Chapter II

REVIEW OF RELATED LITERATURE

The known facts build up the edifice of new theories and principles. Review of research studies serve as a buckle between the old and the new, between the known and the unknown. It is a milestone leading the research on the high road of future. Review of literature develops the researcher's insight and establishes his intellectual superiority over others. A study of relevant literature is an essential step to get a good comprehension of what has been done with regard to the problem under study. “The Literature in any field forms the foundation upon which all future work will be built”. The literature relevant to the present study which has been collected from different sources of reference is described in this chapter.

Reviews related to Psycho-Physiological aspects of Sports

Furedy (1985) conducted a study on an experimental psycho-physiological approach to human bradycardiac reflexes. Bradycardiac reflexes in man are both of scientific and clinical interest. Using the methods of experimental psychophysiology, control over relevant independent variables permits the study of fine-grained temporal physiologic response topographies, and of psychological factors that may modify the reflex. In addition, the physiologic manipulation of temperature affects the reflex in an inverse way over the range of 10 degrees to 40 degrees C, while the sense of control (a psychological variable) attenuates the reflex. The negative-tilt preparation produces a bradycardic response that is ideal as a Pavlovian unconditional response. Some Pavlovian conditioning arrangements, especially an "imaginational" form, do produce significant conditional bradycardiac responding, and this has both potential clinical (e.g., biofeedback-related) and theoretical (e.g., S-R vs. S-S accounts of Pavlovian conditioning) applications. The paper ends with a comment on the cognitive paradigm shift in psychology. Although this shift is of importance, it is suggested that it is also important to "remember the response."
Ghosh, Goswami, & Ahuja (1993) conducted a study on evaluation of a sports specific training programme in badminton players. In that study they have studied the effect of a short three week programme, dominated by specific training, on the aerobic capacity (VO2 max) and ventilatory anaerobic threshold (VanT) of badminton players and also to evaluate the intensity of the specific training on the basis of heart rate and blood lactate concentration. The study was conducted on five women badminton players (age 13-14 yr; height 160-165 cm and weight 47.0-51.5 kg) who were semifinalists in the 1988 sub junior or junior national championships. The VO2 max and VanT were determined at the commencement and at the cessation of the training. The VO2 max was evaluated on an automatic analyser during a graded running protocol on a treadmill and VanT was determined by the gas exchange method from the VE-VO2 relationship. The three week programme was dominated by specific training, apart from other conditioning programme. The findings indicated that the intensity of specific training was quite high, varying from aerobic-anaerobic transition level to aerobic overload region and was able to alter the VO2 max and VanT of the players, even with a short precompetition training.

Tsopanakis et.al (1994). Investigated a study on Stress adaptation in athletes: relation of lipoprotein levels to hormonal response. Increased physical stress is produced in acute exercise conditions before and during a physical trial. The effects of the physical stress on lipid and lipoprotein parameters as well as on testosterone and cortisol levels were examined in male elite athletes. In a sample of 22 measured athletes, 11 showed increases and 11 showed decreases in testosterone levels. Subsequently these subjects were treated as two separate groups for statistical purposes in order to characterise the source of individual differences in response to a stressor. Group 1 showed a 16.1% significant increase in testosterone levels, 13.3% in total cholesterol and low density lipoproteins, and a 105% increase in testosterone/cortisol ratio immediately after an acute bout of physical stress of 30 s. Group 2 showed a -25.8% significant decline in testosterone levels and no significant change in either total cholesterol or lipoprotein concentrations, followed by a significant correlation of all lipid and hormonal parameters to psychophysiological factors, such as skin temperature. A measurement of testosterone/cortisol and total cholesterol and high density lipoprotein (HDL-C) levels
after a bout of acute physical stress may give a picture of the ability to "respond quickly" to stress, which will be useful in assessing the performance of the elite athlete.

Mace, Carroll & Eastman (1994) conducted a study on Effects of stress inoculation training on self-report, behavioural and psychophysiological reactions to abseiling. The study examined the effect of stress inoculation training on the level of self-reported stress and anxiety, overt signs of distress and the physiological impact of the stress of abseiling. Twenty volunteer subjects were randomly assigned to either a 'no training' control group or a stress inoculation training group, following which both groups of subjects had to complete a test abseil from the roof of a 21.2 m building. Prior to descent, two self-report measures were taken: an intensity score derived from the word or phrase chosen by subjects from the Perceived Stress Index to best describe their feelings and a state anxiety score from Spielberger's State Trait Anxiety Inventory. Overt distress was also evaluated by a 'blind' observer also using the Perceived Stress Index. In addition, heart rate was monitored just prior to and throughout the abseil using a telemetry system. The stress inoculation group showed significantly less self-reported anxiety and stress and less behavioural signs of distress as judged by the observer. However, there were no significant differences between the groups in terms of heart rate. In addition, while self-report and the assessment of the observer were highly inter-correlated, these measures were poorly correlated with heart rate.

Blumenstein, Bar-Eli & Tenenbaum (1995) Conducted a study on The augmenting role of biofeedback: effects of autogenic, imagery and music training on physiological indices and athletic performance. In this study, three psycho-regulative procedures of relaxation and excitation were provided in combination with biofeedback to examine their role on physiological and athletic performance variables. Thirty-nine college students were randomly assigned to three groups of psycho-regulatory treatment one placebo group and the control group. Imagery was related to a 100-m run. The treatment and control conditions lasted 13 sessions of 20 min each. During the first seven sessions, the subjects in the treatment groups underwent 10 min of relaxation followed by 10 min of excitation. Biofeedback was found to have a significant augmenting effect on physiological components and athletic performance when accompanied by autogenic,
imagery and music training. Soft music was found to be as beneficial as other relaxation techniques. The results are compared with similar studies applying mental techniques with biofeedback, and new directions of investigation in the psycho-physiological domain are suggested.

Tremayne & Barry (1995) studied an application of psychophysiology in sports psychology: heart rate responses to relevant and irrelevant stimuli as a function of anxiety and defensiveness in elite gymnasts. One problem in the optimization of athletic performance is that consistency in practice situations is not always carried over to competitive situations. There is an increase in irrelevant stimuli in competition which cannot always be gated out satisfactorily by the anxious athlete. We investigated the physiological responses to relevant and irrelevant stimuli of 48 elite female gymnasts differing in levels of anxiety and defensiveness. Cardiac responses were recorded to tone presentations and analyzed as a function of instructions, anxiety manipulation and group. The results suggest that phasic responses of high-anxious gymnasts were larger than those of low-anxious gymnasts. High-anxious gymnasts experience more difficulty in completely gating out the occurrence of irrelevant stimuli than do low-anxious gymnasts. Finally, under anxiety-producing conditions, high levels of defensiveness and anxiety in combination appear to have a debilitating effect on the gymnast's ability to discontinue processing of irrelevant stimuli, while truly low-anxious subjects appear distracted from processing relevant stimuli. Further investigation of the interactions between levels of trait anxiety and anxiety-producing situations in a sport-specific domain appear warranted. The role of defensiveness in these interactions should also be investigated.

Brox et.al.(1996) conducted a study on influence of anthropometric and psychological variables pain and disability on isometric endurance of shoulder abduction in patients with rotator tendinosis of the shoulder. Predictors of isometric endurance of shoulder abduction were investigated in 18- to 75-year-old women (n = 59, mean age 48 years) and men (n = 53, mean age 46 years) with unilateral rotator tendinosis of the shoulder (median duration 1-2 years). They were asked to keep both shoulders abducted at 45 degrees, both wrists loaded with 2 kg, for as long as possible. The average force exerted to keep the required position was 17% higher in men compared to women. Mean
times to exhaustion were: 103 seconds (SD 109) for the involved shoulder and 160 seconds (SD 81) for the uninvolved shoulder in women; compared to 159 seconds (SD 109) and 289 seconds (SD 109) in men. Increased pain, emotional distress and disability were associated with decreased endurance in the involved shoulder. Gender and emotional distress were the most powerful predictors of time to exhaustion in the uninvolved shoulder, and accounted for 41.7% of the total variance (R2). Age, body weight, self-efficacy for pain and active coping were poor predictors. This study indicates that isometric endurance is a psychophysiological measure in patients with shoulder pain. Reported pain, emotional distress and disability should be taken into account for interpretation of results.

Huguet, Touitou & Reinberg (1997) conducted a study on morning versus afternoon gymnastic time and diurnal and seasonal changes in psycho-physiological variables of school children. The aims of this study were to document time-related (morning versus afternoon) effects of physical activities (gymnastics) on a set of physiological and psychological variables in school children, including diurnal changes. For the study, 61 boys and 69 girls, 6 to 11 years of age, volunteered. They were considered healthy according to routine clinical criteria. Better performances were obtained in June than in mid-winter with reference to letter cancellation and random number addition tests. As a group phenomenon, morning (09:00 to 10:00) versus afternoon (14:00 to 15:00) gym was not an influential condition with regard to sleep duration, oral temperature, self-rated fatigue and drowsiness, letter cancellation, addition tests, or salivary cortisol. However, gym-time-related differences were observed in classes of younger subjects (e.g., 6-7 years) with regard to self-rated fatigue and the letter cancellation test. Such variability among subgroups suggests that interindividual differences are likely to exist in younger children with regard to manipulation of environmental factors. In addition, gym itself (without gym time consideration) may be an influential factor with regard to diurnal patterns of some variables (e.g., the letter cancellation test).

