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IMPACT OF VISUOMOTOR BEHAVIOUR REHEARSAL ON PSYCHOMOTOR ABILITY AND SOCCER PERFORMANCE

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ABSTRACT

The present study was conducted to extrapolate the obscure relationships between open and closed-skill activities in defining successful soccer performance. Cognitive-emotional mediators of motor skill transitions were attempted to be examined in eighty-five young male high performing soccer players, while they were engaged in adopting Visuomotor behavior rehearsal (VMBR) training. Evaluation of motor skills and abilities pertaining to bidirectional and bilateral coordination; autonomic indices of emotionality based on latency and amplitude along with soccer skill indices were done to realise core areas of perceptual-motor deficiencies. These evaluations were simultaneously carried out, while players were going through VMBR training, which revealed the shortcomings of majority of the players in integrating perceptual configurations involved in self-paced and externally-paced motor skill tasks. Whole-body reaction time was evaluated as measure of soccer agility skill. We observed that, the cognitively mediated VMBR training gave ample opportunity to the players to conceptualise and interpret inter-linked transitions existing between open and closed-skill activities, and this might have helped them to display excellent agility skill during performance.

KEYWORDS: **VMBR, Autonomic adaptation; psychomotor skill; soccer performance**

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1. INTRODUCTION

Visuomotor behaviour rehearsal (VMBR) has been mostly attempted to resolve performance crises in closed skill activities[1-8], while attempts on open-skilled and serial motor-skill activities remained largely ignored[9-13]. While closed-skills are 'self-paced'[14,15] open skills earnestly need to have time to initiate a movement, which are 'externally-paced'[14,15] based on an interplay of multiple external factors. While closed-skills are largely discrete skills, compared to those production of serial motor skill requires longer time, since each movement element maintains a discrete beginning and end[16]. The cognitive-emotional flexibility and competence required for these transitions are susceptible to cause the major delay in development of optimally perfect schema to produce excellence in performance[11]. Since Behaviour-Inhibition-System (BIS) explains this flexible autonomic adaptation leading towards minimization of perceptions of threats and passive avoidances[17,18] and this phenomenon could be adequately reflected in electrodermal orienting responses[19,20], corroborative explanations onto externally paced agile reactions and self-paced discrete and serial motor tasks involved in soccer could be substantiated by modifications in agile reactions in the soccer players[21,22].

Such a background prompts us to -

1. study the psychomotor processes involved in coordinated performance.
2. identify the psychobiological mediators for agile motor performance.
3. observe outcome of VMBR training on whole-body reaction time performance.

2. METHODOLOGY

2.1. Participants

Eighty-five high-performing soccer players of Kelantan province of Malaysia, aged between 20 – 23 years volunteered as participants. The sample size was calculated using G power 3.1.7 in which the power of the study is set at 95% with 95% confident interval and the effect size F at 0.25[23]. Based on high-performance they were selected by the coaches of Majlish Sukan Negera attached with SMK Putera Kelantan, by sending sequentially numbered, opaque, sealed envelopes (SNOSE) to the coaches. The inclusion criteria for the players was set in a way so that, those who though having high level of soccer skills, were going through considerable extent of performance disaster for a period of at least 3 to 4 months were communicated for participation in this study. After obtaining their signed consent, they were recruited as participants. It was categorically checked that, the players had no previous exposure to Visuomotor Behaviour Rehearsal (VMBR) training program.

2.2. Materials Used

1. Mirror-Tracing Apparatus (Figures-1) – was administered to evaluate motor learning ability of the participants.
2. Two-arm Coordination Test Apparatus (Figure-2) – was used to evaluate bilateral coordination ability of the players.
3. Electronic Reaction Timer (Figures 3) – was used to assess whole-body reaction time of the participants.
4. Skin Conductance Apparatus (Figure-4) – was used to assess the extent of tonic as well as phasic i.e., habituation paradigm component of autonomic regulation as indices of emotionality of the participants.

