

COMPARATIVE EFFICACY OF IMAGERY-BASED RELAXATION AND ABBREVIATED MUSCLE RELAXATION TRAINING ON THE REACTION ABILITY OF NETBALL PLAYERS

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Abstract

In this study, we investigated the benefits of differential psychotherapeutic intervention techniques on the modification of autonomic competence and its impact on the visual reaction ability of young competitive netball players. Thirty-six young female netball players with an age range of 18–24 years were recruited. Upon baseline evaluation of psychomotor (reaction time); physiological (resting heart-rate and VO₂max) and psychobiological (Sc components: latency, amplitude and recovery time) indices, we categorised the subjects into three groups: Group I (control group in which the subjects did not receive any intervention), Group II (experimental group in which the subjects received abbreviated progressive muscle relaxation (APMR) training) and Group III (experimental group in which the subjects received imagery-based relaxation intervention (IRT) training). The subjects from the experimental groups (Group I and Group II) were subjected to their respective interventions (APMR and IRT) for 24 sessions following the protocol, viz., 20 min/day, 2 days/week for 12 weeks). After six weeks of intervention, we conducted mid-term evaluation on all of the aforementioned parameters that had been determined during baseline evaluation. Following this, intervention sessions were continued using the same protocol for six more weeks. At the end of twelfth week, we conducted post-intervention assessment on all psychological, psychomotor and psychobiological variables to verify the effect of training on the dependent measures. Based on the results, we found that there are improvements in various parameters during the mid-term evaluation and post-intervention analysis, which can be rationally attributed to the differential therapeutic interventions introduced to the subjects of the experimental groups. The results suggest that both of the intervention techniques facilitate in improving the reaction ability whereas our in-depth analysis clarifies that netball players with a relatively lower phasic Sc but with higher extent of amplitude, had faster recovery which will be highly beneficial since they are able to regulate their task-focus well enough to yield faster agile reaction performance.

Keywords: Imagery-based relaxation, muscle relaxation, reaction ability

Introduction

In recent years, there has been a remarkable increase in the number of studies pertaining to the integral aspects of reaction ability in producing excellent sports performance (Saha, Saha Srilekha, Mazlan, & Arriffin, 2013a; Saha Srilekha, Saha, & Chattopadhyay, 2013b). In sport psychology research, much emphasis has been given onto the mediators of faster reaction performance, which could be based on cognitive judgements or in the form of pre-requisite emotional resilience i.e. mental toughness and hardiness or the symmetry in motor and movement coordination or the combined interactions between all of these elements.

Reaction ability can be defined as a rapid movement of one's whole body with changes in velocity or direction in response to a stimulus (Sheppard & Young, 2006). This perceptual-motor or psychomotor ability influences the performance outcomes in sports where quick positioning, changes in directions and alert actions are common (Oxyzoglou, Kanioglou, & Ore, 2009; Milanovic, Sporis, Trajkovic, James, & Samija, 2013; Sekulic, Spasic, Mirkov, Cavar, & Sattler, 2013). Apart from this explanation, reaction ability has also been observed as a multi-faceted aspect which, along with the motor abilities, may also depend on several other abilities and aspects such as cortical and autonomic regulations, as well as morphological-anthropometric indices (Saha, Saha Srilekha, Nurfarah Ezzaty, & Naresh Raj, 2014; Sekulic, et al., 2013).

Since sports and games are no more a recreational or amateur affair, and precisely at elite-level, everything is calculated and predicted to ensure success, let us focus our attention to some of the key areas in sport psychology research. Bulk of the research studies have been carried out over the years to identify the specific role of anticipation in minimizing reaction time delays (Penrose & Roach, 1995; McRobert & Tayler, 2005; Renshaw & Fairweather, 2000). Researchers have also examined the role of decision making ability among elite athletes (Togari & Takahashi, 1977 & Suzuki, Togari, Isokawa, Ohashi, & Ohgushi 1988). The concept of motor coordination and whole body reaction has also been reviewed by several researchers (Heyman, 1982 & Tenenbaum, Levi-Kolker, Bar-Eli, & Sade, 1992).

Even though the role of psychobiological evaluation was initiated in the 1960s, studies at that time were mostly focused on emotionality such as arousal anxiety relationships. The evaluation of cognitive aspects and combined interactions of cardiovascular and autonomic functions has been researched actively only in recent studies. So far, in this field of study, the role of ascending tract of RAS in faster sensory processing and its relative contribution in cognitive reflex and the Sympathovagal balance – which is equilibrium between sympathetic and parasympathetic contribution in emotional regulation – have not yet been evaluated rigorously (Saha et al., 2013a; Saha Srilekha, Saha, & Chattopadhyay, 2013b; Saha Srilekha, Saha, Krasilschikov, & Ismail, 2013c & 2014).