Majumdar et al (1997) conducted a study on physiological analysis to quantify training load in badminton. Objective of the study is to estimate the training load of
specific on court training regimens based on the magnitude of variation of heart rate-lactate response during specific training and to determine the magnitude of variation of biochemical parameters (urea, uric acid, and creatine phosphokinase (CPK)) 12 hours after the specific training programme so as to assess training stress. The study was conducted on six national male badminton players. Maximum oxygen consumption (VO2), ventilation (VE), heart rate, and respiratory quotient were measured by a protocol of graded treadmill exercise. Twelve training sessions and 35 singles matches were analysed. Heart rate and blood lactate were monitored during technical training routines and match play. Fasting blood samples collected on two occasions—that is, during off season and 12 hours after specific training—were analysed for serum urea, uric acid, and Analysis of the on court training regimens showed lactate values of 8-10.5 mmol/l in different phases. The percentage of maximum heart rate ranged from 82% to 100%. Urea, uric acid, and CPK activity showed significant changes from (mean (SD)) 4.93 (0.75) mmol/l to 5.49 (0.84) mmol/l, 0.23 (0.04) to 0.33 (0.06) mmol/l, and 312 (211.8) to 363 (216.4) IU/l respectively.

McKay et. al (1997) conducted a study on psycho-physiological stress in elite golfers during practice and competition. This study examined self-reported state anxiety (cognitive anxiety, somatic anxiety and self-confidence) measured by the Competitive State Anxiety Inventory-2 (CSAI-2; Martens, Vealey, Bump, & Smith, 1990) and physiological responses (salivary cortisol concentration and heart rate) in elite golfers prior to, during and on completion of a tournament and practice round. The relationships between psycho-physiological variables were investigated by comparing physiological and psychological responses during competition and practice to each other, and to performance. Performance was determined for each player as the difference between 18 hole score and handicap. Fifteen male Professional Within-subject analysis revealed elite golfers experienced elevated cortisol, heart rate, cognitive and somatic anxiety, and lower self-confidence during competition compared to practice. For both game conditions, the highest cortisol response was measured prior to the commencement of play, whilst state anxiety measures did not change significantly during the golf rounds. Univariate and multivariate analyses failed to reveal significant correlations between the psycho-physiological variables and golf performance. In conclusion, competition and practice
were clearly discriminated by the psycho-physiological variables, but none of these predicted performance.

Kenttä & Hassmén (1998) conducted a study on overtraining and recovery. A conceptual model. Fiercer competition between athletes and a wider knowledge of optimal training regimens dramatically influence current training methods. A single training bout per day was previously considered sufficient, whereas today athletes regularly train twice a day or more. Consequently, the number of athletes who are overtraining and have insufficient rest is increasing. Positive overtraining can be regarded as a natural process when the end result is adaptation and improved performance: the super compensation principle--which includes the breakdown process (training) followed by the recovery process (rest)--is well known in sports. However, negative overtraining, causing mal-adaptation and other negative consequences such as staleness, can occur. Physiological, psychological, biochemical and immunological symptoms must be considered, both independently and together, to fully understand the 'staleness' syndrome. However, psychological testing may reveal early-warning signs more readily than the various physiological or immunological markers. The time frame of training and recovery is also important since the consequences of negative overtraining comprise an overtraining-response continuum from short to long term effects. An athlete failing to recover within 72 hours has presumably negatively over trained and is in an overreached state. For an elite athlete to refrain from training for > 72 hours is extremely undesirable, highlighting the importance of a carefully monitored recovery process. There are many methods used to measure the training process but few with which to match the recovery process against it. One such framework for this is referred to as the total quality recovery (TQR) process. By using a TQR scale, structured around the scale developed for ratings of perceived exertion (RPE), the recovery process can be monitored and matched against the breakdown (training) process (TQR versus RPE). The TQR scale emphasizes both the athlete's perception of recovery and the importance of active measures to improve the recovery process. Furthermore, directing attention to psychophysiological cues serves the same purpose as in RPE, i.e. increasing self-awareness. This article reviews and conceptualises the whole overtraining process. In doing so, it (i) aims to differentiate between the types of stress affecting an athlete's performance: (ii) identifies factors
influencing an athlete's ability to adapt to physical training: (iii) structures the recovery process. The TQR method to facilitate monitoring of the recovery process is then suggested and a conceptual model that incorporates all of the important parameters for performance gain (adaptation) and loss (maladaptation).

Konttinen, Lyytinen & Viitasalo (1998) conducted a study on rifle-balancing in precision shooting: behavioral aspects and psycho-physiological implication. This study investigated sharpshooters' strategies to control their rifle stability during the aiming period. Six elite and six pre-elite shooters completed a simulated realistic shooting task (laser rifle), and their performance was evaluated from behavioral and psycho-physiological perspectives. The analysis of the rifle's barrel movement, indexing the shooter's behavioral performance, supported the view that rifle-balancing is an essential determinant of superior shooting performance. The psycho-physiological data, i.e. the brain slow potentials, suggested that the shooters applied different rifle-hold strategies; the elite shooters concentrated primarily on achieving a stable rifle position using psychomotor regulation, whereas the pre-elite shooters were more reliant on the visual-spatial processing. The present study has implications for the understanding of psychological aspects in competitive precision shooting, as well as for the evaluation of the functional significance of the electrocortical slow potentials in shooting-like closed-skill sports.

Caird, McKenzie & Sleivert (1999) conducted a study on Biofeedback and relaxation techniques improves running economy in sub-elite long distance runners. PURPOSE: The purpose of this investigation was to determine whether a psychophysiological intervention of biofeedback and relaxation could decrease the submaximal oxygen consumption (VO2submax) during treadmill running and improve running economy for a group of trained long distance runners. Before and after a 6-wk control phase, seven long distance runners were tested for running economy, peak oxygen consumption (VO2peak), peak running velocity, and stretch-shortening cycle efficiency. These runners then participated in a 6-wk training program in which they learned and practiced relaxation techniques and ran on the treadmill at a velocity eliciting 70% of peak running velocity for 10 min while biofeedback of heart rate (HR), ventilation (VE),
and VO2 was presented to them. Data indicated that participants were able to lower their VO2, HR, and VE at lactate threshold by 7.3%, 2.5%, and 9.2%, respectively, using relaxation techniques (P<0.05). Post-tests of lactate threshold, VO2peak, peak running velocity, and stretch-shortening cycle efficiency showed that these changes did not occur as a result of a training effect. It was concluded that the improvements in running economy occurred as a result of the psychophysiological intervention.

William & Horvath(1999) investigated a study on individual differences in physiological responses and Type A behavior pattern. The relationships between individual differences in psychophysiological responses and tendency of Type A behavior pattern (TABP) were investigated during mental arithmetic (MA) at a steady rhythm, challenging calculation (Uchida-Kraepelin serial addition test: UK test), music listening, and exposure to an 80 dB SPL of white noise. Each mental task was sustained for 5 minutes. Sixteen healthy Japanese adults, (10 males and 6 females) with an age from 18 to 36 years old volunteered for this study. The KG's Daily Life Questionnaire (KG Questionnaire) was used to investigate the tendency toward TABP, which included three sub-factors: aggression-hostility, hard-driving and time urgency, and speed-power items. Recorded physiological variables were respiratory rate (RR), skin resistance response (SRR), eyeblinks, and heart rate (HR) calculated using frequency analysis to render high frequency power (HF) and the ratio of low/high frequencies (L/H ratio). During the MA and UK tests, significant increases in HR, L/H ratio, RR occurred, while significant decreases in HF were observed. Eyeblinks significantly increased during the MA test and significantly decreased during the UK test. During music and white noise, no significant changes occurred except for SRR, which decreased significantly. The coefficient of variances in each response was over 20% for almost all variables, indicating that individual differences in the magnitude of each response were large, even if the direction (increase or decrease) of the change was the same in almost all subjects. The highest correlation coefficients (r) between the mean values of relative magnitude for each variable and TABP scores during the MA and UK tests were obtained for the L/H ratio (MA: r = 0.591, UK test: r = 0.577) and the RR (MA: r = -0.576, UK test: r = -0.511). These values were statistically significant (p < 0.05). Similar results were obtained for TABP sub-factors. Though other investigations have reported relationships
between HF and TABP, we found no significant relationship. It was suggested that sympathetic nerve activity became greater for TABP individuals than for Type B individuals under stress conditions.