2.3. Procedure

All of the participants upon arrival at the laboratory of the Exercise & Sports Science programme of the School of Health Science, of the Universiti Sains Malaysia was elaborated with the total experimental procedure, and as they agreed to participate, after obtaining written ethical consent from the players to participate in this study they were subjected to evaluation of bilateral symmetry in motor coordination and hand–eye coordination by employing the Mirror Drawing/Tracing Apparatus; Two-arm Coordination Test Apparatus. Thereafter evaluation of Simple Muscular Reaction Time (employing auditory modality) was done. Next to that, they were subjected to evaluation of psychobiological indices of emotionality, in which evaluation of habituation paradigm components of latency and Sc amplitude were evaluated. For this assessment, Sc electrodes were attached to the phalange of his fingers, and the players were supposed to remain in reclining position with eyes closed and in relax composure. After evaluation of basal Sc for a while they were prompted with a white noise as novel and benign stimulation, to record phasic or habituation paradigm psychobiological responses (ERP).

Figure – 2 Bilateral coordination

Figure – 1 Motor skill

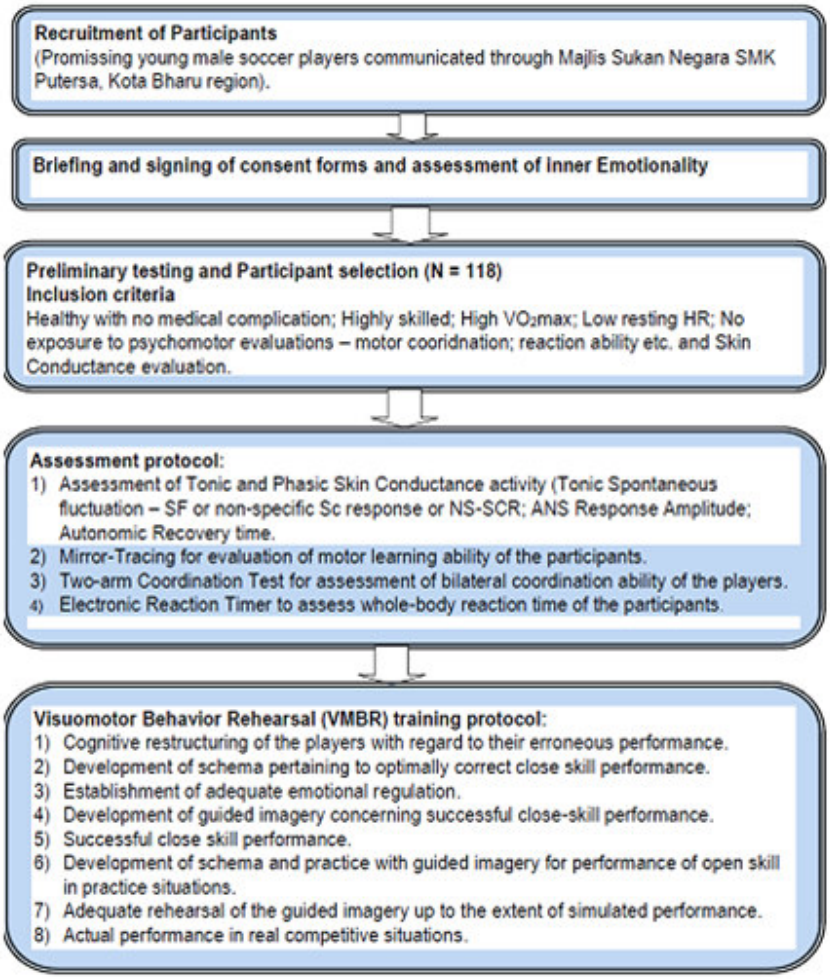

Figure 5
Flow chart of the Experiment

Thereafter players were subjected to evaluation of WRT (whole-body visual reaction activity) by employing the Udyog 2000, device following the standardised protocol[9-11]. In this activity participants were required to react to specified auditory stimulus signals either by depressing or by releasing key of the initiator touch-pad (which denotes reaction time - RT) by employing the index finger of their dominant hand and then they were required to move the hand and the upper body as well (while the lower body remains stationary) towards the other touch key-pad to press the key to denote the movement time (MT). The processor unit assessed the initiation of response (RT) and the accomplishment of the task with the MT response in the second touch key-pad. Finally two sports specific skill tests, such as- with the ball agility and bilateral shooting ability was evaluated (Figure-6)[24].


