CHAPTER II
HISTORICAL AND THEORETICAL PERSPECTIVES

Modern environment and conditions do not require man to climb trees, thus, dismissing opportunities for suspending, lifting and swinging the body, but the biological need for doing the same remains. Today, this need is satisfied by participation in sports, games and physical activities. The participation and motor education demands bodily skills, agility, courage and perseverance. Systematic participation in sports promotes all round harmonious physical and mental development of the individual and is considered one of the best tonic for one’s body, mind and soul.

Wikipedia, the free encyclopedia explains sport as an organized, competitive, entertaining, and skillful physical activity requiring commitment, strategy and fair play, in which a winner can be defined by objective means. This physical activity is governed by a set of rules or customs. In sports, the physical capabilities and skills of the competitor are important key factors, which determine the outcome of winning or losing. The physical activity involves the movement of people, animals and/or a variety of objects such as balls and machines or equipment. In contrast, games such as card games and board games, though these could be called mind sports and some are recognized as Olympic sports, require primarily mental skills and only minimal physical involvement. Non-competitive activities, such as jogging or playing catch, are usually classified as forms of recreation. Physical events such as scoring goals or crossing a line first often define the result of a sport. However, the degree of skill and performance in some sports such as diving, dressage and figure skating is judged according to well-defined criteria. This is in contrast with other judged activities such as beauty pageants and body building, where skill does not have to be shown and the criteria are not as well defined. In the new millennium, new sports have been going further from the physical aspect, involving mental or psychological aspects to a very great extent. Electronic sports organizations are becoming more and more popular. Motorized sports have appeared since the advent of the modern age.

2.1 Sport and Exercise

“Sport is an activity engaged in for amusement and exercise” says Oxford advanced learning dictionary. It’s especially an outdoor activity. Sports and exercise psychology is the scientific study of people and their behaviors in sports and exercise contexts and the practical application of that knowledge (Gill, 2000). Sports and exercise psychologists identify principles and guidelines that professionals can use to help adults and children participate in
and benefit from sports and exercise activities, and also develop skill and strategies to excel in competitive setup.

Many people study ‘sports and exercise psychology’ with two objectives in mind: (a) to understand how psychological factors affect an individual’s physical performance. They study the effects of psychological factors on physical and motor performance. Thus, the researchers study,

1. How does anxiety affect a basketball player’s accuracy in free-throw shooting?
2. Does lacking self-confidence influence a child’s ability to learn to swim?
3. How do coach’s reinforcement and punishment influence a team’s cohesion?
4. Does imagery training facilitate the recovery process in injured athletes and exercisers?

(b) to understand how participation in sports and exercise affects a person’s psychological development, health, and well-being. They try to understand the effects of participating in physical activity on overall development of the person. Thus the researchers study,

1. Does running reduce anxiety and depression?
2. Do young athletes learn to be overly aggressive from participating in youth sport?
3. Does participation in daily physical education classes improve a child’s self-esteem?
4. Does participation in college athletics enhance personality development?

Sport psychology applies to a broad population base. Although some professionals use sport psychology to help elite athletes achieve peak performance, many others are concerned more with children, persons who are physically or mentally disabled, seniors and average participants to understand development through participation in sports. More and more sport psychologists have now focused on psychological factors involved in exercise, developing strategies to encourage sedentary people to exercise or assessing the effectiveness of exercise as treatment for depression. To reflect this, the field is now called sport and exercise psychology, and some individuals focus only on the exercise aspect of the field (Weinberg & Gould, 2003).

It is ironic that most people think of sport psychology as something that applies principally to elite athletes or performance enhancement in a competitive setup only. In fact, youngsters compose the greatest population of sport participants. A large number of children are involved in school and extracurricular physical activity programs, many of the children are involved in organized sport. Sport is one of the few areas in children’s lives in which they can participate intensively in an activity that has meaningful consequences for themselves, their peers and family, and the community alike (Coleman, 1974). Sport participation has
important consequences on their self-esteem and social development and can also have important lifelong effects on the personality and psychological development of children. Mostly, boys participate in sports to have fun, to do something in which they are good at, to improve skills, for excitement of competition and to stay in shape. For girls, participation in sport activity is to have fun, to stay in shape, to get exercise, to improve skills and last comes the reason of to do something in which they are good at (Ewing & Seefeldt, 1996). Most of the motivations children have for participating in sport are intrinsic in nature. Winning clearly is neither the only nor the most common reason for participation. Also, most have multiple reasons for participation, not a single motive. The major reason for withdrawal from sport is interest in other activities, although few withdraw for reasons such as lack of fun, too much pressure or dislike of the coach. Underlying the descriptive reasons for sport withdrawal (such as no fun) is the child’s need to feel worthy and competent. When young athletes feel worthy and competent about the activity, they tend to participate. When they do not feel confident about performing the skills, they tend to withdraw. Not only physical educators, but sports administrators, coaches and community leaders often claim that taking part in sport keeps the youth off the street, out of trouble and out of gangs. According to Youth Development Expert Eric Larson (2000), extracurricular activities like sport have tremendous potential to lead to positive youth development for several reasons. First, sport is intrinsically motivating for many adolescents. Second, it involves sustained efforts on the part of participant directed toward a goal over time. And third, it requires youth to experience setbacks, make adjustments and learn to overcome challenges.