Filaire et al (2001) conducted a study on psycho-physiological stress in judo athletes during competitions. Twelve male judo competitors at interregional level (mean age 22.2+/1.6 years) entered the experimentation after informed consent. Judo athletes completed the CSAI-2 prior to both competitions and collected saliva for cortisol and testosterone analysis on three occasions: during a resting day (baseline values) and prior to and after both competitions. Trait scales of the STAI (Y-2) were used during a resting baseline period with no stressful situations in order to measure participant's self reported anxiety. Cognitive and somatic anxiety was higher in interregional championships compared to regional championships whereas self-confidence was significantly lower. Cortisol levels increased sharply (about 2.5 fold resting levels) throughout both competitions with no changes in testosterone levels. Positive relationships between anxiety components (somatic and cognitive anxiety) and cortisol were noted in both competitions. Salivary cortisol, together with anxiety components, may provide a better sensitive index of physiological stress than testosterone concentrations.

Moya et al (2001) conducted a study on psychophysiological responses to the Stroop Task after a maximal cycle ergometry in elite sportsmen and physically active subjects. Physical fitness moderates the psychophysiological responses to stress. This study attempts to determine whether the degree of fitness could affect the response to physical and psychological stress after comparing two groups of men with good physical fitness. Saliva samples from 18 elite sportsmen, and 11 physically active subjects were collected to determine hormonal levels after carrying out a maximal cycle ergometry. Heart rate and skin conductance level were continuously recorded before, during, and after a modified version of the Stroop Color-Word Task. With similar scores in trait anxiety and mood, elite sportsmen had lower basal salivary testosterone, testosterone/cortisol ratio, and HR before an ergometric session than physically active subjects, but no differences were found in salivary cortisol and blood pressure. Salivary testosterone and cortisol responses were lower and testosterone/cortisol ratio responses
higher in elite sportsmen. During the Stroop Task, elite subjects showed lower heart rate and skin conductance level over the entire measurement period, and greater heart rate recovery with respect to the baseline values than physically active subjects. The effects of two standardised laboratory stressors on a set of psychophysiological variables were different when elite sportsmen and physically active subjects were compared.

Krause, Langrock & Weiss (2002) studied on influence of seasonal variations in training loads on selected amino acids and parameters of the psychoimmunological network in a swimming team. In the last years a shift in amino acid profile was discussed as one reason for the development of staleness. Signs of staleness are among others susceptibility to infection and disturbances in well-being. Beside tryptophane and branched-chain amino acids (BCAA) glutamine is the most discussed amino acid (AA) in this context. Based on the hypothesis of a multifactorial genesis of staleness and these AA being the metabolic link in psychoimmunology, seven young swimmers of regional top level were examined in a longitudinal field monitoring for biochemical, biomechanical and psycho-physiological data at six different training phases across one year. Special interest was spent on phases with the highest training loads (HT I and II) because of the increased risk of appearance of staleness compared with the regeneration phase (RP). The results point out that well controlled and regulated HT does not reduce but increases the plasma levels of glutamate (means and SD; RP 20 +/- 8 micromol/l, HT I 34 +/- 11 micromol/l), glutamine (RP 489 +/- 155 micromol/l, HT I 634 +/- 113 micromol/l) and BCAA (valine RP 164 +/- 54 micro mol/l, HT I 283 +/- 58 micromol/l, isoleucine RP 59 +/- 20 micromol/l, HT I 101 +/- 24 micromol/l, leucine RP 88 +/- 32 micromol/l, HT I 142 +/- 35 micro mol/l). The immunological parameters did not show any significant training-induced changes (sIL-2-R: RP 422 +/- 98 U/ml, HT I 522 +/- 70 U/ml, s-ICAM: RP 157 +/- 11 ng/ml, HT I 185 +/- 32 ng/ml) and don't seem to be suitable as indicators for a "biochemical-psychophysiological" justified control and regulation of training. Possibly the increasing of plasma concentrations of AA by intensive and high volume endurance training is the "store shape" of AA in view of saving and provisioning the organism for further exhausting training loads.
Stamm et al (2003) conducted a study on dependence of young female volleyballers' performance on their body build, physical abilities, and psycho-physiological properties. The aim of the study was to establish which anthropometric characteristics, physical abilities and psycho-physiological properties determine the success of adolescent female volleyballers at competitions. For this purpose we studied 32 female volleyballers aged 13-16 years. The anthropometric examination included 43 measurements, 7 tests of physical fitness, and 4 series of computerised psycho-physiological tests (n=21). The performance of game elements was measured empirically during championship games using the original computer program "Game". The proficiency of performing volleyball elements - serve, reception, feint, block and spike - was calculated by regression models from the 14 anthropometric measurements, 4 physical fitness and 7 psychophysiological test results, which showed significant correlation with proficiency in the game. The predictive power of the models was at least 32% and in average 56%. The anthropometric factor was significant in the performance of all the elements of the game, being most essential (71-83%) for attack, block and feint. Good results in physical ability tests granted success in serve, attack and reception.

Stamm et al (2005) conducted a study on role of adolescent female volleyball players' psycho-physiological properties and body build in performance of different elements of the game. In that study the body-build peculiarities (49 body measurements) and psychophysiological properties (21 computerized tests) of 32 adolescent female volleyballers were studied to assess their significance in performance at competitions. Games were recorded by the original computer program Game, and an index of proficiency representative elements of the game was calculated for each player. Regression analysis was applied to predict the best psycho-physiological and anthropometric models for serve, reception, block, feint, and attack. Seven tests of psycho-physiological indices and 14 anthropometric variables explained 38-98% and 32-83% of skill performance, respectively. Consequently, to improve young volleyball players' performance, everyday coaching should be complemented by detailed assessment of their body build and psycho-physiological characteristics.
Korobeĭnikov et al. (2006) conducted a study on Sexual dimorphism of the psychophysiological indices in sportsmen of higher qualification. To determine the influence of sexual dimorphism on mental characteristics in elite athletes, 24 sportsmen (18-27 years old) (17 men and 7 women members of Ukrainian National Judo Team), 20 sedentary men and 20 sedentary women (20-29 years old) were studied. Results obtained confirmed significant difference of sexual dimorphism indices in athletes and sedentary people. It was determined that sexual dimorphism manifestations in athletes were as follows: (1) short memory capacity (62.58 +/- 3.21%) and coefficient of operational thinking (2.67 +/- 0.16 standard units) was increased in women in comparison with men (55.78 +/- 2.07% and 1.44 +/- 0.30 standard units, p < 0.05, accordingly), (2) on the contrary neurodynamic functions were decreased in women (latent time of simple (266.92 +/- 4.73 ms) and composite (494.44 +/- 6.38 ms) visual-motor reactions and power of nervous processes (18.49 +/- 8.93%) in comparison with men (239.62 +/- 5.26 ms, 440.10 +/- 6.61 ms, 5.33 +/- 0.59%, p < 0.05, respectively). Results obtained indicate influence of sexual dimorphism on psychophysiological functions.

Korobeynikov et al. (2006) conducted a study on psychophysiological diagnostics of functional states in sports medicine. The methods of psychological diagnostics ignored the integral criteria of functional states which are used in athletes. That is the reason why the elaboration of psychophysiological diagnostics criteria for higher qualification athletes was performed. The diagnostics of psychophysiological functions obtains information on individual and typological characteristics of higher neural system, peculiarities of forming and improvement of special experience and indicators of fatigue and hypertension of athletes. The 26 higher qualification athletes (men), members of National team (Judo) were examined. The psychophysiological and neurodynamic functions such as functional mobility of nervous processes, strength of nervous processes, time perception, attention volume, operational thinking coefficient and short-term memory volume were registered by a computer system. The differential scale of functional states of psychophysiological functions in athletes was elaborated. The results of the investigation showed that 10 subjects had high parameters of functional states of psychophysiological functions and 14 have the intermediate level. The functional states of psychophysiological functions in higher qualification athletes characterize the
functional system responsible for the results of sport. The optimization of the perception and information processing using the short-term memory reflects the psychophysiological compensatory mechanisms of a decline of visual perception and information processing capability in athletes. The psychophysiological states in higher qualification athletes are characterized by the functional system responsible for the result of sport.

Kaïdalin et al. (2007) investigated a study on the effect of sensory stimuli of varying modality on the human body functioning and indices of tense muscular activity. The work had a purpose to study benefits of aromatic blends of tonic and relaxing essences and functional music on some of the psychophysiological properties of the human functional state and motor activity. Participants were 30 sprinters (18-22 y.o. males) having the first-class and master ranks. The psychophysiological indices of the athletes' functional state were evaluated with the use of the "CAH" and Spilberger situational anxiety tests, calculated Cardio vegetative index, time for simple motor reaction and reaction to a moving object. Motor activity was evaluated by top running speed determined with a photo-electronic time-keeper and by duration of pedaling on bicycle ergometer at maximal power. The running step parameters were recorded with electropodography. It was shown that the positive effect of the aromatic essence blends and functional music on motor activity developed fairly rapidly but did not last long. The article discusses features and possible ways the aromatic blends and music effect human organism.

