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Perceived Apprehension associated with Disruptive Performance in Players

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Abstract

Present study was aimed at identification of intricate relationship between psychological and psychobiological determinants of performance shortcomings in young-adult amateur-competitive as well as elite athletes of Malaysia. One hundred five highly skilled ball game players (matched in anthropometric, cardiovascular and performance status) and similarly skilled eighty-six other amateur-competitive swimmers were selected by three expert sport instructors as participant. They were assessed with physiological parameters (viz. autonomic measures of arousal) and corresponding psychological (viz. Cognitive flexibility and anxiety) and psychomotor attributes (viz. reaction ability) in relation to performance excellence. Projective analyses of cognitive-emotional make up of the players were done to identify their inner cognitive core related to characteristic resilience; constriction and rigidity; apprehensiveness etc. Perceived apprehension of losing was found substantiated by the psychobiological concomitant autonomic indices of habituation paradigm skin conductance activity related to performance outcomes. Comprehensive understanding of the obscure subjective feelings of disruptive emotionality underlying performance hindrances in sport was attempted. Multiple linear regression analyses and two-way repeated measure ANOVA along with predictive structural analyses were done to observe direct, inverse and supportive relationships between measures of physiological arousal and psychological phenomena related to competitive sports behaviour.

Keywords: Apprehension, psychobiology, cognition, psychomotor ability, sport performance.

Introduction

Anxiety as a negative psychological state in day-to-day life experience has been identified as multi-dimensional in nature, viz. – having at least cognitive (mental) and somatic (physiological) components, which respond differentially to the various stress –eliciting stimuli within the environment[1-3] in their 'Catastrophe theory' have most critically discussed about the theoretical understanding with regard to inhibiting impact of stress and anxiety and the resulting disastrous performance. Facing this, valid and standardized evaluation of anxiety has been topic of serious concern, since subjective self-report questionnaires could carry subject-relevant biasness, and physiological measures on the other hand are not always well-recommended since those are often measure of physiological stress related to environmental pressure, which does not have any significance with negative expectancies or situation-specific or dispositional feeling of anxiety felt an individual performer in the field of sports.

Compared to structured self-report evaluations, unstructured projective evaluations could be preferable[4], since those can reveal hidden emotional crises and internal conflicts related to positive and facilitative as well inhibitive behavioural manifestations in the field of sports. Psychobiological evaluations on the other hand, can provide corroborative objective as well as valid etiological information. Furthermore, since outcomes of psychobiological evaluations cannot be manipulated and hence if utilised properly, can provide with vital information concerning cognitive-emotional processes underlying and behaviour pathology occurring in the field of sports. Skin conductance [Sc] indices, which depend on eccrine sweat gland activity produced by autonomic innervations, could be optimally used as substantiated index of emotionality. Any stimulus capable of producing autonomic arousal can evoke the response and the amplitude of the response if decomposed (with both tonic and phasic components) appropriately can identify any subtle change following slightest environmental changes[5]. Usual practice in researches incorporating Sc activities consider basal or tonic autonomic activity and the frequency and amplitude of spontaneous fluctuation[6,7] [SF]. SF are cognitively mediated by startling episodic events, stemming out of spontaneously occurring non-specific responses caused by sudomotor nerve activity[6].

Since the highly skilled players read and interpret complex situations quickly and initiate decisive action (Saha et al 2005[8]; 2012a[7]), they are susceptible to have more startling responses. In athletics, apart from faster reaction and movements, accurate anticipation of relevant visual cues and the consequent whole body reaction seems absolutely essential to conceptualize different facets of expert[9-10], and thus internal regulation of psychobiological and emotional make-up seems earnestly required for high performance. In course cognitive-emotional mediation of high-performance related preparations, athletes are susceptible have coping deficits and resultant perceived helplessness and apprehensions, which could have concomitant psychobiological manifestation in the form increased SFs and

Sc response changes in the form of changes in latency; amplitude and in recovery time[5,11].

Authors of the present study are trying to point out to their concern over the methodological issues related to the assessment and analyses of the reaction performances in athletics. Introduction of few relevant psychobiological measures such as measures of tonic electrodermal activity as index of emotionality substantiated by the autonomic arousal modulation and the orienting activity in experimental models to fit in correlation analyses would provide the researchers with relevant information related to faster information processing and the inherent psychobiological mechanism leading toward achievement of performance excellence.

With such a background, we wanted to investigate into the substantiated relationship between psychobiological components and projective evaluation of emotionality to examine the aspects of facilitative as well as inhibitive mood in young adolescent athletes. Thus this study purports i. To identify the relationship between the autonomic indices of emotionality along with the projective analysis of emotionality, if any, in the young adult athletes, ii. To see the interrelationships between the phasic measures of skin conductance indices and emotionality evaluated by the projective analyses, if any, in the young adult athletes, and iii. To justify the relationship between the skin conductance orienting reflex indices and emotionality evaluated by projective analysis of emotionality, if any, in the young adult athletes.

Material and Methods

Participants: Altogether one-hundred and five highly skilled and consistently high performing Malaysian male ball game players (soccer) aging between 19.9 and 22.1 years, (hereafter Group A participants having mean age = 20.8 and SD = 1.13), selected as the National cadets by the respective selectors, volunteered as the participants in this study. They were compared with eighty-six amateur-competitive consistently high performing swimmers (hereafter participants of the Group B, mean age = 20.4 and SD = 1.96), representing nine provincial teams and were selected by the respective National selectors of the Republic of Malaysia (Senior National and the Selected Development Squad listed as Malaysia Probable for the Malaysia Games 2011 and ASEAN competitions for the year.