Besides the issues mentioned above, we also intend to focus on the differential role of psychological skills and pathways in order to facilitate improvements in reaction ability. Among the well-known psychotherapeutic techniques used in enhancing sports performance, relaxation exercise training is one of the most actively researched

psychotherapeutic techniques for the following reasons: (1) it produces sustainable effect, (2) unlike psychotherapeutic drugs, it is free from side effects, (3) it is cost-effective and (4) it gives quick relief from mental crises as fast as that is possible with cognitive psychotherapy and with drugs. Progressive Muscle Relaxation (PMR) training is used either directly or adjunctively as a therapeutic intervention technique and it is a body to mind relaxation technique which involves an exercise training program tailored to help an individual under distressful condition to relax; to attain a state of increased calmness; lowering of blood pressure and decelerated cardiac activity etc. (Goleman, 1986) and reduction in neuromuscular hypertension (Silva and Weinberg, 1984). Imagery-based relaxation training on the other hand, helps in identifying the unique tension sensation for a muscle group and then the tension is released to achieve a state of relaxation (McGuigan, 1984). In this study, we intend to observe the relationship between alteration in autonomic competence facilitated by relaxation training and the impact of the intervention on the visual reaction ability of netball players.

With this goal in mind, this study was carried out:

- 1) To determine the effect of abbreviated progressive muscle relaxation (APMR) training on the reaction ability of netball players
- 2) To study the effect of imagery-based relaxation training (IRT) on the reaction ability of netball players
- 3) To compare the efficacy of imagery-based relaxation training over the effect of abbreviated progressive muscle relaxation training on the reaction ability of netball players

Methods

Participants

Calculation of sample size

[1] -- Monday, March 31, 2014-- 19:25:12

F tests -ANOVA: Repeated measures, within-between interaction

Analysis: A priori: Compute required sample size

Input:	Effect size f	= 0.25
	α err prob	= 0.05
	Power (1- β err prob)	= 0.80
	Number of groups	= 3
	Number of measurements	= 3
	Corr among rep measures	= 0.5
	Nonsphericity correction ϵ	= 1
Output:	Noncentrality parameter λ	= 13.5000000
	Critical F	= 2.5108335
	Numerator df	= 4.0000000
	Denominator df	= 66.0000000
	Total sample size	= 36
	Actual power	= 0.8226554

Based on the analysis above, for this study we recruited 36 high performance, young-adult, competitive female netball players within an age range of 18–24 years. They were selected as consistently high performing netball players by their respective coaches. The sample size was calculated using G power 3.1.9. The power of the study is set at 80% with 95% confident interval and the effect size F at 0.25.

Inclusion criteria

- 1) The players identified as having delayed visual reaction time (VRT slower than 0.40 s) and had higher extent of inconsistency in VRT responses, were selected as participants. Based on the abundant data that we have on the reaction ability of young adult male and female ball game players living in and around Kota Bharu, VRT scores of more than 0.40 sec. can be considered as fairly delayed RT.
- 2) The players have problems in attentive performance.
- 3) Participants who have never been exposed to any kind of relaxation training programs.
- 4) The participants who are able to adapt to the intervention training within our stipulated time, i.e. within four sessions.

Exclusion criteria

Here we would like to mention about the exclusion criteria of the participants:

- 1) Players who did not attend at least 10 out of 12 sessions of the training programmes, which is equivalent to a percentage of absenteeism of 90%.
- 2) Players who were unable to learn the basic skills of the intervention technique within our stipulated time, i.e. within four sessions.
- 3) Players who were unable to accomplish the respective training regimes.

It shall be noted that none of the subjects were excluded from this study.

Materials

- 1) Electronic reaction movement timer apparatus (Lafayette Reaction & Movement timer, USA, 2008), and
- 2) Skin Conductance Apparatus (ProComp5 Infinity, USA 2014)

Procedure

The methodology used in this study is described in this section. In order to obtain baseline information, we evaluated the psychomotor (reaction time) and physiological parameters (resting heart-rate and VO₂max) of 36 subjects in a dedicated laboratory for Exercise and Sports Science programme in Universiti Sains Malaysia. We also evaluated the psychobiological indices of the subjects – both tonic and phasic skin conductance components such as latency, amplitude and recovery time. We evaluated the reaction

ability of the subjects using Lafayette reaction and movement timer, which consists of two touch keypads attached to the main processor unit. The subjects were required to react to the specific auditory or visual stimulus signals. This was done either by depressing or releasing the key of the initiator keypad using the index finger of their dominant (which denotes reaction time - RT). The subjects were also required to move their hand and upper body (while their lower body remains stationary) and press the key on the other keypad as quickly as possible. This denotes the movement time (MT). The processor unit assesses the initiation of response (RT) and accomplishment of the task (indicated by the MT response from the second touch keypad). We substantiated this evaluation protocol by assessing the anticipation and whole-body reaction ability in order to ensure that the RT-MT evaluation reveals the perceived sense of competence in the players when they react to the stimulus signals and they intend to perform to the best of their reaction potentiality (Saha, Saha Srilekha, Chowdhury, Fahim, & Salah Uddin, 2012a).