Midgley et al. (2007) conducted a study on criteria for determination of maximal oxygen uptake: a brief critique and recommendations for future research. Although the concept of maximal oxygen uptake (V-dotO(2max)) was conceived as early as 1923, the criteria used to establish whether a true V-dotO(2max) has been attained have been heavily criticised. Consequently, an improvement in the methodology of the existing criteria, or development of new criteria, is required. In order to be valid across experimental studies, new or improved criteria need to be independent of exercise modality, test protocol and subject characteristics. One procedure that has shown potential for yielding valid V-dotO(2max) criteria is the verification phase, which consists of a supramaximal constant speed run to exhaustion performed after the
incremental phase of a V-dotO(2max) test. A peak oxygen uptake (V-dotO(2peak)) in the verification phase that is similar (within the tolerance of measurement error, e.g. within 2%) to the V-dotO(2max) value attained in the incremental phase would indicate that a true V-dotO(2max) has been elicited. Verification of the maximal heart rate would also indicate that a subject has given a maximum effort. Although the validity of the present methodology for identifying an oxygen uptake (V-dotO(2)) plateau is questionable, a V-dotO(2) plateau criterion based on the individual slope of the V-dotO(2)-work-rate relationship should improve its validity. This approach also allows determination of the 'total V-dotO(2) plateau', which is in contrast to currently used V-dotO(2) plateau criteria that are based on the difference in V-dotO(2) between only two test stages or V-dotO(2) data points. The ratings of perceived exertion scale has been criticised for being a one-dimensional measure of physical effort and V-dotO(2max) criteria based on a multidimensional psychophysiological approach should increase validity. Visual analogue scales can be used to assess aspects such as muscular pain, determination and overall perceived effort. Furthermore, they are easy to complete and have demonstrated good reliability and validity in clinical and health settings. Future research should explore these and other potential approaches to developing new or improved V-dotO(2max) criteria, so that, ultimately, a standardised set of V-dotO(2max) criteria can be established. At present, however, the greatest challenge is identifying V-dotO(2max) criteria that remain valid across studies.

Arroyo-et al (2008) conducted a study on psychophysiological effects of massage-myofascial release after exercise: a randomized sham-control study. The aim of this study was to evaluate the effect of massage on neuromuscular recruitment, mood state, and mechanical nociceptive threshold (MNT) after high-intensity exercise. This was a prospective randomized clinical trial using between-groups design. The study was conducted at a university-based sports medicine clinic. Sixty-two (62) healthy active students age 18-26 participated. Participants, randomized into two groups, performed three 30-second Wingate tests and immediately received whole-body massage-myofascial induction or placebo (sham ultrasound/magnetotherapy) treatment. The duration (40 minutes), position, and therapist were the same for both treatments. Dependent variables were surface electromyography (sEMG) of quadriceps, profile of mood states (POMS)
and mechanical nociceptive threshold (MNT) of trapezius and masseter muscles. These
data were assessed at baseline and after exercise and recovery periods. Generalized
estimating equations models were performed on dependent variables to assess differences
between groups. Significant differences were found in effects of treatment on sEMG of
Vastus Medialis (VM) \( p = 0.02 \) and vigor subscale \( p = 0.04 \). After the recovery
period, there was a significant decrease in electromyographic (EMG) activity of VM \( p =
0.02 \) in the myofascial-release group versus a nonsignificant increase in the placebo
group \( p = 0.32 \), and a decrease in vigor \( p < 0.01 \) in the massage group versus no
change in the placebo group \( p = 0.86 \). Massage reduces EMG amplitude and vigor when
applied as a passive recovery technique after a high-intensity exercise protocol. Massage
may induce a transient loss of muscle strength or a change in the muscle fiber tension-
length relationship, influenced by alterations of muscle function and a psychological state
of relaxation.

Cervante et al. (2009) conducted a study on heart-rate variability and
precompetitive anxiety in swimmers. The aim of this study was to test the utility of heart-
rate variability (HRV) analyses as a noninvasive means of quantifying cardiac autonomic
regulation during precompetitive anxiety situations in swimmers. Psychophysiological
state evaluation of 10 volunteer <<master>> swimmers (6 women and 4 men) was
obtained by comparing baseline training condition (TC) with competition condition (CC).
Self-evaluation of precompetitive somatic anxiety measured by CSAI-2 showed
significant increase from the TC to CC. Analysis showed that during higher
precompetitive anxiety level, a significant reduction in the timing (RMSSD), frequency
(HFms2 and HFnu) and Poincaré plot (SD1) of heart-rate variability was observed, and a
significant increase in the low frequency to high frequency ratio (LF/HF %). The results
indicate a shift towards sympathetic predominance as a result of parasympathetic
withdrawal. Our results provide an HRV analysis in a valid, useful and non-invasive way
to evaluate the change of sympathovagal balance in presence of precompetitive stress.

Kim et al., (2009) conducted a study on psychophysiological stress response
during competition between elite and non-elite Korean junior golfers. The purpose of this
study was to investigate the effects of stress hormone and competition state anxiety
response between elite and non-elite junior golfers in competition. Six elite (Handicap: 2.67 +/- 0.82; 16.2 +/- 1.38 yrs) and six non-elite (Handicap: 7.83 +/- 1.17; 15.8 +/- 0.75 yrs) Korean junior golfers participated in this study. Physiological stress and psychological stress responses were measured on four occasions (at rest, prior to, during, after competition) by salivary cortisol and Competitive State Anxiety Inventory-2 (CSAI-2) respectively. In salivary cortisol, no interaction was found between groups and the test occasions. However, both groups showed significantly increased levels between rest and all other occasions and between prior to and after competition. The interpretation of this finding is limited by the interaction with the diurnal rhythm of cortisol secretion. In cognitive state anxiety, significant interaction was found. Elite golfers had significantly lower cognitive state anxiety scores than non-elite golfers at rest, prior to and during competition. No interaction was shown in somatic state anxiety. However, there was significant difference among occasions. Both groups had higher somatic state anxiety scores prior to and during competition than after competition. No interaction was shown in self-confidence, but elite group had significantly higher scores than non-elite group at all occasions. This study demonstrates the differences of psychophysiological response in competition between elite golfers and non-elite golfers.

Filaire et al., (2009) conducted a study on psychophysiological stress in tennis players during the first single match of a tournament. The purpose of this investigation was to study the physiological and psychological states of 16 tennis players (8 males, 8 females) during the day of the first match of a tennis tournament and their relation to performance. Athletes completed the Competitive State Anxiety Inventory-2, including both intensity and direction subscales prior to the first match and collected saliva for cortisol analysis on several occasions: during a resting day (baseline values) and prior to and after both competitions. Results showed the males and females have different responses in the CSAI-2 subcomponents. Somatic anxiety was significantly higher (+23%; p<.05) in females compared to males whereas self-confidence was significantly higher in males (+34%; p<.05). Winners had significantly lower cognitive anxiety and higher Self-confidence scores than losers. Somatic anxiety was significantly higher in the losers. Our results showed a cortisol response to competition, which was especially characterized by an anticipatory rise. Males had the same pattern of cortisol responses
than females, even if the cortisol concentrations were significantly higher in females the
day of the competition. According to the outcome, significant differences between
winners and losers cortisol concentrations were observed whatever the hour of taking
(except in the evening), cortisol concentrations being the highest at the loser's. The
measurement of cortisol at the same time that self-reports psychological indicators would
provide an approach to examine changes in anxiety, and its relationship to performance.

Klin Khir (2009) did a study on character and speed of restoration of
psychophysiological functions after application of various kinds of anesthesia in
conditions of a "one-day" stationary. The frequency of operative interventions, performed
according to the "one-day" stationary technology is raising every day. The patients are
chosen in accordance with conventional methods, while somatic state of a patient and
the further operation volume playing the leading role. But in 30% of patients in the early
postoperative period and in 10.4% in the late postoperative period the high psychic
functions disorders occur, which are called postoperative cognitive dysfunction. The
investigation is devoted to studying of character and speed of restoration of
psychophysiologic functions after application of various general anaesthesia in conditions
of the "one-day" stationary. There was proved, that apart of general anaesthesia scheme
applied, in all the patients the cognitive functions defect was noted in postoperative
period. These functions are restored most quickly in application of propofol in the
scheme and slower in mononarcosis with ketamin.

Maikala et al. (2009) conducted a study on psychophysiological responses in
women during cart pushing on different frictional walkways. The aim of this study was to
evaluate psychophysically determined acceptable forces, cardiopulmonary, and calf
muscle metabolic responses in 15 workers while they pushed an instrumented cart on two
walkways. In addition to the potential for increased musculoskeletal disorders in workers,
pushing on various terrains is associated with occurrence of slips and falls at the
workplace. Using a psychophysical approach, participants chose the maximum
acceptable cart weight they could push without strain on walkways with coefficient of
friction equaling 0.68 (plywood) and 0.26 (Teflon-coated.). Then, while participants
pushed their psychophysically chosen cart weight for 2 hr on each walkway, horizontal
and vertical forces applied on the cart handle and physiological responses were collected. Cardiopulmonary responses were measured using a telemetric metabolic cart. A tissue hemoglobin index (THI) and a tissue oxygenation index (TOI) from the right and left calf muscles were obtained using near-infrared spectroscopy. Participants generated higher horizontal forces (by 26%) on plywood than that on Teflon. Cardiopulmonary and TOI and THI responses were similar between walkways. However, greater ratios of absolute oxygen uptake per force (by 19%) and TOI per force (by 24%) on Teflon were demonstrated in the horizontal direction than on plywood. This increased muscle oxygenation-force ratio, coupled with increased oxygen uptake per force generated on Teflon, might suggest that pushing on the slippery surface results in higher metabolic demand. Findings from the present study will assist in revising previously established acceptable forces and in relating these forces to physiological responses with respect to pushing on different frictional walkways.