Materials and Measures: i. Reaction Movement Timer Apparatus (Lafayette Instrument Corporation, USA 2001) was used to assess complex reaction and movement time of the participants. ii. Photocell Whole-Body Reaction and Movement Timer Apparatus (Lafayette Instrument Corporation, USA 2001) were used to assess both the visual and auditory whole - body reaction time of the participants. iii. Skin Conductance Apparatus (Udyog Apparatus, India, 2000 and Autogenic Corporation, USA 2006) was used to assess the extent of autonomic regulation as index of emotionality in the participants. iv. Rorschach inkblot test[12] was administered to evaluate the personality and emotionality of the participants.

Procedure: Previous data on high soccer and swimming performance related to reaction performances of majority of the participants were available in the data bank with the researchers of the present study, which were collected on the afore-mentioned players during a period of more than one and half years (since October 2010 up to the October 2012, mostly on the basis of available long-term record of their reaction ability judged in the laboratory of sport psychology in the Universiti Sains Malaysia - by employing the Precision Reaction and Movement Timer; Bassin Anticipation Timer and Whole-body Movement Timer – Lafayette Instrument Corporation, Illinois, USA 2001). Thus on the basis of the long-term records of psychological measures and on the basis of their pre-inclusion reaction performances, the inclusion criterion for the purpose of present study was set. Psychobiological analyses of the present study (autonomic regulation and orienting amplitude; recovery time etc.) employing measures of skin conductance activities-Sc), all the participants were assessed during the competitive tournaments in the make-shift laboratory conditions in the competitions venues. Special cares were taken to nullify any erroneous influence from any subject-relevant; sequence-relevant and stimulus-relevant interference, which could have significant manipulative effect on the psychological make-up of the participants. All of these assessments were done following standard [4,7,8,13].

Participants were subjected to projective evaluation of emotionality followed by (employing the Rorschach Inkblot test) following standard method of administration[7, 13]. On the basis of the obtained data, emotional measures of resilience, suspicion, integrity, flexibility, impulsivity and constriction etc. were derived (Saha et al. 2013b[13]), which were later on integrated on the basis of decomposition of Sc indices (viz. latency; amplitude and recovery time)[13-15] transformed to develop index of Perceived apprehensiveness. Tonic and habituation paradigm Sc activity indices were decomposed as – basal or tonic Sc; SF or NS-SCR (non-specific Sc response, which is also termed as spontaneous fluctuation or SF) and tonic consistency measures; and, phasic Sc, and stimulus-specific orienting response measures (viz. latency; amplitude and recovery time)[13-15].

The data were treated with SPSS 20.0 and reports on correlation analyses, prompted the authors to look into prediction analyses. Thereafter analyses of two-way repeated measure of ANOVA were performed to justify the relative contribution of psychobiological variables in predicting apprehensiveness in the high performing players. Multiple linear regression analyses were done to identify how far the psychobiological variables (autonomic regulation and orienting reflex information obtained from skin conductance measures) differentially contributed in the shared aetiology of perceived sense of apprehensiveness.

Results and Discussion

Reports on descriptive statistics were summarized in the Tables 1 and 2, which represented somewhat consistency in the data obtained from the participants of both of the groups (Gr. A and B). Moderate and lower extents of standard deviation indices clarified that the data were considerably free from huge dispersions.

Table-1
Reports on descriptive measures (Gr. A - Soccer Players)

Descriptive Statistics (Data obtained from the Soccer Players)			
Variables Assessed	**Mean**	**Std. Deviation**	**N**
Faster Latency (Sec.s)	1.93	1.41	105
Moderate Latency (Sec.s)	3.15	2.07	105
Delayed Latency (Sec.s)	4.09	1.82	105
Short Amplitude (logmicrosiemen)	4.28	5.51	105
Moderate Amplitude (logmicrosiemen)	8.36	4.68	105
High Amplitude (logmicrosiemen)	13.89	9.14	105
Faster Recovery time (Sec.s)	2.03	0.35	105
Moderate Recovery time (Sec.s)	6.62	2.57	105
Delayed Recovery time (Sec.s)	11.08	5.58	105
Emotional Flexibility (scores)	5.84	1.63	105
Integrity (scores)	10.63	2.04	105
Impulsivity (scores)	9.67	1.08	105
Irritability (scores)	3.17	0.49	105
Self esteem (scores)	2.47	0.56	105
Suspicion (scores)	8.19	2.01	105
Resilience (scores)	28.12	10.8	105
Constriction (scores)	19.75	5.19	105

Table-2
Report on descriptive measure (Gr. B - Swimmers)