Since the outcomes of any unprecedented performance leads to subjective feelings of apprehensions pertaining to the issue of either success or failure, we intended to analyze this feeling of competitive performance related to apprehensiveness (Saha et al., 2012a) on the basis of autonomic indices of emotionality. The tonic and phasic skin conductance (Sc) indices along with the evaluation of the startling response (SF) and autonomic response latency, amplitude and recovery time will adequately reveal the autonomic adaptation associated with the feelings of apprehension (Beauchaine, 2001; Dawson, Schell, & Filion, 2000). In light of this discussion, let us make it a little bit clear regarding the concept of skin conductance activity, which assesses the autonomic indices of emotionality. Skin conductance judges emotionality in two ways: tonic and phasic. Tonic Sc provides information on the usual level of emotionality whereas phasic Sc clarifies the nature of changes in emotionality with respect to the different types of stimulation. In this study, we decomposed phasic Sc data into latency amplitude and recovery time. Orienting latency is the time lapse between the onset of stimulation and the corresponding autonomic change to occur. Orienting amplitude indicates the startling response to sudden changes in emotionality whereas orienting recovery time is the time taken to recover from the heightened emotionality. We evaluated Sc based on the tonic sweat gland activity (which is basically an evaluation of the basal Sc) and we measured the habituation paradigm response-specific or event-related responses using phasic modalities (latency, as well as amplitude and recovery from stress) (Dawson, Schell, & Filion, 2007; Saha et al., 2012a). We collected the data on the reaction ability and psychological evaluation of the subjects by implementing stringent methodological control and applying a number of psychomotor and psychobiological indices.

We used the research randomizer program, and we equally and randomly categorized the subjects into three groups: Group I (control group in which the subjects did not receive any intervention), Group II (experimental group in which the subjects received APMR training) and Group III (experimental in which the subjects received IRT training). We used the following protocol for therapeutic interventions: 20 min/day, 2 days/week over duration of 12 weeks. In other words, intervention trainings were imparted for altogether 24 sessions.

After six weeks of intervention, we conducted mid-term analysis on the psychological, psychomotor and psychobiological parameters of all subjects to verify the effect of training on the dependent measures. Following this, we proceeded with the therapeutic sessions for six more weeks using the same protocol. At the end of the twelfth week, we conducted post-intervention analysis on all variables to verify the effect of training on the dependent measures.

We analysed the data using SPSS 22.0 software. We performed descriptive analysis as well as analysis of the mean differences and two-way repeated measures ANOVA. We also used multiple linear regression analysis to determine the predictive relationships between the psychobiological and psychomotor variables.

Results

The descriptive data along with the differences in the measurements between groups obtained from different phases of intervention are summarized in Table 1 and Table 2. Based on the results, it can be seen that there are no pre-intervention differences and hence, the changes observed during post-intervention analysis can be attributed to the differential therapeutic interventions introduced to the subjects of the experimental groups.

Table 1: Mean of simple muscular visual reaction ability of subjects from Group I, Group II and Group III across experimental sessions

Groups	Visual reaction ability		
	Pre-intervention	Mid-intervention	Post-intervention
Group I (Control group)	0.36 ± 0.10	0.37 ± 0.12	0.37 ± 0.11
Group II (APMR training)	0.38 ± 0.04	0.35 ± 0.16	0.34 ± 0.03
Group III (IRT training)	0.38 ± 0.06	0.35 ± 0.07	0.33 ± 0.10
Mean difference	–	–	*(p < 0.05)

Table 2: Mean of movement time activity of subjects from Group I, Group II and Group III across experimental sessions

Groups	Movement time activity		
	Pre-intervention	Mid-intervention	Post-intervention
Group I (Control group)	0.54 ± 0.06	0.56 ± 0.09	0.53 ± 0.12
Group II (APMR training)	0.53 ± 0.03	0.51 ± 0.12	0.50 ± 0.09
Group III (IRT training)	0.56 ± 0.03	0.54 ± 0.08	0.51 ± 0.08
Mean difference	–	*(p < 0.05)	*(p < 0.05)

Table 3: Tests of within-subjects effects to determine the effect of the covariates of psychomotor and psychobiological parameters observed among subjects from Group II (APMR training)

Variable source	Statistics	Type III sum of squares	Df	Mean square	F	Sig.
Reaction time	Greenhouse-Geisser	352500.03	1.04	340599.22	31.66	0.00
Latency	Greenhouse-Geisser	156.77	1.06	147.30	0.03	0.87
Movement time	Greenhouse-Geisser	1201526.86	1.19	1007625.17	41.59	0.00

Based on the results obtained from repeated measures ANOVA (Table 3), it can be seen that there is a significant difference in the reaction time and movement time performance scores between phases of the experiment for subjects with APMR training (Group II). However, there is no significant difference in the performance scores between phases of the experiment for other psychobiological parameter.