2.2 Mallakhamb

Mallakhamb, the scientific ancient traditional Indian art, gives best exercise to each and every part of the body, from the tip of the fingers to the tip of the toes. Varieties of intricate yogic and acrobatic movements are performed, generally by men, on the Pole Mallakhamb, which is 3.4 meters tall, broader at the base and gradually tapering to the top. It is made of seasoned teak. The females perform on 5 meters long cotton rope suspended from a ceiling. Mallakhamb is a demonstrative and competitive sport. It is also seen as an excellent fitness exercise. Generally children and adolescents learn Mallakhamb to participate in demonstrations, reality shows or participate in Mallakhamb competitions. Regular competitions of Mallakhamb are held for the junior age group on Pole Mallakhamb for boys and Rope Mallakhamb for girls. In senior age group, the men have to perform on 3 varieties of Mallakhamb, viz. the fixed Pole Mallakhamb, the Hanging Mallakhamb and the Rope Mallakhamb and the women perform only on the Rope Mallakhamb. Bottle Mallakhamb,
Weapon Mallakhamb, Sugarcane Mallakhamb are some demonstrative varieties of Mallakhamb. In adult population, Mallakhamb is becoming popular as a fitness activity.

2.2.1 Historical Background

Hanuman, the God of power and strength is associated with the divine art of Mallakhamb. The monkey tribe inhabits in jungles and is constantly jumping, swinging, hanging, performing aerobatics and acrobatics on the trees and creepers, all as routine activity. Alertness, vigilance and untiring activity are the major characteristics of this tribe. Viewing these inherent qualities of the monkey tribe and the outstanding feats of Mahabali Hanuman in the Ramayana, it is rightly presumed that the originator and promoter of the art of Mallakhamb could have been none, but Hanuman.

The ancient depicts of archeological surveys, old paintings and carvings, a short description and pictorial representation of certain exercises similar to Mallakhamb, can also be traced in the 12th century classic, ‘Manasollas’ an epic by Someshwar Chalukya in 1135 A.D. The sport, dormant since then, was resurrected in 19th century during the reign of Peshwa Bajirao II in the Deccan region. During his rule, two renowned wrestlers from the kingdom of Hyderabad, Ali and Gulab, visited the royal court of Peshwa and challenged the wrestlers of the kingdom. As both the wrestlers had won all their bouts on the way to Pune, none of the employed 52 wrestlers in the court dared to accept the challenge. Only one vibrant youth of 18 years, pujari of the Peshwa, Balambhattdada Deodhar accepted this challenge and asked for time for preparation. He went to the hill of Goddess Saptashrungi Devi at Nashik in Maharashtra. The anecdote says that the Goddess blessed him in his dreams and told him that Lord Hanuman, the God of strength and energy will teach him few tricks. It was then Lord Hanuman showed him an effective method of practicing wrestling skills on a wooden pole as if it is ones’ partner. Balambhatttada practiced accordingly, came back to Pune on the stipulated day and won the bout against Gulab in few minutes. Seeing the performance of Balambhatttada, Ali did not dare to fight and accepted the defeat. This not only kept up the prestige of the court of the Peshwa, but very soon Mallakhamb got adopted as a complementary exercise for wrestling, which was very popular in India then. In 1818, Peshwa Bajirao II was defeated by the British and send to exile to Kanpur, Uttar Pradesh. Balambhatttada accompanied the Peshwa and enroute to Kanpur established Mallakhamb at the Akhadas, the wrestling areas at various places in Maharashtra, Gujrat and Uttarprade sh. ‘Malla’ denotes a man of power or strength, a wrestler, Khamb signifies a pole. Initially, Mallakhamb was popular as a complementary exercise for the wrestler, who, in the absence of a partner, considered the pole as a partner for practice. Now Mallakhamb is recognized as
an independent sport and is getting promoted as an exercise and fitness apparatus, a demonstrative activity and a competitive sport.

2.2.2 Types of Mallakham

1. Pole Mallakham: A vertical wooden pole, made usually of teakwood, is fixed in the ground. It is most common variety of Mallakham performed either individually or in a group. Demonstrations on pole are performed holding burning torches in hands, tying weapons to the body or by keeping candles on the forehead.

2. Hanging Mallakham: A smaller version of Pole Mallakham, this Mallakham is suspended with the help of hooks and chains. Since this Mallakham swings forwards and backwards and also revolves around itself, it is more difficult to perform.

3. Rope Mallakham: A simple cotton rope, 5 meters in length, hung to a ceiling comprises the Rope Mallakham. Variety of yogic postures and acrobatic, speedy elements are performed on it.

The above three varieties are a part of competitive Mallakham. Few varieties of demonstrative Mallakham are,

1. Bottle Mallakham: A unique demonstrative apparatus, in which the Mallakham is kept on 24 or more glass bottles and breathtaking individual and group performances are executed with precision and perfection.