Descriptive Statistics (Data obtained from the Swimmers)			
Variables Assessed	**Mean**	**Std. Deviation**	**N**
Faster Latency (Sec.s)	3.13	1.98	86
Moderate Latency (Sec.s)	4.85	3.07	86
Delayed Latency (Sec.s)	7.09	3.82	86
Short Amplitude (logmicrosiemen)	2.13	2.75	86
Moderate Amplitude (logmicrosiemen)	6.36	7.86	86
High Amplitude (logmicrosiemen)	11.29	4.88	86
Faster Recovery time (Sec.s)	4.03	3.35	86
Moderate Recovery time (Sec.s)	9.62	6.87	86
Delayed Recovery time (Sec.s)	13.81	8.51	86
Emotional Flexibility (scores)	4.14	6.13	86
Integrity (scores)	12.33	6.94	86
Impulsivity (scores)	6.12	4.08	86
Irritability (scores)	4.05	1.59	86
Self esteem (scores)	2.31	1.96	86
Suspicion (scores)	7.05	4.51	86
Resilience (scores)	19.52	11.18	86
Constriction (scores)	16.45	7.25	86

Tables 3 and 4 however represented differences observed amongst the participants of the groups A and B on all of the psychological and psychobiological measures obtained from them, which implied that, the participants of Gr. A, i. e., the soccer players were observed to be in advantageous situation on all of the parameters assessed compared to their swimmer counterparts (Gr. B).

These reports further revealed that, soccer players had relatively faster autonomic response latency; higher Sc amplitude and faster autonomic recovery compared to the swimmers, and who were observed to have higher emotional flexibility and integrity as well as impulsivity and constriction, but had lower self-esteem and resilience – which however depicted an altogether complicated scenario for the swimmers in their emotional make-up compared to the soccer players who were despite having better psychobiological competence were more prone to have higher apprehensiveness.

Reports from the tables 5 and 6 revealed the results of Mauchly's test of sphericity for each of the main effects and three interaction effects of the psychobiological parameters. Tests indicated that except for the main effects of recovery, all of the other main and interaction effects 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 7 and 9 (tables of tests of within-subjects effects), which are reported in the next section one by one.

We can report the results as for the soccer performers, 'there was a significant main effect of latency, $F(1.22,32.8) = 136.47$, $p < .000$, which implied that, if effects of other variables are ignored, autonomic conditions of the response latency were different from each other (table 7). Similarly the output for amplitude

Table-3
Reports on test of significance of variance between Groups A and B (psychobiological parameters)

Measures obtained	Faster Latency (Sec.s)	Moderate Latency (Sec.s)	Delayed Latency (Sec.s)	Short Amplitude (logmicrosiemen)	Moderate Amplitude (logmicrosiemen)	High Amplitude (logmicrosiemen)	Faster Recovery time (Sec.s)	Moderate Recovery time (Sec.s)	Delayed Recovery time (Sec.s)
P- values	2.78*	6.39**	2.26*	7.29**	4.04*	9.54**	2.13*	4.13*	3.69*

*P<0.05; **P<0.01

Table-4
Report on test of significance of variance between Groups A and B (psychological parameters)

Measures obtained	Emotional Flexibility (scores)	Integrity (scores)	Impulsivity (scores)	Irritability (scores)	Self esteem (scores)	Suspicion (scores)	Resilience (scores)	Constriction (scores)
P- values	6.03**	2.64*	1.09	1.14	2.58*	3.39*	4.01*	6.52**

*P<0.05; **P<0.01

Table-5
Mauchly's Test of Sphericity[a]
Measure: MEASURE_1 Obtained from the Soccer Players

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[a]		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Latency	.354	27.035	2	.000	.607	.621	.500
Amplitude	.816	5.280	2	.071	.845	.895	.500
Recovery	.985	.396	2	.820	.985	1.000	.500
Latency * Amplitude	.173	44.595	9	.000	.641	.714	.250
Latency * Recovery	.294	31.114	9	.000	.618	.685	.250
Amplitude * Recovery	.452	20.159	9	.017	.679	.762	.250

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept: Within Subjects Design: Latency + Amplitude + Recovery + Latency * Amplitude + Latency * Recovery + Amplitude * Recovery + Latency * Amplitude * Recovery

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Table–6
Mauchly's Test of Sphericity[b]
Measure: MEASURE_2 Obtained from the Swimmers

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b]		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Latency	.223	39.001	2	.000	.563	.570	.500
Amplitude	.068	70.078	2	.000	.517	.520	.500
Recovery	.121	54.969	2	.000	.532	.536	.500
Latency * Amplitude	.000	302.930	9	.000	.298	.304	.250
Latency * Recovery	.003	146.890	9	.000	.344	.356	.250
Amplitude * Recovery	.000	228.815	9	.000	.266	.268	.250
Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.							
a. Design: Intercept: Within Subjects Design: Latency + Amplitude + Recovery + Latency * Amplitude + Latency * Recovery + Amplitude * Recovery + Latency * Amplitude * Recovery							
b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.							

Table-7
Tests of Within-Subjects Effects
Measure: MEASURE_1 Obtained from the Soccer Players

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Latency	Greenhouse-Geisser	34321.265	1.215	28254.663	136.467	.000
Error(Latency)	Greenhouse-Geisser	6790.473	32.797	207.044		
Amplitude	Greenhouse-Geisser	38052.970	1.689	22523.496	472.471	.000
Error(Amplitude)	Greenhouse-Geisser	2174.587	45.616	47.672		
Recovery	Sphericity Assumed	332.811	2	166.405	5.033	.010
Error(Recovery)	Sphericity Assumed	1785.549	54	33.066		
Latency * Amplitude	Greenhouse-Geisser	56444.254	2.563	22024.813	285.268	.000
Error(Latency*Amplitude)	Greenhouse-Geisser	5342.322	69.194	77.207		
Latency * Recovery	Greenhouse-Geisser	824.956	2.472	333.772	5.367	.004
Error(Latency*Recovery)	Greenhouse-Geisser	4150.210	66.734	62.191		
Amplitude * Recovery	Greenhouse-Geisser	786.818	2.715	289.769	8.704	.000
Error(Amplitude*Recovery)	Greenhouse-Geisser	2440.595	73.314	33.290		