Table 4: Tests of within-subjects effects to determine the effect of covariates of psychobiological parameters observed among subjects from Group III (IRT training)

Variable source	Statistics	Type III sum of squares	Df	Mean square	F	Sig.
Latency	Greenhouse-Geisser	34321.27	1.22	28254.66	136.47	0.00
Amplitude	Greenhouse-Geisser	38052.97	1.69	22523.50	472.47	0.00
Recovery time	Greenhouse-Geisser	332.81	1.97	168.92	5.03	0.01

Likewise, it can be observed from Table 4 that there is a significant difference in the psychobiological parameters (latency, amplitude and recovery time) between phases of the experiment for subjects with IRT training.

Table 5: Results of multiple linear regression analysis

Model <i>a</i> (Dependent variable: visual reaction ability)	Unstandardized coefficients		Standardized coefficients	T	Sig.
	B	Std. Error	Beta		
Intercept	8.97	2.24		4.01	.000
Phasic skin conductance	1.35	.58	.54	2.33	.036
Orienting amplitude	-2.53	.49	-.87	-5.16	.001
Recovery time	.66	.17	.92	3.88	.004

^a($F(5, 31) = 8.09, p < 0.002$), model adj. $R^2 = 81.4\%$

Note: Only subjects from Group III (IRT training) are included.

The results of the multiple regression analysis are summarized in Table 5. It is found that the psychobiological measures (i.e. phasic Sc, orienting amplitude and recovery time) of model *a* are significant and explains 81.4% of the total variability in the visual reaction time. The model shows that there is a direct relationship between the predictor variables

such as phasic Sc; and recovery time, while there is an inverse relationship between the amplitude and reaction time.

Discussion and Conclusions

The results shown in Table 1 and Table 2 represent the post-intervention differences in the psychomotor measures observed among the subjects from Group I, Group II and Group III. In general, the subjects from the experimental groups (Group II and Group III) had better visual reaction ability and movement time activity compared to those from the control group (Group I).

The subjects who received intervention training (Group II and Group III) had relatively faster autonomic response latency, higher Sc amplitude and faster autonomic recovery compared to those from the control group (Group I). For this reason, the subjects from these two groups had higher emotional flexibility and integrity, as indicated by the results shown in Table 3 and Table 4. The subjects who received IRT training (in particular, Group III) probably had an extra edge compared to their counterparts in the other groups (McRobert & Tayler, 2005; Renshaw & Fairweather, 2000) since they developed better emotional adaptive qualities and psychobiological competence, and had lesser apprehensiveness (Beauchaine, 2001; Dawson et al., 2000).

The results of the multiple regression analysis are shown in Table 5. Model *a* reveals that the IRT intervention technique is indeed beneficial, and the independent predictor variables (phasic Sc; amplitude and recovery time) explain 81.4% of the total variability in the extent of visual reaction time performance outcomes observed in netball players who received IRT training. What does this model indicate? In essence, this model shows that netball players with relatively lower extent of phasic Sc will have faster VRT. The negative relationship between amplitude and VRT implies that netball players with higher autonomic amplitude will be able to perform faster VRT. It has been observed in previous studies that faster recovery from autonomic stress results in faster VRT (Suzuki et al., 1988; Saha Srilekha et al., 2013b). However, this type of explanatory relationship between the psychobiological indices with VRT and MT was not observed among netball players who received APMR training. The relationship here indicates that netball players evident with relatively lower phasic Sc, but higher extent of amplitude and faster recovery from autonomic stress will benefit the most since they are able to regulate their task focus well enough to yield faster agile reaction performance (Dawson et al., 2007; Saha et al., 2013c).

Based on the findings in this study, we conclude that:

- 1) Both APMR and IRT intervention techniques have a positive impact on the reaction ability of netball players investigated in this study.
- 2) The IRT training only marginally improves the visual reaction ability of the netball players whereas the APMR training gives the netball players better edge in terms of movement time performance outcome.
- 3) The improvement in reaction ability of the netball players is contributed by the enhancement in the subjects' psychobiological make-up. This is due to the fact

that the positive variations in phasic Sc; amplitude and recovery time indices will facilitate in improving the visual reaction time of the netball players, which is the case for subjects with IRT training.

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