Sato et al (2009) conducted a study on clinical efficacy of individual cognitive behavior therapy for psychophysiological insomnia in 20 outpatients. Twenty patients (14 of them women) suffering from psychophysiological insomnia (PPI) were enrolled for cognitive behavior therapy (CBT). The mean age of the patients was 56.9 years, and the mean duration of insomnia morbidity was 8.9 years. Each received individual combined CBT treatments consisting of stimulus control, sleep reduction, cognitive therapy and sleep hygiene education over a period of 1 month. Methods: Just before the CBT and after its completion, sleep measurements were conducted that involved (i) sleep logs, Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS), and the Pittsburgh Sleep Quality Index (PSQI); (ii) actigraphy measurement; (iii) dissociation between subjective and objective evaluation of sleep calculated from sleep logs and actigraphy results; and (iv) correlation between DBAS and the aforementioned sleep parameters. Because the intention was to focus on patients’ incorrect cognition about sleep, the definition ‘changes in dissociation between the sleep log and actigraphically measured sleep’ was used as the primary outcome and ‘changes in DBAS score’ as the secondary outcome. Results: After the CBT the following was found: (i) underestimation by PPI patients of the objective evaluation of sleep; (ii) a decrease in the dissociation between the subjective and objective evaluation of sleep; (iii) improvement of the DBAS; and (iv) improvement of
sleep logs and actigraphy measurements. Moreover, there was a correlation between the improvement of PSQI, sleep logs and DBAS. Conclusion: CBT for insomnia is able to redress incorrect cognition about sleep, leading to improvement of the disorder.

Luft, Takase & Darby (2009) investigated a study on heart rate variability and cognitive function: effects of physical effort. This study investigated alterations in heart rate variability (HRV) and cognitive performance before and after physical effort, for 30 high-level track and field athletes (23 males and 7 females). Interbeat intervals were assessed at the baseline and during each task of a CogState cognitive battery (simple reaction time, choice reaction time, working memory, short-term memory and sustained attention). Time and frequency domain measures of HRV were compared between conditions and between tasks. The results indicated differences in HRV between executive and non-executive tasks. There was a significant increase in sympathetic-modulation-related indices after physical effort. The differences between executive and non-executive tasks were the same in post-test. Correlations were found between HRV and cognitive performance, which differed by speed and accuracy. We conclude that HRV is related to cognitive demand and that the correlation between HRV and cognitive performance seems to be stronger after physical exercise. The results raise questions about the psychophysiological meaning of different HRV signals and this has implications for future research about the relationship between HRV and cognition.

Dudnyk, Korobeĭnikov & Iahello (2009) did a study on psychophysiological states in humans with different levels of adaptation to muscular activity. The influence of straight muscular activity to peculiarities of forming of psychophysiological states in humans has been studied. Two groups of sportsmen with different levels of adaptation to muscular activity were investigated. The first group composed of the sportsmen with higher level of adaptation to muscular activity (27 members of Ukrainian national team of Greco-Roman wrestling, aged 18-26), the second group contained the sportsmen with the average level of adaptation to muscular activity (24 sportsmen, average qualification, student of specialty gymnasium, aged 18-26). The results showed that psychophysiological states in humans with higher adaptation level to muscular activity are characterized by more determined organization of information processing system and
heart rate regulation compared to humans with simple adaptation level. In addition, in sportsmen who have higher level of adaptation to intensive muscular activity the balance with vagus-sympathetic tonus mechanisms of vegetative regulation of heart rate is showed.

Smeets (2010) conducted a study on autonomic and hypothalamic-pituitary-adrenal stress resilience: Impact of cardiac vagal tone. Resilience refers to the ability to cope with stressful events. Variation in the activity of the stress-responsive sympatho-adrenal-medullary and hypothalamic-pituitary-adrenal axes is particularly important for adaptive stress responses and thus may give rise to individual differences in resilience. Here, we investigated whether cardiac vagal tone and adult attachment style are related to psychophysiological stress resilience by exposing a sample of healthy young men and women (n=68) to a laboratory stress test while monitoring autonomic (heart rate, salivary alpha-amylase), hypothalamic-pituitary-adrenal (salivary cortisol), and psychological stress levels. Our results demonstrate that adult attachment style did not influence autonomic, hypothalamic-pituitary-adrenal, or psychological stress responses. In contrast, higher resting cardiac vagal tone was associated with stress-induced increases in cortisol. This suggests a role for sympathetic influences on heart rate regulation in hypothalamic-pituitary-adrenal stress responses, and extends previous observations of a link between vagal tone and stress resilience.

Blain et al, (2010) did a study on a cardiorespiratory classifier of voluntary and involuntary electrodermal activity. Electrodermal reactions (EDRs) can be attributed to many origins, including spontaneous fluctuations of electrodermal activity (EDA) and stimuli such as deep inspirations, voluntary mental activity and startling events. In fields that use EDA as a measure of psychophysiological state, the fact that EDRs may be elicited from many different stimuli is often ignored. This study attempts to classify observed EDRs as voluntary (i.e., generated from intentional respiratory or mental activity) or involuntary (i.e., generated from startling events or spontaneous electrodermal fluctuations). Eight able-bodied participants were subjected to conditions that would cause a change in EDA: music imagery, startling noises, and deep inspirations. A user-centered cardiorespiratory classifier consisting of 1) an EDR
detector, 2) a respiratory filter and 3) a cardiorespiratory filter was developed to automatically detect a participant's EDRs and to classify the origin of their stimulation as voluntary or involuntary. Detected EDRs were classified with a positive predictive value of 78%, a negative predictive value of 81% and an overall accuracy of 78%. Without the classifier, EDRs could only be correctly attributed as voluntary or involuntary with an accuracy of 50%. The proposed classifier may enable investigators to form more accurate interpretations of electrodermal activity as a measure of an individual's psychophysiological state.

Dieleman et al. (2010) conducted a study on perceived and physiological arousal during a stress task. Anxiety and depression might be two different valid constructs that often co-occur, or they could be different manifestations of the same underlying vulnerability. A theoretical framework to address this question is the tripartite model, by Clark and Watson, which hypothesizes that physiological hyperarousal (PH) is specific for anxiety. Knowledge about the relationship between PH, psychophysiological measures, perceived arousal, and anxiety would increase our understanding of the validity of the PH construct in this model. Our objective was to assess whether (a) hypothalamic-pituitary-adrenocortical (HPA) axis functioning, and (b) perceived arousal before, during and after stress can differentiate anxious from depressive children. In a general population sample of 225 children aged 8-12 years, self-reported anxiety and depressive symptoms were assessed using the Multidimensional Anxiety Scale for Children (MASC) and the Children's Depression Inventory (CDI). Perceived arousal was assessed using a self-report questionnaire before, during and after a stress task. Basal and reactive HPA-axis functioning were used as indices for psychophysiological arousal. Our data showed that the relation between perceived arousal and anxiety problems is stronger than the relation with depressive problems. Reactive HPA-axis functioning is reduced in children with depressive problems. Some evidence was found in support of the tripartite model. Our findings indicate that perceived arousal to a challenge might be a useful tool to assess the PH component of the tripartite model. Reactive HPA-axis functioning might be able to differentiate between anxiety and depressive problems in children in a general population sample, but effect sizes are small and replication is needed.
Madden et al. (1989) completed a study titled coping styles of competitive middle distance runners. The Ways of Coping with Sport (WOCS) was administered to a population of middle distance runners selected to attend a training camp for elite athletes. The 66-item WOCS, which has been previously administered to amateur and elite basketball players (Madden, Summers and Brown, 1988), yields a similar factor structure to the Ways of Coping Checklist of Folkman and Lazarus (1985). Eight factors were identified through the application of principal components analysis. In the current study, coping profiles were determined for international, national and state level middle distance runners. The items comprising Seeking Social Support (scale 2), increased effect and Resolve (scale 4) and Problem-Focused Coping (scale 1) were reported consistently as strategies for coping with a slump in personal performance in competitive running. The results were discussed in relation to history of injury, extent of training, and level of competitive experience.