could be reported as $F(1.69,45.6) = 472.47,\ p < .000$, which were different from each other. For the output of autonomic recovery which required correction, could be reported as, $F(2,54) = 5.03,\ p < .010$. For the interactions we could report them as, there was significant interaction between latency and amplitude $F(2.56,69.2) = 285.27,\ p < .000,$ which implied that, autonomic activities across different levels of autonomic amplitude, was different for different levels of latency. Similarly, $F(2.47,66.7) = 5.37,\ p < .004$ and $F(2.71,73.3) = 8.70,\ p < .000,$ were reported for the significant interactions between latency and recovery and for the interactions between amplitude and recovery respectively (table 7).

Table-8
Estimated Marginal Means (Obtained from the Soccer Players)

1. Latency				
Measure: MEASURE_1				
Latency	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	11.034	1.068	8.843	13.225
2	16.766	.489	15.763	17.768
3	.496	.099	.294	.699

2. Amplitude

Measure: MEASURE_1

Amplitude	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	1.950	.107	1.730	2.169
2	7.383	.701	5.944	8.822
3	18.962	.455	18.028	19.896

3. Recovery

Measure: MEASURE_1

Recovery	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	8.591	.375	7.821	9.361
2	9.491	.502	8.460	10.522
3	10.213	.510	9.166	11.260

4. Latency * Amplitude

Measure: MEASURE_1

Latency	Amplitude	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
1	1	3.848	.336	3.160	4.537
	2	17.265	1.908	13.349	21.180
	3	11.988	1.162	9.605	14.372
2	1	2.071	.041	1.987	2.155
	2	5.321	.918	3.438	7.203
	3	42.905	1.202	40.438	45.372
3	1	-.070	.011	-.093	-.047
	2	-.435	.011	-.458	-.412
	3	1.994	.297	1.385	2.602

5. Latency * Recovery

Measure: MEASURE_1

Latency	Recovery	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
1	1	9.870	1.185	7.438	12.301
	2	12.394	1.331	9.663	15.125
	3	10.837	1.337	8.095	13.580
2	1	15.023	.595	13.803	16.243
	2	15.948	.446	15.034	16.862
	3	19.326	1.096	17.076	21.575
3	1	.880	.240	.387	1.373
	2	.132	.070	-.012	.277
	3	.476	.074	.324	.628

6. Amplitude * Recovery

Measure: MEASURE_1

Amplitude	Recovery	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
1	1	1.649	.126	1.389	1.908
	2	2.159	.257	1.632	2.685
	3	2.042	.110	1.816	2.268
2	1	5.627	.724	4.142	7.112
	2	6.374	.747	4.841	7.907
	3	10.148	1.168	7.753	12.544
3	1	18.497	.598	17.270	19.724
	2	19.941	.733	18.437	21.446
	3	18.448	.749	16.912	19.985

The levels of latency are labeled simply as 1, 2 and 3, which has referred to as short or faster, moderate and delayed latency, and the table of means reflected that very few latency scores were delayed compared to maximum numbers of moderate latency followed by faster latency responses.

The levels of amplitude are labeled simply as 1, 2 and 3, which has referred to as short, moderate and high amplitude, and the table of means reflected that very few autonomic amplitudes were short followed by more moderate compared with maximum numbers of high amplitude response indices.

The levels of recovery are labeled simply as 1, 2 and 3, which has referred to as faster, delayed and very delayed recovery, and the table of means reflected that autonomic recovery scores were evenly distributed across the responses obtained.

We can report the results as for the swimmers, 'there was a significant main effect of latency, $F(1.12,30.4) = 34.39$, $p<.000$, which implied that, if effects of other variables are ignored, autonomic conditions of the response latency were different from each other (table 9). Similarly the output for amplitude could be reported as $F(1.04,27.9) = 31.66$, $p < .000$, which were different from each other. For the output of autonomic recovery and the interaction effects between latency and recovery, and amplitude and recovery as well, significant effects were not observed, which implied that autonomic recovery indices did not vary across different participants. For the interaction between latency and amplitude, we could report them as, there was significant interaction between latency and amplitude $F(1.19,32.2) = 41.59$, $p < .000$, which implied that, autonomic activities across different levels of autonomic amplitude, was different for different levels of latency (see table 9).