2. Niradhar Mallakham: It is the Mallakham without any support. The slanting base stands freely on a platform and the player has to perform it by keeping the balance of Mallakham, along with oneself.

Every year competitions of Mallakham are conducted at the District, State and the National level by the Mallakham Association. The Mallakham competitions are also a part of School games and the Interuniversity competitions. Invitational Mallakham tournaments too are organized at various levels by Sport Associations and other Organizations. The players compete in various age groups and have to perform a ‘Compulsory Set’ and one ‘Optional Set’ without any unnecessary pauses, falls or help. The performance is evaluated in accordance with the rule book, the ‘Code of Points’, on the basis of difficulty, execution and the nature of combination.

2.2.3 Current Status of Mallakham

Today Mallakham has become an independent sport in itself and is practiced all over India. Almost every State in India has a State Association which is affiliated to the apex body, the Mallakham Federation of India. It is a registered body recognized by Government of India, Department of Sports and also by the Indian Olympic Association. It is gaining
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popularity abroad too. Regular training centers of Mallakhamb have started in Germany, Singapore and USA. Many foreign nationals are coming to India to learn this traditional Indian sport. Recently, International Mallakhamb Federation is also formed.

2.2.4 Benefits of Mallakhamb

Mallakhamb is an exercise that gives perfect shape, form and strength to each and every muscle and remarkable control over the limbs of the body and every part is given true justice. The conspicuous features of Mallakhamb exercise are its vivid artistic tricks and feats. There are various grips and catches involving a network of hands and feet, the grace and beauty are very much enhanced by the balanced and well-controlled transitions, turns, bends and coils. Mallakhamb exercise thus proves superior to many other modes and types of exercises, both Indian and Foreign. This exercise in particular stimulates the mind and builds the body. In Mallakhamb exercise, the mind remains calm and composed. One remains always energetic, cheerful and active. The magnificent display of artistic and difficult feats shows the value of patience coupled with deep concentration. Thus, Mallakhamb promotes overall development, both physical and psychological to the maximum possible extent.

2.3 Intelligence

The word intelligence is derived from Latin verb intelligere, which means to comprehend or to perceive. It is described in terms of one’s capacity for logic, abstract thinking, self awareness, knowledge, memory, planning and problem solving.

2.3.1 Definition and nature of Intelligence

Intelligence is defined in variety of ways. It is commonly defined as ‘the ability to learn from one’s experience, acquire knowledge and use resources effectively in adapting to new situations or solving problems’ (Sternberg & Kaufman, 1998). Charles Spearman (1863-1945) observed that people who are bright in one area are usually bright in other areas as well. In other words, they tend to be generally intelligent. Spearman (1904) saw intelligence as two different abilities, both measurable by intelligence tests. The ability to reason and solve problems was labeled ‘g factor’ for general intelligence, whereas a person’s ability to excel in certain areas such as music, business or art was labeled as ‘s factor’, for specific intellectual abilities. A traditional IQ test would most likely measure g factor, but Spearman believed that superiority in one type of intelligence would predict superiority overall. Louis Thurston (1938) rejected Spearman’s notion of general intellectual ability or the ‘g factor’. After analyzing the scores of many participants on some 56 separate ability tests, Thurston identified seven ‘Primary Mental Abilities’ viz, verbal comprehension, numerical ability, spatial relations, perceptual speed, word fluency, memory and reasoning. He maintained that
all intellectual activities involve one or more of these primary mental abilities. He suggested
that a profile showing relative strengths and weaknesses on the seven primary mental abilities
would provide a more accurate picture of a person’s intelligence. Harvard psychologist
Howard Gardner (1999) listed seven different kinds of intelligences, and later added two
more. The nine types of intelligence are linguistic, logical-mathematical, spatial, bodily-
kinesthetic, musical, interpersonal, intrapersonal, naturalistic and existentialist. Psychologist
Robert Sternberg (1997) formulated a ‘Triarchic theory of Intelligence”, which proposes that
there are three types of intelligence, the analytical, creative and practical intelligence.

The positive role of emotions can be traced back many centuries. The Stoic
philosophers of ancient Greece viewed emotion as too individualistic and self absorbed to be
reliable guide for insight and wisdom. Later, the Romantic Movement in late 18th century and
early 19th century stressed how intuition and empathy could provide insights that were
unavailable through logic alone. Analytically focused definitions of intelligence
predominated for a long time. It was Sternberg (1985) who challenged mental abilities
researchers to pay more attention to creative and practical aspects of intelligence. Gardener
(1983) defined an intrapersonal intelligence that concerns access to one’s feeling life, the
capacity to represent feelings and the ability to draw upon them as a means of understanding
and a guide for behavior. Shortly thereafter, in their controversial book, ‘The Bell Curve’,
Heirnstein and Murry (1994) revived debate about the genetic basis for traditionally defined
intelligence and the degree to which intelligence is affected by environmental circumstances.
Instead of crystallizing support for the genetic intelligence position, the effect of the book
was to energize many educators, investigators and journalists to question whether the
traditional view of intelligence was conceptualized too narrowly and to embrace the notion
that there might be other ways to be smart and successful in the world.