Smith (1989) completed study on effects of coping skills training on generalized self-efficacy and locus of control. A number of studies have shown that mastery experiences strengthen self-efficacy expectancies that are specific to the mastery situation, in this study I assessed the effects of cognitive-behavioral coping skills training on generalized expectancies concerning self-efficacy and locus of control in test-anxious college students. Compared with a waiting-list control group, the trained subjects exhibited significant decreases on trait and state measures of test anxiety and a higher level of academic performance on classroom tests, as well as changes in specific self-efficacy expectancies relating to test anxiety management and academic performance. Consistent with generalization predictions derived from self-efficacy theory, the coping skills group also exhibited decreases in general trait anxiety and increased scores on a trait measure of generalized self-efficacy. Locus of control was unaffected by the program, and changes in general self-efficacy were unrelated to changes in locus of control.
control, suggesting the possibility that different parameters of experience are related to changes in the two types of generalized expectancies.

Prinz et al. (1994) did a study on “An evaluation of peer coping-skills training for childhood Aggression”. Peer coping-skills (PCS) training is a new school-based intervention designed to promote pro social coping among school-age children. The intervention is based on a coping-competence model that addresses the development of antisocial and asocial coping among youth at elevated risk for conduct disorder. PCS training was tested in a controlled evaluation with children in Grades I to 3 who exhibit high rates of aggressive behavior, and it was found to increase pro social coping via information exchange, improve social skills, and reduce aggression. These improvements were maintained into the next school year, as reacted in a 6-month follow-up assessment by teachers. Competent-non aggressive children who also participated not only showed no adverse effects but demonstrated skill enhancement. Children, parents, and teachers in the ethnically diverse sampler tend PCS training as highly acceptable. It is recommended that PCS training be combined with family and Classroom intervention strategies over multiple years to prompt the development of competence and to increase the likelihood of preventing conduct disorders in high-risk youth.

Smith (1995) did a study on “Development and Validation of a multidimensional measure of sports specific psychological skills: The athletic coping skills inventory-28.” Confirmatory factor analysis was used as the basis for a new form of the athletic coping skill inventory (ACSI). The ACSI-28 contains seven sport specific subscales: Coping with adversities, peaking under pressure, goal setting/mental preparation, concentration, freedom from worry, confidence and achievement motivation, and coachability. The scales can be summed to yield a Personal coping resource score, which is assumed to reflect a multifaceted psychological skill construct. Confirmatory factor analyses demonstrated the underlining factor structure for both male and female athletes. Psychometric characteristics are described, and evidence for construct and predictive validity was presented.
Anshel (1996) completed a study on coping styles among adolescent competitive athletes. The use of approach and avoidance coping styles and task-focused and emotion-focused coping strategies in competitive sport was explored. Four hundred twenty-one adolescent males from New South Wales, Australia, who were currently competing in team sports indicated their usual responses to each of 8 acute stressors commonly experienced in sport, using a 128-item inventory. The reliability coefficient (Cronbach’s α) for each stressor ranged from .81 to .92. Twenty-six of the original 128 items on the inventory were retained, on the basis of factor analysis. Correlations between stressors indicated that coping styles were a function of type of stressor, providing support for the transactional model. Goodness of fit was high (.87). The present results partially support the construct of coping style among adolescent-aged sports competitors.

Seiffge-Krenke & Klessinger (2000) in a prospective study, long-term effects of avoidant coping on adolescents’ depressive symptom, the impact of different types of coping styles on adolescents’ depressive symptoms was investigated. One hundred and ninety-four adolescents participated in 4 annual assessments of coping styles and depressive symptoms. Longitudinal analyses revealed long-term differences in depressive symptoms, depending on coping style. Adolescents with an approach-oriented coping style reported the fewest depressive symptoms at Time 3 and Time 4, whereas avoidant copers reported the most at both times. Higher levels of depressive symptoms 2 years later were found in all adolescents who used avoidant coping, irrespective of whether they used avoidant coping consistently at Time 1 and Time 2 or changed from approach-oriented coping to avoidant coping at Time 2. This effect was independent of gender and time. The results suggest that most adolescents show an overall adaptive way of coping, but a small subgroup shows a fairly rigid use of avoidant coping. They further suggest that all forms of avoidant coping, whether stable or not, were linked with high levels of depressive symptoms even 2 years later.

Cunningham et al. (2002) conducted a study titled enhancing coping resources in early adolescence through a school-based program teaching optimistic thinking skills; anxiety, stress, and coping. This study examined the effectiveness of a universal school-
based prevention program that was designed to increase coping resources in preadolescents through the modeling and teaching of optimistic thinking skills. School psychologists, together with classroom teachers, implemented an eight-week program in eight Year 5 and 6 class groups as part of the regular school curricula. One hundred and sixty children who participated in the program were compared to 135 children in 8 control groups on pre- and post-test questionnaires. Post-test responses show that children who participated in the program reported significant improvements in coping efficacy, and reductions in depressive attributions and use of the non-productive coping strategies of worry, wishful thinking, not coping, and ignoring the problem when compared to controls. These results support the feasibility of implementing low-cost, non-intrusive programs in school settings that address the emotional health of all young people. Support is also provided for theories that suggest attributions for events and coping efficacy influence the selection of coping strategies.

Prakash and Coplan (2003) in their study ‘shy skaters’? Shyness, coping and adjustment outcomes in female adolescent figure skaters, examined the associations between shyness and adjustment outcomes in competitive adolescent figure skaters. At Time 1, 40 female figure skaters completed self-report of shyness, athletic self-esteem and psychological coping style. At Time 2, approximately nine months later, skaters completed a measure of competitive anxiety immediately prior to a competitive performance. Competitive placement at this performance was also recorded. Results revealed that shyness was associated with increased outcomes associated somatic (physiological) anxiety prior to competitive performance. Additionally, shyness was negatively related to athletic self-esteem and competitive performance, but these relations were moderated by the skaters’ use of psychological coping styles. The results are discussed in terms of the role of coping style as a protective factor against the potential negative with shyness in the realm of athletics.

Frydenberg et al. (2004) conducted a study titled prevention is better than cure: coping skills training for adolescents at school. They suggests that Children and adolescents today face a plethora of stressful problems, including family and relationship
conflict, death of close family members or friends, and academic and social pressures. Such problems have been found to contribute to an increased risk of various emotional-social-cognitive difficulties in adolescence. These include academic failure, social misbehavior, interpersonal problems, and depression. Programs that promote coping with normative stress, delivered to the whole population, have been considered to represent a promising direction for the prevention of social emotional difficulties. The best of coping: developing coping skills program (Frydenberg & Brandon, 2002) was introduced in two school settings on four separate occasions. Evaluation of the results provides modest support for coping skills enhancement but provide a warning about the need for caution when implementing and evaluating the Program. First, it appeared to have some opposing effects on males and females. Second, improvements in students’ coping responses were apparently related to the authenticity of implementation of the Program. The findings are discussed with regard to the need to implement programs through which we can teach adolescents coping responses, which include optimism and problem-solving skills, so that they may handle problems and stressors more effectively. Additionally, an important feature of such programs is a focus on the reduction of the use of non-productive coping skills. With an increase in psycho-social problems, the need to provide school-based programs is discussed, with emphasis placed on program implementation. In particular, the probable need for ongoing involvement of psychologically trained school counselors with teachers, through the life of the program.

Anshel & Si (2008) in their study tried to determine the extent to which approach and avoidance coping styles are consistent in response to different sources of acute stress experienced during sport competition, a test of trait and transactional coping theories. Elite athletes from the Peoples Republic of China (N = 391, 253 males and 138 females) indicated their coping strategy following each of eight sources of acute stress experienced during the contest. Eight items were designated as approach coping and eight items were avoidance coping items. Confirmatory factor analysis with approach coping and avoidance coping was a satisfactory fit for all stressors (GFI = .92, RMSEA = .06, X² [461] = 79.02, p<.25). Low Pearson product-moment intercorrelations, examining the relationship between coping styles for each stressor, indicated relative independence
between coping styles among stressors. Moderate to high intra-item reliability (i.e., Cronbach alphas) indicated that responses to approach and avoidance coping items were consistent for each stressor. Taken together, these results lent support for the transactional coping theory that coping style is a function of the type of stressful event, and provide insights into the coping patterns of elite athletes from the Peoples Republic of China.