Table-9
Tests of Within-Subjects Effects
Measure: MEASURE_2 Obtained from the Swimmers

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Latency	Greenhouse-Geisser	588805.499	1.126	523118.901	34.392	.000
Error(Latency)	Greenhouse-Geisser	462253.899	30.390	15210.566		
Amplitude	Greenhouse-Geisser	352500.033	1.035	340599.223	31.657	.000
Error(Amplitude)	Greenhouse-Geisser	300645.058	27.943	10759.072		
Recovery	Greenhouse-Geisser	156.765	1.064	147.302	.034	.869
Error(Recovery)	Greenhouse-Geisser	124806.948	28.735	4343.439		
Latency * Amplitude	Greenhouse-Geisser	1201526.862	1.192	1007625.168	41.589	.000
Error(Latency*Amplitude)	Greenhouse-Geisser	780035.182	32.196	24227.910		
Latency * Recovery	Greenhouse-Geisser	11518.117	1.376	8368.403	.810	.411
Error(Latency*Recovery)	Greenhouse-Geisser	384102.876	37.162	10335.818		
Amplitude * Recovery	Greenhouse-Geisser	1239.067	1.064	1164.088	.129	.738
Error(Amplitude*Recovery)	Greenhouse-Geisser	259089.204	28.739	9015.227		

Table-10
Estimated Marginal Means (Obtained from the Swimmers)

1. Latency				
Measure: MEASURE_1				
Latency	**Mean**	**Std. Error**	**95% Confidence Interval**	
			Lower Bound	**Upper Bound**
1	14.133	.401	13.310	14.956
2	59.036	8.572	41.447	76.625
3	8.054	3.556	-15.349	-.758

2. Amplitude				
Measure: MEASURE_1				
Amplitude	**Mean**	**Std. Error**	**95% Confidence Interval**	
			Lower Bound	**Upper Bound**
1	52.242	6.823	41.190	66.294
2	6.272	.910	4.404	8.139
3	6.602	.710	5.145	8.058

3. Recovery				
Measure: MEASURE_1				
Recovery	**Mean**	**Std. Error**	**95% Confidence Interval**	
			Lower Bound	**Upper Bound**
1	11.591	2.375	7.821	19.361
2	12.491	4.502	7.460	21.432
3	18.213	3.510	13.166	31.260

4. Latency * Amplitude					
Measure: MEASURE_1					
Latency	**Amplitude**	**Mean**	**Std. Error**	**95% Confidence Interval**	
				Lower Bound	**Upper Bound**
1	1	42.905	1.202	40.438	45.372
	2	-.070	.011	-.093	-.047
	3	-.435	.011	-.458	-.412
2	1	159.096	24.969	107.863	210.328
	2	15.037	2.739	9.418	20.656
	3	2.976	.481	1.990	3.962
3	1	-45.274	9.949	-65.687	-24.861
	2	3.848	.336	3.160	4.537
	3	17.265	1.908	13.349	21.180

5. Latency * Recovery					
Measure: MEASURE_1					
Latency	**Recovery**	**Mean**	**Std. Error**	**95% Confidence Interval**	
				Lower Bound	**Upper Bound**
1	1	14.870	1.185	7.438	12.301
	2	22.394	1.331	9.663	15.125
	3	19.837	1.337	8.095	13.580
2	1	14.023	.595	13.803	16.243
	2	21.948	.446	15.034	16.862
	3	11.326	1.096	17.076	21.575
3	1	2.880	.240	.387	1.373
	2	5.132	.070	-.012	.277
	3	6.476	.074	.324	.628

6. Amplitude * Recovery					
Measure: MEASURE_1					
Amplitude	**Recovery**	**Mean**	**Std. Error**	**95% Confidence Interval**	
				Lower Bound	**Upper Bound**
1	1	12.905	1.202	40.438	45.372
	2	-10.070	.011	-.093	-.047
	3	-2.435	.011	-.458	-.412
2	1	105.041	24.969	107.863	210.328
	2	34.037	2.739	9.418	20.656
	3	7.416	.481	1.990	3.962
3	1	-15.274	9.949	-65.687	-24.861
	2	6.848	.336	3.160	4.537
	3	11.265	1.908	13.349	21.180

The levels of latency are labelled simply as 1, 2 and 3, which has referred to as short or faster, moderate and delayed latency, and the table of means reflected that compared to soccer players large number of swimmers had delayed latency, but alike the soccer players maximum numbers of players had moderate latency followed by faster latency responses.

The levels of amplitude are labelled simply as 1, 2 and 3, which has referred to as short, moderate and high amplitude, and the table of means reflected altogether different compared to the soccer performers, as majority of the participants had short autonomic amplitudes, followed by moderate and high amplitude response indices.

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In Table 11 and 12, summary of linear multiple regressions are presented. Significant models emerged for the models *a* and *b* (impacts of decomposed components of measures of skin conductance on emotional resilience was evaluated). In the Table 11 (which was obtained from the swimmers) the model *a* however, was found to explain 81.0% of variance in changes in the extent of emotional resilience. Similarly the model *b* which was conceived on soccer performers, depicted psychobiological indices of emotionality along with measures of reaction ability, could explain 90.0% of extent of changes in emotional resilience of the soccer players.

Table–11

Model *a* - Summary of multiple linear regression analysis (based on data obtained from the Gr. B participants – Swimmers)

Dep. Variable – Emotional resilience	Unstandardized Coefficients		Standard Coefficients	t	Sig.
	B	Std. Error	Beta		
(Intercept)	-.449	.115		-3.904	.000
Spontaneous fluctuation	.199	.058	.268	3.431	**.001*** **
Response Latency	-.735	.095	-.332	-7.737	**.000*** **
Anticipation	-1.749	.358	-1.858	-4.885	**.000*** **
Reaction Ability	.917	.323	.793	2.839	**.027***
Orienting Amplitude	-.502	.080	-.434	-6.275	**.000*** **

[a](F (4, 83) = 16.039, P <0.000)) Model Adj.R^2 =81.0%.