Some psychologists broadened the concept of intelligence even further, beyond the
intellectual realm to include emotions, and the area of Emotional intelligence got introduced.

2.3.2 Emotional Intelligence

The articles by Salovey and Mayer (1990) introduced emotional intelligence as ‘the
ability to monitor one’s own and others’ feelings and emotions, to discriminate among them
and to use this information to guide one’s thinking and actions’. The best-seller book
‘Emotional Intelligence’ by Goleman (1995) stated that emotional intelligence rather than
analytical intelligence predicts success in school, work and home.

Thus, Emotional Intelligence represents the ability to perceive, appraise and express
emotion accurately and adaptively; the ability to understand emotion and emotional
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knowledge, the ability to access and/or generate feelings when they facilitate cognitive activities and adaptive action; and the ability to regulate emotion in oneself and others (Mayer & Salovey, 1997). It refers to the ability to process emotion laden information competently and to use it to guide cognitive activities like problem solving and to focus energy on required behaviors. The term suggested to some that there might be other ways of being intelligent than those emphasized by the standard IQ tests, that one might be able to develop these abilities and that emotional intelligence could be an important predictor of success in personal relationships, family functioning and the workplace.

Emotional intelligence is a relatively new and growing area of behavioral research, having caught the imagination of the general public, the commercial world and the scientific community. The concept resonates with a current zeitgeist emphasizing the importance of self awareness and understanding, redressing a perceived imbalance between intellect and emotion in the life of collective western mind. It also connects with several cutting edge areas of psychological science, including the neuroscience of emotion, self regulation theory, studies of metacognition and the search for human cognitive abilities beyond ‘traditional’ academic intelligence. The insight that emotion and intelligence (cognition) can complement each other became the basis of formulation of the various current models of emotional intelligence. At the core of these various models is the understanding of emotional intelligence as a construct to recognize the meaning of such emotional patterns and to reason and problem solve on the basis of them (Mayer & Salovey, 1997; Salovey & Mayer, 1990). Some of the prominent models are, Peter Salovey and John Mayer’s Cognitive model of emotional intelligence, Daniel Goleman’s (1995) Understanding of emotional intelligence, Saarni’s (1997) Emotional Competence model and Bar-On’s (2000) Relational model of emotional intelligence. Deducing from their framework of emotional intelligence as a theory of intelligence, Mayer, Salovey and Caruso (2000) make a distinction between different models of emotional intelligence that are mixed and those that are pure (or ability models focusing exclusively on mental abilities). Mixed models contain a mélange of abilities, behaviors, and general disposition and conflate personality attributes- such as optimism and persistence, with mental ability. They suggest that the model proposed by Daniel Goleman and Bar-On are mixed models while their own model is a pure or ability model.

It strongly appears that emotional intelligence influences day-to-day problem solving in school, communities, business and organizations. At individual level, it predicts communication skills, leadership, problem solving and aesthetics (Shanwal, 2004). The concept of emotional intelligence is also gaining research support. A study (Barckett, Mayer
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& Warner, 2004) found that a measure of emotional intelligence was related to problems experienced by college students. Male students, whose emotional intelligence was low, were more likely than other students, to experience alcohol and drug problems.

The measurement of emotional intelligence has generated considerable interest but has remained elusive to concretization for the want of better models to explain the phenomenon of emotional intelligence (Shanwal, 2004). In the Indian context, some research has been done linking emotional intelligence and Yoga (Kumar, Sujir, Ramaswami & Godbole, 2005). Both deal with managing one’s emotions and one’s lives, the real meaning of Yoga is ‘Self realization’. Goleman (1995) too identifies self-awareness as the most important aspect of emotional intelligence because it allows self-control.

2.3.3 Emotional Intelligence – Indian perspective

The Sanskrit term for intelligence is Buddhī, deriving from the root ‘bud’, which means to perceive or become aware. It is much more than the survival skill of IQ, it is the aspect of consciousness, filled with light that illuminates the Truth. Buddhī has a higher power of reasoning, called Vivek in Sanskrit, the power to choose what is right or true. Emotional intelligence from the Vedic Psychology is described as ‘unification of mind – body – spirit to realize our true potential for the universal well being and abundance of joy’. It is not a theoretical or academic concept or construct, but applied science of turning information into knowledge and wisdom. It is the science that connects us on one side to our own Higher Self and on the other to the larger consciousness. It also illuminates the unused potential of our brain and release creativity. Emotional intelligence begins with self – knowledge leading to self – realization to self actualization. Vedic psychology has listed out step by step process to achieve emotional intelligence through purification of body, mind and awakening of consciousness. Our understanding of self is very limited, hence rediscovering what body is made up of, how it stores memory, how personality develops and traps us in self image are the basics of emotional intelligence. Since information does not lead to transformation, actual yogic exercises and life style changes are integral part of emotional intelligence, so is proper breathing. Living meaningful/purposeful life is integral to Eastern perspective, which also gets reflected in our conceptualization of emotional intelligence (Kapadia, 2009)