Figure – 3 Whole-body reaction time assessment


Figure – 4 Skin conductance

Figure 6
Slalom soccer Agility drills test serdarevic

Thereafter players were clarified with regard to their own short-comings in motion and movement coordination and performance skills representations. In this cognitively mediated intervention, erroneous movements were disintegrated into a combination of few closed skills, which were well-learned skills for all of the players. Players by and large had problems pertaining to the transitions from one close to another closed skill component. These areas of shortcomings were clarified to the players. Thereafter while they were kept in Sc biofeedback conditioning, rectified schemas of their correct performance were clarified to them. With the help of guided imagery they were subjected to rehearse those skills, while improvements in their imagery construction and rehearsal were monitored and recorded. Finally at the last phase of activity, they were supposed to perform the task in a open skill condition, and enhancement in their performance, if any, would be considered as the outcomes of the experiment. Finally, all of the afore-mentioned analyses were carried out once again to verify the changes or alteration or modifications, if any, were ensured by virtue of VMBR training. Intraclass correlations, one-way repeated measure of ANOVA were done to identify impact of VMBR training on soccer skill[24] performances.

4. RESULTS AND DISCUSSION

Outcomes of this study were analyzed with major focus onto modifications in psychomotor behavior of the players. They were observed as having confusions and misinterpretations with regard to their perceived and actual levels of motor abilities; skills and coordination. Further to that, they were mostly inclined to have lateral asymmetry in coordinated performances.

Table 1
Means and Mean Differences in the level of Bilateral Coordination observed amongst the soccer players across the phases of experimental sessions

Statistics	Bilateral Coordination (% of task accomplished)		
	Pre-introduction of VMBR	In course of VMBR adoption	Final Outcome
Mean	54.88	64.63	81.07
SD	7.18	20.04	16.21
Phase to Phase Mean Difference	From Pre-VMBR to Adoption phase *($p < 0.05$)	From VMBR Adoption phase to final outcome *($p < 0.05$)	
	From Pre VMBR to Final phase **($p < 0.01$)		

In the Table 1, outcomes revealed that, in case of bilateral coordination impact of VMBR was evident as beneficial for improvement both during adoption phase and at the final phase of evaluation as well.

Table 2
Means and Mean Differences in Skin Conductance Latency observed amongst the soccer players across the phases of experimental sessions

Statistics	Skin Conductance Latency (in millisec.s)		
	Pre-introduction of VMBR	In course of VMBR adoption	Final Outcome
Mean	7.17	5.43	3.87
SD	2.63	4.12	1.29
Phase to Phase Mean Difference	No difference from Pre-VMBR to Adoption phase	From VMBR Adoption phase to final outcome *($p < 0.05$)	
	From Pre VMBR to Final phase **($p < 0.01$)		

Table 2 shows the outcomes of skin conductance latency, revealing that outcomes of VMBR training was only evident at the final phase of evaluation, while no such improvement during the adoption of VMBR training was not evident.

Table 3
Means and Mean Differences in Skin Conductance Amplitude observed amongst the soccer players across the phases of experimental sessions

Statistics	Skin Conductance Amplitude (in logmicrosiemens)		
	Pre-introduction of VMBR	In course of VMBR adoption	Final Outcome
Mean	8.55	10.66	13.41
SD	5.73	6.04	4.21
Phase to Phase Mean Difference	From Pre VMBR to Adoption phase *($p < 0.05$)	From VMBR Adoption phase to final outcome *($p < 0.05$)	
	From Pre VMBR to Final phase **($p < 0.01$)		

In the Table 3, outcomes revealed that, in case of Skin Conductance Amplitude impact of VMBR was evident as beneficial for improvement both during adoption phase and at the final phase of evaluation as well.

Based on the aforementioned outcomes it was assumed that, apart from the perceived deficiency in observing correct postural behavior, players were also had shortcomings pertaining to perceptual configuration of various sub-sections of the movements in accordance with the whole action and transitions in between. Intraclass correlation analyses were done to observe limitations in bidirectional and bilateral symmetric movements and in simple muscular reaction ability as well. Tables 4A (86% correlation) and 4B (61.1% correlation) revealed that in bidirectional activities, engaging both right-hand and left-hand lateral sides of the body, players were capable to produce similar extents of consistency. More interestingly, players were observed as having bilateral symmetry

Table 4*A- Intraclass Correlation outcomes between bidirectional Motor Learning Task performances observed amongst the soccer players as outcomes of VMBR training (when right-hand lateral side was considered)*

Intraclass Correlation Coefficient

		95% Confidence Interval		F Test with True Value 0			
	Intraclass Correlation[b]	Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.755[a]	.646	.833	7.148	64	64	.000
Average Measures	.860[c]	.785	.909	7.148	64	64	.000