Omar-Fauzee et al. (2009) in their study the effectiveness of imagery and coping strategies in sport performance investigated the effectiveness of imagery and coping strategies in sport performance. Participants were 106 person, both male (n=42) and female (n=64) aged between 17 and 45 years old who represented the different level of participants of sport. Which is State players (n=46), National players (n=38) and District/university players (n=22) in various sports competitions. Participants completed the SIQ questionnaires to measure imagery skill while using ACSI-28 questionnaires to measure coping skill. Result showed Malay respondents is the higher interested in the study are 79 persons. Meanwhile, sports involved of respondents are others sport (archery, football/futsal, netball, rugby, hockey and athletics) which are 50%. The most level of age participated are 21 to 24 years old. Most probably, in this age level, some of them represented for national (n=38) and state (n=46). The result of this study showed that the SIQ and ACSI-28 is reliable to the respondents participated which is the Cronbach’s alpha coefficients, mean and standard deviation of all the variables are presented were .932. For the ACSI-28, the participants most frequently used coping skills is the confidence (M=2.0802, SD=.5644) and the least frequently used is coachability (M=1.5519, SD=.4361). From the resulted, there were significant differences in one subscales of ACSI-28 coping with adversity between male and female, which are concentrated with t (106) = 2.118, p = .037. One Way ANOVA analysis subscales with level of participants result showed that all subscales imagery (SIQ) were significant differences with levels of participation. In addition five subscales ACSI-28 also were significant differences with level of participations in this study. It might be because of the participated from a national and state player (n=38, n=46). In addition, result showed only subscales coping with diversity are significant differences where p=.037(M=2.0448, SD=.5115) compare the rest of subscales ACSI-28.
Mental Toughness: Theory and Measurement

Despite the apparent importance of mental toughness, limited research has been conducted on the topic. In particular, there is a lack of mental toughness measures that have been evaluated in relation to even minimum levels of psychometric criteria—reliability, factor structure, and construct validity. Sport psychologists (researchers and practitioners), coaches, sports commentators, sports fans, and athletes acknowledge the importance of mental toughness in sporting performance (Goldberg, 1998; Hodge, 1994; Tunney, 1987; Williams, 1988). In early work on the issue, Loehr (1982, 1986) emphasized that athletes and coaches felt that at least fifty percent of success is due to psychological factors that reflect mental toughness. Similarly, Gould, Hodge, Perterson, and Petlichkoff (1987) emphasized that coaches feel that mental toughness is important in achieving success, while Norris (1999) has emphasized the importance of mental toughness in developing champion athletes.

Norris (1999) conducted a project to achieve greater understanding of the developmental and psychological processes of tennis champions. Phenomenological research design, employing the qualitative in-depth interview was used. Constant comparative analysis, as applied to grounded theory, was used to guide data collection and analysis. Champions were asked to describe their processes toward championship achievement, and what facilitated their athletic and psychological development. Of particular interest was how they traced their development, which included the following themes: The roles of parents, teachers, coaches and mentors, conceptualizations of mental toughness, process versus outcome orientations to competition, the zone, triumphing when not in the zone, sportsmanship, regulation of emotion, self-talk, self-knowledge, self-complexity, motivation, confidence, dreams and childhood imaging, goal setting, acting skills when competing, humor, independent thinking, discipline, the history of their personal competitiveness, and their achievement of successfully contending with the psychological pressures of competition.
Common to nearly all the participants was an enduring love of the game of tennis, the joy of competing, and a strong desire to do supremely well and work hard in whatever endeavor the champions pursued.

Correlations with existent literature and previous research were present in the domains of family and social factors, most of the experiential characteristics of peak performance, and the importance attributed to having a coach or mentor who had the ability to relate well personally and professionally. In contrast to some previous research about champions and high achievers, most of these champions had not met an abundance of pain and trauma in their personal lives.

How champions define ‘champion’ was an area of this research new to literature. Emergent from the interviews were three styles of definition: External, reflecting accomplishment; External--Internal, meaning accomplishment and exemplary self-conduct; and Internal, reflecting both model self-conduct--and the value that a champion is one who fully actualizes innate potential. Potential seeking is how most of the champions described their drive for championship development and their orientation to life.

Thomas et al. (1996) investigated the psychological and psychomotor skills associated with ten-pin bowling, and a number of characteristics identified by Gould, Eklund, and Jackson (1993), and Gould, Finch, and Jackson (1993) are present and suggested in the study. Findings from Thomas et al. (1996) exemplify how thought control, and management of emotion in pre-performance and performance routines can be developed through time to play an important part in the game. For all of the dimensions and mental skills suggested from previous literature, the ability to apply these skills when it matters most is when mental toughness has been achieved. Meeting the demands and handling the pressures is vital and one lapse can cause huge consequences. Thomas et al. (1996) created a 37-item questionnaire incorporating specifically the factor of mental toughness to evaluate concentration and coping with pressure during competitive bowling. It was found that the subsection of mental toughness showed one of the highest results for reliability with a coefficient of 0.80 for internal reliability and 0.87 for test-
retest reliability. Also 89% were correctly classified as skilled bowlers from the responses to the items in the seven subscales of the Ten-Pin Bowling Performance Survey, with mental toughness one of the major components. From this 89%, successful players like these reported that they perform well under pressure, have no difficulty handling the pace, can concentrate for long periods, and often come from behind to win. Although the previous studies provide insights into the mentally tough performer, there are none that attempt to define mental toughness, while also stating sufficiently all the characteristics associated with mental toughness. It has been found that only 9% of coaches have been successful in developing or changing mental toughness in performers they worked with, therefore Jones et al. (2002), and Gould et al. (2002) attempted to clarify how to achieve such goals, and did so with relative success. Through using participants that had achieved full honors and represented their country in the Olympics or commonwealth games, Jones et al. (2002) implemented interviews to try and complete a profile of the mentally tough performer. The procedure was carried out in three stages. In stage 1 the athletes were drawn into a focus group and asked to discuss (a) a definition of mental toughness, and (b) a list of qualities and attributes of the ideal mentally tough performer. In stage 2, individual interviews were carried out on each athlete where they were asked for their definition of mental toughness, views on the focus group definition, and sentiments regarding the attributes associated with mental toughness. Stage 3 involved the researchers independently then collectively reviewing the participants’ comments. The definition and attributes of the ideal mentally tough performer were presented to all participants in the form of questionnaires for agreement rating of definitions and rank orders of the attributes.

Fourie and Potgieter (2001) investigated the components of mental toughness as reported by 131 expert coaches and 160 elite athletes from 31 sport codes. The written statements of coaches and athletes were analysed by means of an inductive content analysis. This resulted in the identification of 12 components of mental toughness. These are: motivation level, coping skills, confidence maintenance, cognitive skill, discipline and goal-directedness, competitiveness, possession of prerequisite physical and mental requirements, team unity, preparation skills, psychological hardiness, religious convictions and ethics. The coaches regarded concentration as the most important
characteristic, while the athletes regarded perseverance as most important. The coaches rated the effectiveness of coaches and sport psychologists in strengthening the characteristics of mental toughness more highly than athletes did.

Gould, Dieffenbach, and Moffett (2002) chose to investigate the psychological characteristics, and their development, of Olympic champions. Both questionnaire and interview data from 10 Olympic champions (winners of 32 Olympic medals), their coaches (n=10), parents, guardians and/or significant others revealed that these athletes could be characterized by: the ability to cope with and control anxiety; confidence; sport intelligence; the ability to focus and block out distractions; competitiveness; a hard-work ethic; the ability to set and achieve goals; coach-ability; high levels of dispositional hope; optimism; adaptive perfectionism; and mental toughness/resilience. Results also revealed that a number of individuals and institutions influenced the athletes’ psychological development, specifically the athlete’s community and immediate family, non-sport as well as sport environment personnel, and the sport process itself. Coach and family influences were particularly important and ways in which these sources influenced the athletes were both direct, such as teaching or emphasizing certain psychological lessons, and indirect, such as involving modeling or unintentionally creating certain psychological environments.

The literature on mental toughness is characterized by a general lack of conceptual clarity and consensus as to its definition, as well as a general failure to operationalize the construct in a consistent manner. This study by Jones (2002) addressed two fundamental issues surrounding mental toughness: how can it be defined? And what are the essential attributes required to be a mentally tough performer? Ten international performers participated in either a focus group or one-to-one interviews, from which a definition of mental toughness and the attributes of the ideal mentally tough performer emerged. The resulting definition emphasized both general and specific dimensions, while the 12 attributes covered self-belief, desire/motivation, dealing with pressure and anxiety, focus (performance-related), focus (lifestyle-related), and pain/hardship factors.
Despite widespread agreement on the importance and benefits of mental toughness and calls to identify psychological attributes that create champions, high quality research into mental toughness is limited. Most recently, Jones, Hanton and Connaughton (2002) conducted a qualitative study of elite athletes, aiming to define mental toughness and to determine the essential attributes required to be a mentally tough performer. The definition that emerged from their analysis concluded that: Mental toughness is having the natural or developed psychological edge that enables you to: 1) Generally, cope better than your opponents are with the many demands (competition, training, lifestyle) that sport places on a performer; and, 2) Specifically, be more consistent and better than your opponents in remaining determined, focused, confident, and in control under pressure.

Bull, Shambrook, James, and Brooks (2003) focused specifically on mental toughness in cricket and addressed two main objectives. First, to obtain a better understanding of what mental toughness is within cricket and second, to identify how existing mentally tough English cricketers developed their mental toughness. Twelve English cricketers identified by 101 English cricket coaches as being among the mentally toughest during the previous 20 years were interviewed. Analysis of their 1:1 focused interview transcripts identified the following four themes which were subsequently used to disseminate findings to England’s cricket coaching and playing population. Environmental Influence: parents, childhood, need to ‘earn’ success, opportunities to survive early setbacks, exposure to foreign cricket; Tough Character: resilient confidence, independence, self-reflection, competitiveness with self as well as others; Tough Attitudes: never-say-die mindset, go-the-extra-mile mindset, thrive on competition, belief in making a difference, exploit learning opportunities, willing to take risks, belief in quality preparation, determination to make the most of ability, self-set challenging targets; Tough Thinking: Think Clearly – good decision-making, keeping perspective, honest self-appraisal; Robust Self-Confidence – overcoming self-doubts, feeding off physical conditioning, maintain self-focus.