2.3.4 Measuring Emotional Intelligence

The first comprehensive, theory based battery for assessing emotional intelligence was the Multifactor Emotional Intelligence Scale (MEIS), which can be administered through interaction with a computer program or via paper and pencil (Mayer, Caruso & Salovey, 1998). The MEIS comprises 12 ability measures that are divided into four branches,
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(a) perceiving and expressing emotions; (b) using emotions to facilitate thought and other cognitive activities; (c) understanding emotion; and (d) managing emotion in self and others (Mayer & Salovey, 1997). Branch 1 tasks measure emotional perception in ‘Faces, Music, Designs and Stories’. Branch 2 measures ‘Synesthesia Judgments (How hot is anger?) and Feeling Biases (translating felt emotions into judgments about people)’. The four tasks of branch 3 examine the ‘Understanding of Emotion’. Sample questions include ‘Optimism most closely combines which two emotions?’ A participant should choose ‘pleasure and anticipation’ over less specific alternatives such as ‘pleasure and joy’. Two tests of branch 4 measure ‘Emotion Management in the Self and in Others’. These tasks ask participants to read scenarios and then rate four reactions to them according to how effective they are as emotion management strategies focused on self and on others.

2.3.5 Interventions to improve Emotional Intelligence

Interventions to improve emotional intelligence in a variety of context are developed.

1. Interventions in Education - Lot of material are developed to cultivate emotional intelligence in school children. For example, in a guidebook for developing emotional intelligence curricula for elementary school children, Schilling (1996) recommends units of self-awareness, managing feelings, decision making, managing stress, personal responsibility, self-concept, empathy, communication, group dynamics and conflict resolution.

2. Interventions in the workplace - Interventions to increase emotional intelligence also can be found in the workplace (Goleman, 1998). These workplace programs are at much earlier stage of development than those designed in classroom. They consist training sessions on human relations, achievement motivation, stress management and conflict resolution.

2.3.6 Emotional Intelligence and Artistic Sports

As in any athletic endeavors, success in the artistic sports, such as figure skating, gymnastics, synchronized swimming etc. depends on high standards of technical skill and physical fitness, including endurance, strength and flexibility. However, artistic sports are distinguished by their unique need for mental skills training. Mental skills refers to the ways athletes control their thinking and emotions to perform effectively, especially in competitions in which they perceive the most pressure to do their best. Mentally skilled people are equipped to behave intelligently, responsibly and with emotional toughness in the face of challenges and adversity (Smith, 1998). A number of unique features set the artistic sports apart and create a need for a distinct approach to developing mental skills.

The outcome of the competition is decided by the collective subjective opinion of a panel of judges rather than by direct competition with opponents as in team sports such as
basketball, football, volleyball, soccer and hockey or in individual/dual sports such as tennis, golf, competitive swimming and wrestling. The situation often leads to athletes’ excessive concern about evaluation, which in turn causes a loss of focus on personal performance because of anxiety about who the judges are, how the evaluation will take place and whether the evaluation will be fair or not. The other area of concern is what other competitors will do or have done and how many points one should score in comparison to others. These distractions add to athletes’ perceptions of pressure during both training and competition. Because of the aesthetic emphasis in artistic sports, body type and appearance play a significant role in the subjective evaluations made by judges. Beautiful, in these sports, is usually defined as extreme slenderness along with an attractive face and body proportions. These expectations create potential self-esteem problems for athletes and can at times lead to serious eating disorders among other complications. Successful performances are characterized by artistry, grace of movement, and, at their best, an individual style and expressiveness that draws on the unique personality, physique and movement style of the performer. Expressiveness in this sense means that the movement conveys emotions that underlie and complement the action.

Unlike team sport where team cohesiveness is important, teammates here become rivals competing against one another, either solo or in duets or pairs, a fact that often complicates social relations among members of the same team or club, not to mention its effects on relations among parents of players. Whether solo or in duets or pairs, or in a team or group, performers compete one at a time, alone in a spotlight in front of critical audience that includes judges, coaches, other competitors, spectators including family and in top competitions, an unseen television audience. The presence of these audiences adds greatly to the pressure perceived by performers. There is no place to hide.

Finally, unlike sports that require reacting in real time to the unpredictable actions of opponents, the artistic sports involve meticulously rehearsed routines that athletes perform in competition, whether a gymnastics vault of a few seconds, a routine of a minute and half on the parallel bars, a single figure in synchro, or a solo or pairs routine in figure skating up to several minutes in length. Since the presentation of performance is for a very short duration, a slip, a fall or any major error costs the chances of individual and/or team championships and the efforts put in for several hours can just get washed in few seconds. This condition can lead to stage fright entirely comparable to that experienced by dancers, singers, musicians and actors and also severe performance anxiety.
Thus, success in competition in any of the artistic sports depends on being able to reproduce, when called upon, a near perfect performance that has been learned and practiced, rehearsed and refined, over and over again. Success demands great precision and control yet a pleasing, expressive style. In all but the most mentally prepared individuals, the demands of artistic sports are often enough to generate a high degree of perceived pressure. These fears, with self doubt, nervousness or the spotlight effect produced by the silent scrutiny of coaches, spectators, other competitors and a panel of highly critical and analytical judges, results in potentially threatening mix of factors. The television coverage and media hype add yet another distracting dimension.