Table 4*B- Intraclass Correlation outcomes between bidirectional Motor Learning Task performances observed amongst the soccer players as outcomes of VMBR training (when left-hand lateral side was considered)*

Intraclass Correlation Coefficient

		95% Confidence Interval		F Test with True Value 0			
	Intraclass Correlation[b]	Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.440[a]	.251	.596	2.569	64	64	.000
Average Measures	.611[c]	.401	.747	2.569	64	64	.000

in their given motor learning task (86.8% correlation). Findings thus confirmed that, with the help of VMBR training players could resolve their problems pertaining to directional and lateral dominance related crises. Table 4D thus reveal that, in simple reaction time performance engaging dominant lateral side of the body, majority of the players could display consistency in producing faster reaction ability[9-11,19-22]. These findings of consistency in psychomotor performance were also suggestive of enhancement in perceptual-motor skill of the players, which might have helped them in adequate skill acquisition. At this point, we thought it would have been valid enough to know how far the players would be capable to produce agile reactions required for successful soccer performance.

Table 4*C- Intraclass Correlation outcomes in Bilateral Motor Learning Task performances observed amongst the soccer players as outcomes of VMBR training (when both right and left-hand lateral side were considered)*

Intraclass Correlation Coefficient

		95% Confidence Interval		F Test with True Value 0			
	Intraclass Correlation[b]	Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.766[a]	.662	.841	7.553	84	84	.000
Average Measures	.868[c]	.796	.914	7.553	84	84	.000

Table 4D- Intraclass Correlation outcomes between simple muscular reaction ability observed amongst the soccer players as outcomes of VMBR training (when the dominant lateral side was considered)

Intraclass Correlation Coefficient

		95% Confidence Interval		F Test with True Value 0			
	Intraclass Correlation[b]	Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.630[a]	.488	.749	6.660	56	112	.000
Average Measures	.836	.741	.900	6.660	56	112	.000

Table 5 shows the outcomes of reaction ability, revealing that outcomes of VMBR training was only evident at the final phase of evaluation, while no such improvement during the adoption of VMBR training was not evident.

Table 5
Means and Mean Differences in Auditory Whole-Body Reaction Performance observed amongst the soccer players across the phases of experimental sessions

Statistics	Auditory Whole-Body Reaction Performance (in Sec.s)		
	Pre-introduction of VMBR	In course of VMBR adoption	Final Outcome
Mean	0.34	0.32	0.27
SD	0.19	0.14	0.06
Phase to Phase Mean Difference	No difference from Pre-VMBR to Adoption phase	From VMBR Adoption phase to final outcome *($p < 0.05$)	
	From Pre VMBR to Final phase **($p < 0.01$)		

Findings of Table 5 implied that, for whole-body reaction performance, in which faster anticipations and transitions from one segment of movement to another requires adequate motor educability and coordination, some of the players were not up to the mark, and hence modifications in performance were not evident. This phenomenon of observed no improvement and later improvement in WRT performance could be better understood on the basis of outcomes of Tables 6A, 6B, 7A & 7B.

Table 6A
Mauchiy's Test of Sphericity [a]

Measure: Reactiontime							
					Epsilon[b]		
Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Greenhouse -Geisser	Huynh-Feldt	Lower-bound
Agility	.861	7.942	2	.019	.878	.905	.500

Reports from the Tables 6A and 7A revealed the results of Mauchly's test of sphericity for the main effects of agility. Tests indicated that the main effects of agility violated the assumption of sphericity and therefore the *F-values* for those effects were required to be corrected. Thus all of the outputs (results of ANOVA with corrected *F-values* wherever required), are represented in the Tables 6B and 7B (tables of tests of within subjects effects), which were reported in the next section one by one.

Table 6B
Tests of Within-Subjects Effects

Measure: Reactiontime

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Agility	Sphericity Assumed	303.747	2	151.873	1.689	.190
	Greenhouse-Geisser	303.747	1.756	173.009	1.689	.193
	Huynh-Feldt	303.747	1.810	167.817	1.689	.193
	Lower-bound	303.747	1.000	303.747	1.689	.199
Error(Agility)	Sphericity Assumed	9710.456	108	89.912		
	Greenhouse-Geisser	9710.456	94.806	102.425		
	Huynh-Feldt	9710.456	97.739	99.351		
	Lower-bound	9710.456	54.000	179.823		