Table–12

Model *b* - Summary of multiple linear regression analysis (based on data obtained from the Gr. A participants – Soccer Players)

Dep. Variable – Emotional resilience	Unstandardized Coefficients		Standard Coefficients	t	Sig.
	B	Std. Error	Beta		
(Intercept)	-.262	.076		-3.447	.001
Spontaneous fluctuation	.293	.049	.295	5.980	**.000*** **
Response Latency	-.535	.097	-.633	-5.515	**.000*** **
Anticipation	-.213	.053	-.313	-4.019	**.009****
Reaction Ability	-.196	.047	-.222	-4.170	**.002*** **
Orienting Amplitude	-.981	.256	-1.362	-3.832	**.005*** **
Autonomic Recovery	.973	.181	1.573	5.376	**.000*** **
Phasic Skin Conductance	.659	.079	.603	8.342	**.000*** **

[b](F (6, 98) = 21.967, P <0.000)) Model Adj.R^2 =90.0%.

Table–13

Model *c* - Summary of multiple linear regression analysis (based on data obtained from the Gr. B participants – Swimmers)

Dep. Variable – Apprehensiveness	Unstandardized Coefficients		Standard Coefficients	t	Sig.
	B	Std. Error	Beta		
(Intercept)	.397	.063		6.302	0.000
Spontaneous fluctuation	-.153	.061	-.075	-2.508	0.026
Response Latency	-.119	.034	-.184	-3.501	0.004
Amplitude	.243	.051	.263	4.767	0.000
Orienting recovery	-.108	.031	-.169	-3.483	0.006

[c](F (5, 79) = 14.241, P <0.000)) Model Adj.R^2 =68.0%.

Table–14
Model *d* - Summary of multiple linear regression analysis (based on data obtained from the Gr. B participants – Soccer Players)

Dep. Variable–Apprehensiveness	Unstandardized Coefficients		Standard Coefficients	t	Sig.
	B	Std. Error	Beta		
(Intercept)	.448	.039		11.487	0.000
Spontaneous fluctuation	-.198	.054	-.069	-3.667	0.024
Amplitude	-.184	.037	-.178	-4.973	0.000
Orienting recovery	.264	.047	.271	5.617	0.000
Response Latency	-.142	.032	-.168	-4.438	0.000

[d](F (9, 94) = 24.331, P <0.000)) Model Adj.R^2 =88.2%.

In Table 13 and 14, summary of linear multiple regressions predicting changes in the perceived sense of apprehensiveness are presented. Significant models emerged for the models *c* and *d* (impacts of decomposed components of measures of skin conductance on emotional resilience was evaluated). In the Table 13 (which is obtained from the swimmers) the model *c* however, is found to explain 68.0% of variance in changes in the extent of apprehensiveness. Similarly the model *d* which is conceived on soccer performers, depicted psychobiological indices of emotionality along with measures of reaction ability, could explain 88.0% of extent of changes in sense of apprehensiveness of the soccer players.

Here in this section we would intend to focus more on in-depth analyses of the obtained results, based on the existing theoretical framework. Tables of mean difference (tables 3 and 4) revealed that, soccer players had relatively better psychobiological i.e., autonomic competence, and which is evident in their faster autonomic response latency; higher Sc amplitude and faster autonomic recovery compared to the swimmers, who were better able to regulate their inner emotionality, as those were evident from the projective evaluation. Both autonomic indices and projective evaluation revealed that, players of both of the groups had higher apprehensiveness. Here we would like to see the pathways to apprehensiveness in them. ANOVA results also are suggestive of differential nature of main as well as interaction effects in between the psychobiological components of emotionality, which implied that, there might be differential contributory relationships.

At this point we intended to pay more attention to the outcomes of the regression analyses, and that could aptly explain changes in emotional resilience and in the perceived sense of apprehensiveness both in the soccer players as well as in the swimmers (models a, b. c and d revealed great extents of relationships). In-depth scrutiny of the relationships revealed that, high extent of emotional resilience observed in the swimmers as well as soccer players have been contributed differentially by the predictor psychobiological variables. Observed high extent of emotional resilience in the swimmers is contributed by higher extents of spontaneous fluctuation (SFs); faster latency; shorter amplitude and relatively delayed reaction ability (RT). Contrary to that, faster reaction ability RT) and delayed recovery from autonomic stress along with high SFs; faster latency; shorter amplitude contributed in higher emotional resilience in soccer players. Here we observed differential contributory influences in players who are engaged in different activities. Since soccer players are more engaged in faster reaction performances, they are observed to have faster RT compared the swimmers, but they also had delayed autonomic recovery, which perhaps had been a source of complication to some of the players[7,8]. Further to that, relationships between high extent of SFs and emotional resilience observed in players of the both of the groups, which appeared to have been markedly controversial. Previous researches from identical experimental set-ups revealed SFs as indices of startle response characterised by higher extents of sudomotor nerve firing[4,5,7,8,11,13,14,15] resulting in high-strung emotionality. Thus from the models a and b, high extents of SFs; and delayed recovery have been identified as most serious concerns over performance inhibiting emotional crises. Models c and d further pointed out that, higher perceived apprehension observed both in the swimmers as well as in the soccer players is contributed largely by lower extents of SFs; faster latency; and additionally larger amplitude and faster recovery in swimmers, but lower amplitude and delayed recovery in the soccer players. While faster latencies are primarily indices of lack of orientation[16]; observed larger amplitude and faster recovery in the swimmers, are also indices of orienting response[7,15,17] in players, faster latency in the swimmers could be identified as the most potential factor of impairment. Soccer players on the contrary had mostly suffered because of their limitation related to delayed recovery from stress, which might have been related to their deep-seeded and long-lasting emotional over-loading[7,8].