All this has tended to distort and complicate the motivations of youngsters and their parents and their coaches. Not only unrealistic expectations from many sectors, there is also great deal of pressure to win, even in local competitions, from the earliest ages. Many young people who have turned to sport for fun, excitement, fitness, friendship or challenge find themselves caught up in situations they are ill-equipped to handle. Success, in the face of these conditions, call for a considerable degree of mental skill, or emotional intelligence.

Mallakhamb is an artistic sport, with similar demands. It involves very high regulation of emotions. The skills have to be learnt in the face of fear. Learning of every new skill puts cognitive and emotional demands on the performer and involves constant challenges.

Adults who receive aerobic training showed substantial improvements in performance on tasks requiring executive control compared with anaerobically trained participants (Kramer et al., 1999).

2.4. Executive Functions

Executive processes are the processes that modulate the operation of other processes that are responsible for the coordination of mental activity so that a particular goal is achieved. They consist of those capacities that enable a person to engage successfully in independent, purposive, self-serving behavior.

Baddeley’s multicomponent model of working memory (Baddeley, 1986; Baddeley & Hitch, 1974) is an ideal starting point from which to clarify the use of the term ‘executive functions’ in the current literature. Although initially vaguely defined as coordinating and regulating storage components and working memory processes (Baddeley & Hitch, 1974), it was considered to be model of a supervisory attentional system (Norman & Shallice, 1986), which described the central executive as a capacity limited attentional control system. Baddeley (1996) proposed four potential functions: (a) coordinating performance in simultaneous tasks (e.g., in dual task paradigms), (b) switching between retrieval strategies
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(e.g., in the random generation task), (c) focusing attention on relevant stimuli and ignoring irrelevant stimuli (e.g., in the flanker task), and (d) activating and manipulating information from long-term memory (e.g., in the reading span task). More recently, Miyake et al. (2000) used latent variable analysis to identify three separable executive key functions related to Baddeley's (1996) categories: shifting, updating, and inhibition. Shifting involves changing between multiple tasks, operations, or mental sets (Monsell, 1996), while updating involves actively maintaining and manipulating relevant information in working memory (Morris & Jones, 1990). Inhibition involves the deliberate suppression of dominant, automatic, or prepotent responses, as prototypically required in the Stroop task (Stroop, 1935).

Executive processes involve,

- **The kind of selective attention** that typically acts on the contents of working memory and directs subsequent processing so as to achieve some goal. This attention, often called executive attention, is distinguished from the kind that selects certain spatial positions in the outside world and determines what gets perceived in the first place.

- **Switching executive attention** from one activity, or process, to another.

- **Ignoring or inhibiting information** that has already been perceived.

- **Scheduling** a sequence of activities.

- **Monitoring** performance.

These five processes are referred to as executive processes; the term comes from Baddeley's (1986) influential model of working memory in which there are separate short term storage systems for verbal and visual information and a central executive that operates on the contents in storage. Executive processes organize our mental lives, just as a corporate executive coordinates a business's activities: in both the cases the function is administrative, not ‘hands on’.

Attempts to behaviorally distinguish between ‘executive’ (E) and ‘non-executive’ (NE) functions has been made in order to develop a functional taxonomy distinguishing performances, skills or behaviors that are characteristic of executive function from those that are not (Rabbit, 1997).

- Executive control is necessary to deal with novel tasks that require us to formulate a goal, to plan, and to choose between alternative sequences of behavior to reach these goals, to compare these plans in respect of their possibilities of success and their relative efficiency in attaining the chosen goal, to initiate the plan selected to carry it through, amending it as necessary, until it is successful or until impending failure is
recognized. Executively controlled behavior need not be much more complex than NE behavior. Very complex behavior sequences can be carried out automatically under NE control. The example would be of a skilled driver negotiating complex traffic while carrying on non trivial conversation, Chess grand masters rapidly selecting among extremely difficult lines of play recognizing generically familiar positions during ‘lightening chess’ tournaments.

- NE behavior tends to be initiated by, and to continue automatically in response to, changes in environmental input. Even very complex NE behaviors are externally driven and controlled by sequences of environmental events or by previously learned plans or programs held in long term memory. In contrast, the E behaviors can be initiated and controlled independently of environmental input, and can retain the adaptive flexibility to rescue plans even when environment does not behave as anticipated and no guidance is available from previous experience.

- Executive control not only manages transactions with the external world, but also with the ‘internal information environment’ of long term memory. Thus, the Executive control extends beyond the current internal and external information environment to restructure interpretation of the past as well as to attempt active control of the future (Burgess, 2002). The NE retrieval of information from memory is in response to learned associations and environmental cues and active, ‘strategic’ or ‘planned’ memory search carried out under voluntary control.