We can report the results (Table 6B) as for the soccer performers, 'there was no main effect of change in agility, $F(1.76,94.8) = 1.69$, $p < .193$ which implied that, if effects of other variables are ignored, psychomotor conditions observed amongst the players pertaining to the agility behaviour were not different from each other (table 6B). We can interpret this outcome that at the initial stage (during the adoption of VMBR training) all of the players could not adequately adopt the cognitively mediated intervention, and hence could not right away adopt to the transitions from the discrete motor skill to serial motor skill[14-16]. Outcomes of Table 7B however revealed that, finally the players could conceptualize the training, which might have helped them to display better coordinated serial skills involved in WRT performance. The output for agility performance evident in Table 7B could be reported as $F(1.80,97.2) = 3.84$, $p < .029$, which implied that, WRT performance at different levels of agility were different from each other.

Table 7A
***Mauchly's Test of Sphericity*[a]**

Measure: Reactiontime

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b]		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Agility	.889	6.222	2	.045	.900	.929	.500

Table 7B
Tests of Within-Subjects Effects

Measure: Reactiontime

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Agility	Sphericity Assumed	885.867	2	442.933	3.839	.025
	Greenhouse-Geisser	885.867	1.801	491.999	3.839	.029
	Huynh-Feldt	885.867	1.859	476.572	3.839	.028
	Lower-bound	885.867	1.000	885.867	3.839	.055
Error (Agility)	Sphericity Assumed	12462.133	108	115.390		
	Greenhouse-Geisser	12462.133	97.230	128.172		
	Huynh-Feldt	12462.133	100.377	124.153		
	Lower-bound	12462.133	54.000	230.780		

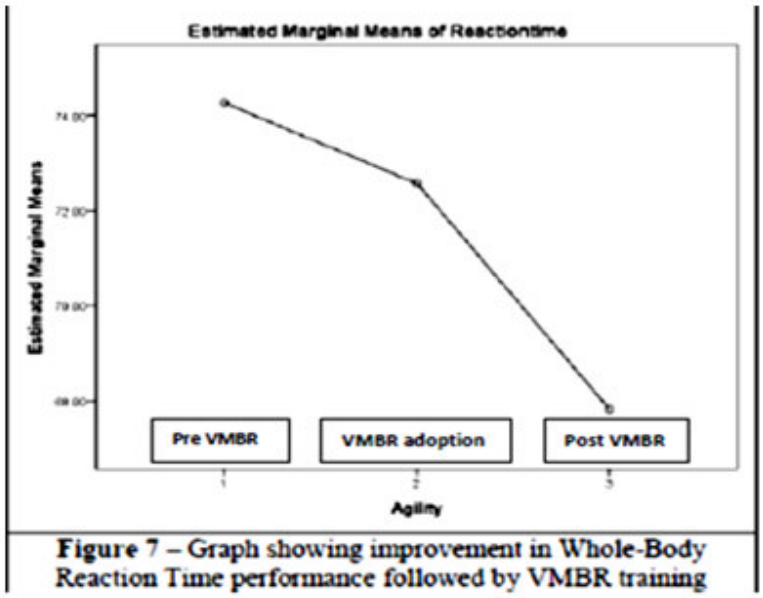

Figure 7 – Graph showing improvement in Whole-Body Reaction Time performance followed by VMBR training

Visuomotor behaviour rehearsal actually helps in enhancement in information-processing involved in motor control. This process involves faster stimulus recognition followed by appropriate response selection[24]. Based on the outcomes of this experiment, it could be postulated that owing to enhanced perceptual-motor coordination (as it was revealed through improved maximal voluntary contraction) and heightened emotional regulation (enhanced Sc recovery time), perhaps the ideomotor ability of the players got improved, which in turn helped them to enjoy better motor control required for performance excellence in soccer[12,13&16]. Finally the outcomes however clarified that once transitions from the discrete to serial motor skills were realized by the players VMBR training could modify the agile reactions involved in the whole-body reaction performance (Figure 7). Present finding of WRT changes however got support the previous findings obtained on similar population[19-22] and also on diverse range of participants[19,20].

4. CONCLUSION

Findings of this study could be summarised as the bilateral coordination and autonomic competence were observed as significant factors for improvement in agile reactions. Apart from that, the VMBR training helped in developing schema required for adequate transitions from discrete to serial motor skill development, which evidentially helped the players to display faster agile performance.

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CONFLICT OF INTEREST

Conflict of interest declared none

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