measures of arousal, a dimension indicating the extent to which the subject is activated or excited. Kahneman (1973) used physiological measures of skin resistance and heart rate as indirect measures of the attention demand of various tasks (Zaichkowsky and Baltzell, 2001).

Regulating a range of optimal arousal in order to become a more efficient and consistent high-level performer is a difficult skill that is usually developed over time with much practice and training. Hanin's Zone of Optimal Functioning (ZOF) depicts the interaction of emotional states and optimal performance. This theory considers differences in arousal levels and emotions and their influence on ideal performance states. Some athletes thrive on higher levels of arousal for optimal performance, whereas others find this state to be counterproductive to performance (Zaichkowsky and Baltzell, 2001).

Addressing the influence of emotions that pertain to athletes will assist them in identifying their zone of optimal performance. This occurs during biofeedback as the individuals visualize their psycho physiological response to emotions and implement self-regulation strategies to control the effects of dysfunctional emotions (Davis and Sime, 2005). Therefore in biofeedback training, the clinician assists the athlete in developing strategies to gain voluntary control over biological responses that are not normally, consciously controlled. This is referred to as self-regulation (Blumenstein and Tenenbaum, 1997). During this self-regulation process, the athlete learns to regulate various physiological states with instrumentation and then proceeds without the use of feedback devices. Eventually, the athlete transfers the knowledge acquired through biofeedback training into other arenas of life (Crews *et al.*, 2001). Ultimately, the client is trained to perceive unhealthy biological responses during daily activities and is able to substitute healthier responses in such events (Raymond *et al.*, 2005). Research in sport psychology and biofeedback is primarily concerned with issues related to affect, emotions, arousal and focus and their relationship to performance (Blumenstein and Tenenbaum, 2002). Arousal regulation and focus are known to be crucial aspects to quality performance. The advantage of utilizing biofeedback training as a means to prepare for competition is to facilitate cognitive and affective awareness which is likely to improve the probability of a successful performance (Raymond *et al.*, 2005).

Research has shown that psychological and physiological stress, experienced by athletes during training and competition, can be regulated by biofeedback training (Blumenstein and Tenenbaum, 2002). To date the roles of sport psychologists is very important; about coaches, players and other related team members. This research studies about the Taekwondo, one kind of the Martial Art. Few forms of sports competition include a greater segment of mental skills than martial arts. Psychological aspects of martial arts combat are extensive before, during and even after the event. Concepts such as psychological preparation, concentration, anticipation, flow, emotional control, self-control, confidence and competitiveness are at the heart of this ancient form of combat. A discussion of the application of sport psychology to martial arts includes examining the combatants' desirable

psychological dispositions that explain or predict success, and the mental skills and behavioral tendencies before, during and following competition (Mark *et al.*, 2007).

There is debate regarding psycho physiological techniques and performance enhancement because it is difficult to ascertain their true relationship. Do psycho physiological techniques truly result in improved athletic performance, or are the cognitive-affective responses merely a byproduct of the intervention program?

Methodology:

This study involved 16 elite males were divided to experimental and control groups purposefully and systematically (according to federation physical test), with a minimum of three years experience at the international level or overseas competition. The test (as pre-tests and post-tests) to assess visual selective attention included: Integrated Visual and Auditory Continuous Performance Test (IVA–Advanced). IVA - AE is an integrated auditory and visual continuous performance test designed to assess two major factors - Response Control and Attention. The test task involves responding or inhibiting a response for a total of 500 trials for the Basic Test or 1000 Trials for the Extended Test. Each trial lasts only 1 second, thus the test demands constant sustained attention.

Athletes received 45 minutes of a Heart Rate Variability (HRV) and Respiration Biofeedback Training (BFB) and also Neurofeedback Training (NFB) in every session (15 session), that included increasing in total HRV and decreasing the rate of respiration. Also the procedure of the research involved NFB training with these protocols: (1) to train the skill of focus, and relaxation skills. (2) For the aim of decreasing Theta power/ Beta power, Busy Brain ratio, and Intensity waves.