- E functions are necessary to initiate new sequences of behavior and also to interrupt other ongoing sequences of responses, if required. E functions can suppress, or inhibit and replace, automatic and habitual responses with task appropriate responses. They can also check involuntary perseveration by appropriately ‘switching’ attention to new sources of information. E processes control the allocation of attention, particularly in complex tasks in which a variety of different demands must be met simultaneously.

- E functions are necessary to prevent responses that are inappropriate in context.

- E functions are involved in dual task performance, in which simultaneous performance of the two tasks may require strategic allocation of attention and synchronization of responses in order to service both. Simultaneous performance of two E tasks is seen as especially demanding because, in effect, it may involve coping
with all of the demands intrinsic to task 1 and task 2 and also, in addition, with the
demand of strategically controlling allocation of attention between tasks.

- While carrying out plans to cope with novel demands, E functions are necessary to
  monitor performance in order to detect and correct errors, to alter plans when it
  becomes clear that they are becoming unlikely to succeed or to recognize
  opportunities for new and more desirable goals and to formulate, select among,
  initiate, and execute new plans to attain them.

- E control can enable attention to be sustained continuously over long periods. Among
  other benefits, this allows prediction of outcomes of long, complex sequences of
  events.

- E behaviors are accessible to consciousness, while NE behaviors are not.

Studies on the influence of fitness training on cognition have differed not only with
regard to the methodological concerns, but also with regard to the theoretical framework in
which they have been conducted. Many researchers have taken an atheoretical approach,
selecting cognitive tasks with little or no theoretical justification. Other researchers have
either explicitly or implicitly assumed that fitness effects would be most likely to be observed
in tasks such as simple reaction time or finger tapping, which presumably tap low level
central nervous system function uncontaminated by subject strategies or high level cognition
(Dustman, Emmerson & Shearer, 1994., Spirduso & Clifford, 1978). This is known as ‘speed
hypothesis’. Other researchers have suggested that fitness effects might be most readily
observed for visuospatial tasks (Shay & Roth, 1992, Stones & Kozma, 1989) because
visuospatial processes have been demonstrated to be more susceptible to aging than verbal
skills. This is known as ‘visuospatial hypothesis’. Chodzko-Zajko (1991), Chodzko-Zajko
and Moore (1994) have suggested tasks that require controlled, effortful processing should be
more sensitive to fitness differences among older adults than tasks that can be executed via
automatic processing. This ‘controlled processing hypothesis’ is based on earlier research by
Schneider and Shiffrin (1977), who proposed a theory of skill acquisition in which task
components or skill transition from effortful processing to automatic processing with
consistent practice. Kramer et al. (1999) have argued that improvements in fitness would be
reflected in enhancements in executive control processes such as coordination, inhibition,
scheduling, planning and working memory. These tasks stand in contrast to controlled tasks
in that they do not become automatic over time and require constant mediation by a central
executor. This is known as ‘executive control hypothesis’.
One of the major reasons for thinking that executive processes form a distinct class of cognitive processes comes from relatively early studies of patients who had suffered frontal brain damage as a result of a closed head injury and injury caused by an external bump that does not pierce the skull. The prefrontal and the frontal lobes are involved in carrying out executive processes.

2.4.1 Role of Frontal Lobe in Executive Functions

One of the oddest incidents and most significant in its early influence on thinking about frontal lobe function resulted from an accident to a railway worker, Phineas Gage, in 1848. Part of Gage’s job was to pack explosives into drilled holes with a 3-foot-long rod called a tamping iron. When a charge went off prematurely, the tamping iron was driven into his head, entering below the left cheekbone and exiting through the top of his skull. Gage survived, recovered physically and suffered little intellectual damage, but his behavior was radically changed. A trustworthy, hardworking, calm person had now become an irresponsible, aggressive and impulsive person. John Harlow, the physician who treated him at the time of accident and studied him, drew a connection between the area of greatest damage in the frontal lobes and the lack of social restraint that Gage showed subsequently. In the 20th century, Hebb and Penfield (1940) were the first to observe some of the most striking facts about frontal-lobe patients. Such patients perform relatively normally on an IQ test, yet are often incapable of leading a normal life. It is as if they have all their cognitive components intact but have lost the ability to organize and control them. The obvious hypothesis was that the frontal lobes implement these control processes-the executive processes-and consequently damage to the frontal lobes leads to a breakdown in executive processes and a breakdown in normal life.

The brain area involved is not the entire frontal lobe, but only the anterior part of it, the prefrontal cortex (PFC). The PFC has many anatomical properties that make it suitable for implementing executive processes. It is extremely large in humans, disproportionately so compared to most of the primates. This suggests that the PFC may be responsible for some of the more complex activities that humans carry out, such as mentally sequencing a list of activities. The PFC receives information from virtually all perceptual and motor cortical areas and a wide range of subcortical structures as well. This mass of connections provides a good infrastructure for combining the diverse sources of information needed for complex behavior. The PFC also has multiple projections back to sensory, cortical and motor systems that allow it to exert a top-down influence on other neural structures, including those mediating the perception of objects (Miller, 2000). The idea that every executive process is primarily
mediated by the PFC is the frontal executive hypothesis. This hypothesis has been widely accepted for a long time, and it has usefully stimulated a great deal of research.