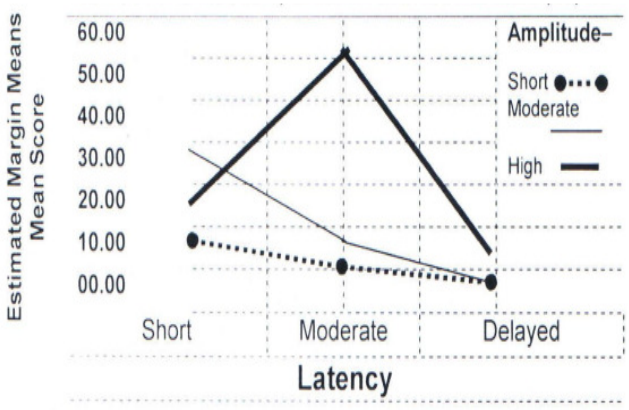

Figure-1
Relationship between psychobiological latency and amplitude as index of emotionality as observed in the Ball Game players

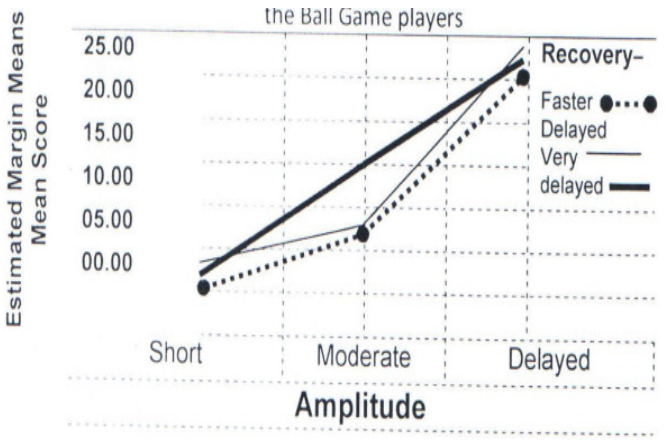

Figure-2
Relationship between psychobiological amplitude and autonomic recovery as index of emotionality as observed in the Ball Game players

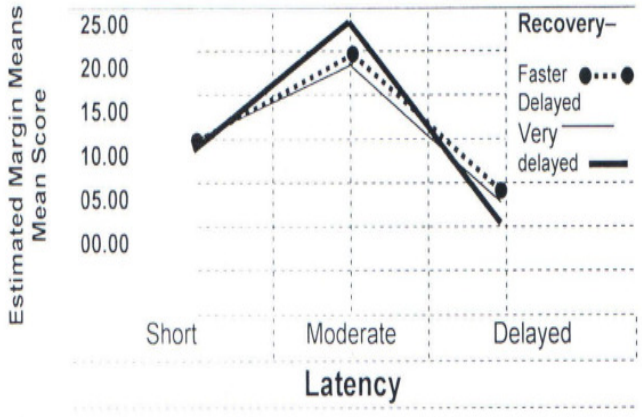

Figure-3
Relationship between psychobiological latency and recovery as index of emotionality as observed in the Ball Game players

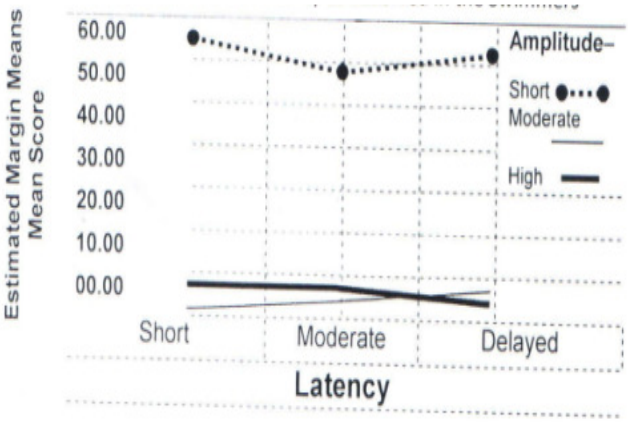

Figure-4
Relationship between psychobiological latency and amplitude as index of emotionality as observed in the Swimmers

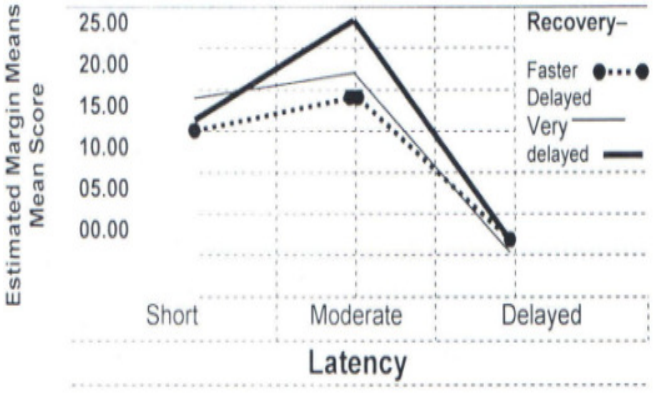

Figure-5
Relationship between psychobiological latency and recovery as index of emotionality as observed in the Swimmers