The instruments used in gathering physiological data were a Pro Comp Infinity (the hardware) and Biograph Infinity (the software).

The first an interview was conducted with each athlete to explore how they had, to date, used specific psychological skills such as stress and anxiety control, relaxation, and focus. The athletes were also asked to talk about their performance in competition from the previous season. Following the interview, physiological base line data was collected to establish the athlete's psychophysiology baseline. During each training session, the athlete completed 45 minutes of Bio/Neurofeedback training (BFB: 30 m & NFB: 15m). Each of athletes received several Biofeedback sensors for temperature, EMG, HRV, EDR, EEG. Biofeedback sensors were temporarily applied to the athlete's body to record data. The changes of physiological factors were shown by monitor which was a graphical program. As post test after these psycho physiological training the IVA–Advanced was done such as pretest.

Results:

The t-test was applied for data analysis and the result was: there is a significant difference between the pretest and posttest scores of the experimental (9.25) and control group (0.25) in Visual Selective Attention ($t_{(7.69)} = 3.71, p < 0.05$).

According to the tables:

Table 1: The result of t test to analysis visual selective attention.

Sig.	df	t	Lovin test		mean	Group	Variable
			Sig.	F			
0.006	7.69	3.71	0.008	9.73	9.25	experimental	Visual selective attention
					-0.25	control	

Conclusions:

The purpose of this study was to explore the Bio/Neurofeedback training, which trains self-awareness and self-regulation of physiological and mental-emotional states (arousal) to improve the types of attention, according to the relationship between (attention and arousal). The result indicated: there is a significant difference between the pretest and posttest scores of the experimental and control group in Visual Selective Attention. It can thus be concluded that BNFK training increases Visual Selective Attention in order to improve self-regulation of elites' Arousal. The athletes can enhance their attention because it gives them new tools for stress managing, arousal and anxiety regulation, therefore their sport performance can augment after gaining this psychology skill. These findings support Schwartz and Anderasik's statements (2003) because they developed self-regulation techniques to decrease their sympathetic arousal.

The athletes became more aware of their own early signals of stress. They were able to use this signal as cues to relax or shift focus while doing tasks (Ravizza, 2006), He has suggested that the key learning is when the athlete starts to understand their own cognitive patterns and begins to identify and manage them while performing. Obviously, Visual Search and Attention Rules influence performance in sport. The visual search for regulatory information in the performance environment is an active search that a person engages in according to the action he or she intends to perform.

Historically, Bio/ Neurofeedback training has been used extensively in the treatment of health related disorders such as hypertension, tension headaches, migraine headaches, anxiety disorders, and insomnia (Collins and McPherson, 2006). Biofeedback training has been shown to successfully improve concentration, attention and focus in a wide variety of domains (Schwartz & Andrasik, 2003). For instance, Schwartz and Andrasik (2003) state that noticeable positive outcomes using, Bio/Neurofeedback training were observed in the treatment of Attention-Deficit/Hyperactivity Disorder (ADHD), anxiety disorders, mood disorders, seizures disorders, and traumatic brain injury. Based on the fact that, Bio/Neurofeedback training has been proven to be a successful technique used for the treatment of these disorders, it becomes interesting to consider the technique within the sport domain. In the sport setting, particularly with elite athletes, Bio/Neurofeedback training is highly appropriate. The measurement of the autonomic and central nervous system responses by psycho physiological assessment is especially relevant because of the psychological and physiological stressors inherent in the competitive environment (Blumenstein and Tenenbaum, 2002). Furthermore, athletes are motivated to continuously evaluate their performance and thereby are accustomed to feedback (Blumenstein and Tenenbaum, 1997). Maybe researches in the field of Bio/Neurofeedback training provide credible information to athletes, as well as coaches, sport psychologists and other support staff working with the athletes (Dupee, 2008).

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