Burke (2003) carried out a study to identify both mental skills and training done during the preparation by the Mount Everest climbers. The main factor that was identified
to was program planning, mental fitness, imagery, focus, short term goal, previous experience, supports from experienced climbers, believe in one’s self and ability and the relationship of physical and mental. This research had shown that mental skill is not only important for the athletes in the competition but it should also be mastered by mountain climbers. Therefore, there is no exemption for football players to understand mental skills. The position and medals won are the predictor of the team’s achievement in this study. Many previous studies stated that medals (Gould et al., 2000; Jones et al., 2007) and the success of the athletes (Gucciardi et al., 2008) are what measure their success in sport in various level.

Martin et al (2004) investigated the psychological performance inventory, is mental toughness test tough enough. They evaluated the construct validity of responses to Lohers (1986) sport psychology performance inventory (PPI) by 263-student athlete from an elite sports high school. When they perused, exploratory factor analysis that resulted in 5-factor model that fitted the data well. However, further analysis showed that key correlates of M.T were more strongly correlated with the factors based on the original structure these factors based on the alternative structure in conclusion neither the original PPI nor the subset of PPI items in the better-fitting alternative model was a round measure of mental toughness, indicating that a good fits a necessary but not sufficient condition for construct validation. Hood instrumentation must be strong in terms of conceptual / theoretical consideration, psychometrics properties and relationship to key correlates hypothesized to be meaningfully related to it.

In Australia, Middleton and colleagues (2004a, b, c) have not only presented a new definition of mental toughness, they have also developed a Mental Toughness Inventory (MTI) and a model of mental toughness that is both multi-dimensional and hierarchical. Middleton, Marsh, Martin, Richards, & Perry (2004a) asserted that the Jones et al. (2002) definition was inadequate in that it only described the outcomes of being mentally tough and did not define mental toughness itself. Based on their qualitative research with 33 participants (25 elite athletes and eight non-athletes with extensive elite level sport experience as either sports scientist, coach, psychologist or management), they concluded that “mental toughness is defined as an unshakeable perseverance conviction
towards some goal despite pressure or adversity” (Middleton et al, 2004a). The authors contend that this definition states not only what mental toughness is but also identifies the actions of mental toughness (e.g., emotion management, perseverance, and task focus) as well as the role of some the factors that orient individuals to be mentally tough (self-belief, determination commitment, attitude and task familiarity). In total they too identified 12 mental toughness characteristics namely, self-efficacy, mental self-concept, potential, task-specific attention, perseverance, task familiarity, personal bests, task value, goal commitment, positivity, stress minimisation, and positive comparisons.

Middleton et al., (2004a) subsequently developed a model of mental toughness that seems to capture the complexity of the concept with considerable specificity. In brief, the model separates mental toughness into ‘orientation’ and ‘strategy’ with further distinctions emphasizing factors that are either ‘actions’ (coping strategies, focusing attention) or ‘personal characteristics’ (self-belief, motivations). In addition, their 67-item mental toughness inventory (MTI: Middleton et al., 2004c) is designed to measure 12 separate components of mental toughness as well as global mental toughness (13 factors in total). The MTI instrument was piloted among 479 (200 females; 279 males) aspiring elite athletes from a special sports high school in Sydney. Participants competed in several major team and individual sports and ranged in age from 12 to 19 years of age.

Devonport (2006) used semi-structured interviews to explore the views of three high performance kickboxers regarding the contribution of psychology to the development and maintenance of expert performance within kickboxing. The results provide a useful insight into the experiences of high performance kickboxers, identifying those mental skills and psychological attributes that are perceived to contribute to success. Participants identified seven mental skills that they believed to be linked to success in kickboxing; 1) effective use of self-talk, 2) relaxation, 3) heightened concentration, 4) self-regulation of arousal, 5) goal setting, 6) coping with being hit, and 7) imagery. Three psychological characteristics were identified by all participants as contributing to success, 1) high self-efficacy, 2) highly motivated and 3) mental toughness. Although not specifically identified by participants, it is suggested that a fourth psychological characteristic was also apparent. Participants demonstrated varying
degrees of emotional intelligence thorough their ability to monitor and manipulate their emotional states prior to and during competition. Martial artists used a number of long and short-term psychological strategies in preparing for competition. Furthermore, whilst mental skills were not systematically practiced, all participants endeavored to integrate some form of mental training within physical training. It is recommended that sport psychologists help martial artists develop and refine individualized mental training routines, assisting with the formal integration of psychological training into physical training. Martial artists spend the majority of their time practicing as opposed to competing. As such, the integration of mental skills training within physical training may help ensure quality practice, and facilitate the effective transfer of mental skills into competition.

The research by Mohamad et al (2009) was to explore the affect of higher score of mental toughness in the early stage of the league towards winning among Malaysian football players. The instrument used in this study was the questionnaire of Psychological Performance Inventory (PPI) by Loehr, 1986. The difference between the mental toughness between the categories of elite and non elite, professional and amateur players was measured. Other than that, the relationship between the players’ category, status and achievement with the seven dimension of mental toughness (Self confident (SC), Negative energy control (NE), Attention control (AT), Visual imagery control (VI), Motivational (MT), Positive energy control (PE) and Attitude control (AC) was evaluated. The results from the descriptive analysis showed that the mental toughness of Malaysian football players is at an excellence level. T-test had been conducted and the results shows that there is no significant difference on the mental toughness from the aspect the players’ category, (p = 0.136 > 0.05), but there is a significant difference on the status of the players, (p = 0.02 < 0.05). One way ANOVA and Pos Hoc test show a significant difference between the four dimensions of mental fitness among the players from various teams of different achievements. The results obtained are NE [(3,128) = 7.768, P < 0.05], AT [(3,128) = 8.828, P < 0.05], VI [(3, 128) = 5.789, P < 0.05] and PE [(3,128) = 4.896, P < 0.05]. There is no significant difference on the dimensions of SC, MT and AC (P > 0.05). Pearson Correlation analysis shows a low and significant association between the status and mental fitness of the players (r = -0.262, p = 0.02, <
The findings who the dimension of SC ($r = -0.270, p = 0.002 < 0.01$); NE ($r = -0.175, p = 0.045 < 0.05$); AT ($r = -0.249, p = 0.004 < 0.01$) and VI ($r = -0.176, p = 0.043 < 0.05$) have a low correlation and inversed relationship between the dimensions and the status of the players. Overall, this study shows that the mental toughness of Malaysian football players is at an excellent level. Status is seen as a factor that gives a lot of impact on the player especially in motivating them to attain their best achievement and also affect their mental toughness. This means that the mental toughness of the players could be enhanced if the players really understand the professionalism of the game and put it into practice.

**OVERVIEW OF THE REVIEW**

Over the last few years there has been a considerable increase in research into the psycho-physiological basis of performance.

Sport psychologists (researchers and practitioners), coaches, sports commentators, sports fans, and athletes acknowledge the importance of mental toughness in sporting performance. Currently there exists no comprehensively sound measure of mental toughness and further work is required to develop a multifaceted mental toughness measure that is strong on conceptual, within-network, and between-network grounds. Both quantitative and qualitative approaches have been applied in mental toughness research. Acknowledging the essential need of mental toughness, coaches have come to agree that mental toughness is a factor that could determine the success of an athlete. Studies on mental toughness and performance not only focused on certain sports but there are also many studies conducted on extreme recreational sports such as mountain climbing.

Loehr (1982) suggested that mental toughness was the reaction from the athlete’s ability to use the energy positively when facing a crisis and a positive behaviour when facing challenges. In 1986, James E. Loehr produced a book entitled ‘Mental toughness for sport: Achieving athletic excellence’ and gave a detailed explanation on mental toughness. This particular theory emphasized on the importance of emotional control and
stability to achieve an ideal state or what known as ‘Ideal Performance State’. Control over emotions are needed during the competition. This model listed seven psychological skills as factors for mental toughness; self confidence, negative energy control, attention control, visualization and imagery control, negative energy control and attitude control. Although this theory was criticized on the effectiveness of the PPI questionnaires (Middleton et al, 2004c), a few researchers had used this theory as a foundation for their studies on athletes’ mental toughness (Bhambri, Dhillon & Sahni, 2005; Fourie & Potgieter, 2001; Jones et al, 2002, 2007; Kuan & Roy, 2007).

Age, gender and level of competition effects on mental toughness have theoretical, practical, and methodological implications. Unfortunately there is a complete dearth of research that examines the effect of these variables on mental toughness.