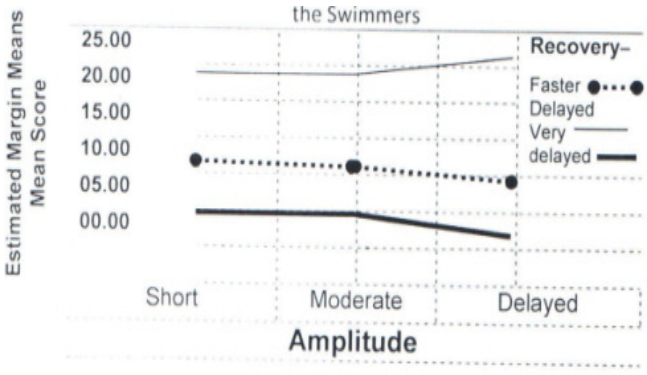

Figure-6
Relationship between psychobiological amplitude and autonomic recovery as index of emotionality as observed in the Swimmers

Depending on above-mentioned analogy, the observed contributions of the psychobiological indices of emotionality are graphically represented to provide better understanding with regard to their inherent interrelationships. The graph-1 however

is conceived on the relationships observed in the soccer players. The graph I however clarified that, short amplitude in the soccer players, which had contributions on higher perceived apprehension, did not get affected by latency, while moderate level of amplitude appeared to have been affected by the faster latency, which is also identified as contributor to higher apprehensiveness. Further to that, moderate levels of latency have been observed to have higher impact on high level of amplitude. Interestingly enough, shorter or faster latency have been observed to have been associated with high amplitude in a fewer of the soccer players. Thus it could be postulated that, uncontrolled SFs; faster latency and delayed recovery have been identified as significant source of crises in the soccer players, which might have resulted in higher apprehension. Apart from that, the figure-2,3, further strengthened the notion of the contributory association between shorter amplitude and delayed recovery, resulting in over-loading of emotionality, which might have engraved crises in the soccer players. Figure-2, have further represented that, autonomic recovery in case of the soccer players had been thoroughly affected by the changes in the extents of amplitude. As the extent of amplitude progressed to higher amplitude, faster, delayed as well as very delayed recovery kept on changing linearly up to the extent, which might have made the soccer players vulnerable to have coping deficits. This could be the especially the case for this particular group of soccer players, but the figure-3 also have pointed out to the fact of the interrelationships between autonomic response latency and recovery ratio or the time taken by the soccer players to get relieved from the residual stress on their own. Moderate extent of latency in the soccer players are observed to have been largely linked with recovery in the players, which characteristically revealed that changes in recovery are not largely affected by delayed latency, but has been influenced by faster latencies and obviously by moderate levels of latencies as well. Figure-3 has clarified that moderate levels of latencies had larger impacts on faster, delayed and more onto largely delayed autonomic recovery. Thus the analyses have so far clarified that; psychobiological indices being interrelated can have harmful influence onto the emotional make-up and emotional regulation in the soccer players, which may result in observable coping deficits; perceived sense of helplessness; apprehensiveness and performance disaster thereby[4,7,8].

In case of the swimmers, similar characteristic features of interrelationships between psychobiological indices have been observed, which are graphically represented in figure-4,5,6. The figure-4 however revealed that, in case of swimmers compared to what was observed in the soccer players, an altogether differential nature of relationships is depicted. Unlike the soccer players, changes in the response latencies did not affect both high and moderate level of amplitude obtained from the swimmers. Interestingly, it was observed that, changes in latency although did not have any clear impacts on the moderate as well as high amplitude, but high extent of amplitude was found associated largely with the short amplitude irrespective of the changes in the response latencies. Swimmers are usually more vigilant and attentive to reaction performances, and hence they are more susceptible to have faster reaction ability and orienting reflex (comprising of moderate latency, larger and sharp amplitude and sharp or very fast autonomic recovery)[14,15], and hence these indices have been observed in this particular group of swimmers (characteristically larger amplitude; faster recovery were observed along with faster latency). Graph V also have pointed out to the fact of the interrelationships between autonomic response latency and recovery ratio or the time taken by the swimmers to cope with the mounting stress or to get relieved from the residual stress on their own[18,19]. Moderate extent of latency in the swimmers were observed to have been largely linked with faster recovery in the swimmers, which characteristically revealed that changes in recovery are not largely affected by delayed latency, but has been partially influenced by faster latencies and obviously by moderate levels of latencies as well. Figure-5 has clarified that, alike the soccer players, moderate levels of latencies had larger impacts on faster, delayed and more onto largely delayed autonomic recovery. Figure-6, on the other hand, pointed out with regards to the interrelationships between amplitude and recovery. This graph has clearly depicted that, in case of the swimmers, changes neither in faster, nor in delayed and nor in the substantially delayed autonomic recovery are contributed by the extents of amplitude[20]. Precisely enough, changes in recovery observed in the swimmers happened irrespective if changes in amplitude.

Conclusion

In sum findings of the study could be accounted as the followings: i. Emotional resilience has been observed as the one of the vital cognitive-emotional component, which was aptly substantiated by autonomic measures such as response latency; amplitude; recovery time and tonic Sc component of spontaneous fluctuation (SF). ii. Both high and low extent of SFs along with other psychobiological indices, have been observed as potential determinant predictor of emotional changes leading toward apprehension. iii. Soccer players and swimmers were observed to have differential psychobiological and emotional mechanisms mediating development of perceived sense of apprehensiveness.

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