Frontal damage and the frontal hypothesis: A number of tests used to diagnose frontal-lobe damage demonstrate the extent of deficits in executive processing. When administered to neurologically healthy people, these tests can also tell us something about the way executive processes work. Stroop task, a classic psychological test of attentional function devised in the 1930s by J. Riddley Stroop is widely used (Stroop, 1935). In the standard version, the names of colours are presented in coloured ink, and the participant’s task is to name the ink colour and ignore the colour name. Sometimes the colour name and print colour are compatible, as when the word ‘blue’ is printed in ‘blue’. At other times, the colour name and the print colour are incompatible, as when the word ‘black’ is printed in ‘blue’. The task is to name the ink colour, so the correct answer in both examples here is ‘blue’. With normal participants accuracy is high even for incompatible trials, but it takes longer to respond to them than to respond to compatible trials. It is as if participants have to do some extra processing on incompatible trials, but that such processing succeeds. Frontal-lobe patients who have damage to the PFC, particularly to the dorsolateral PFC, show a different pattern of results. Their accuracy level on incompatible trials is significantly lower than that of neurologically healthy participants. The standard interpretation of these results is that to succeed in the task, participants must selectively attend to the ink colour or inhibit the colour name (or both), and the frontal participants are known to be impaired in selective attention and inhibition (Banich, 1997). There is some support for the idea that executive attention and inhibition are executive processes: they are clearly metaprocesses and are mediated by PFC.

2.4.2 The Executive Processes

Executive attention, attention switching, response inhibition, temporal coding-plus-sequencing, and monitoring are the five executive processes that have been systematically studied. These five processes appear to be required in many real-life situations.

Executive Attention directs subsequent processing, is needed whenever multiple representation in working memory, or multiple processes operating on representations, compete for the control of cognition and behavior. During a game of chess, the player has to attend to various pieces in sequence, while solving a crossword puzzle; the person attends to some spaces and words, while inhibiting the others. It is difficult to think of a complex mental event that does not require executive attention. Executive attention determines which of the contenders will gain control. In Stroop task, the basic finding for normal participants is that it takes less time to say the print colour, when the colour is compatible with the colour
name (red printed in red ink) than when it is incompatible (blue printed in red ink). When an automatic response must be overcome, some other processes must be brought into play so that the behavior satisfies the goal. Same is true for any stimulus – response compatibility task. A stimulus – response compatibility is a measure of the degree to which the assignment of the correct response to a stimulus is constant with the way people would act naturally. In a typical version of a task designed to assess stimulus – response compatibility, a stimulus is presented on either left or right side of a display. In the compatible condition, participants respond to the stimulus on the left by pushing a left-sided key and to a stimulus on the right by pushing a right-sided key. In the incompatible condition, the stimulus- response assignments are reversed. Response times are faster in the compatible than the incompatible condition (Kornblum & Lee, 1995). When the connection is automatic, little executive attention is required. But when the two sources of information are not compatible, one must attend to the relevant information- ‘it’s the colour that matters’- and perhaps inhibit the automatic connection. This attention and inhibition amounts to some extra cognitive work, and one is usually aware of having to do it.

Attention Switching involves moving the focus of attention from one entity to another. We keep going in the crowded environment by focusing on one or another aspect of what’s going on as needed. To control internal processing, one must not only attend to some representations and processes, but must be able also to switch the attention from one representation or processes to another. Switching attention is often studied by having participants do one task on the first trial, another task on the next trial, then return to the first task on the third trial, the second task on the forth trial and so on until the set of trials is complete. This alteration of tasks is compared to the case in which the participant performs the same task throughout the entire set of trials. Sets with alternating tasks are known as alternating blocks; sets with only one task are known as pure blocks. The general finding that has been obtained many a times is that participants require more time to respond on alternating blocks than on pure blocks. This time difference, usually about 100 to 300 milliseconds, is often referred to as switching cost. Of course, this kind of task does not reflect what happens in real life as in one does not alternate between say cooking and talking on phone, also will attend to the door bell at the same time if need arises.

Inhibition of response is the suppression of partially prepared response. It is an important kind of inhibition that occurs frequently in life. If people start saying everything that came to their mind, or performed every action that they think of, people would end up becoming friendless or worse. A number of psychiatric disorders appear to be marked by lack
of response inhibition, as in the speech and behaviors in schizophrenia or blatant lack of response inhibition in some obsessive compulsive disorder. Sometimes it comes as a personality trait in which a person is unable to delay gratification. A number of experimental tasks have been designed to study response inhibition and its neural underpinnings. One is the go/no-go task, a classic test that has been widely used to assess frontal lobe functioning. Participants are presented with a sequence of stimuli, say, letters, and instructed to push a button at the appearance of every letter (a ‘go’ response) except X (‘no-go’). As long as X occurs relatively infrequently, when it does appear the task clearly requires the participant to inhibit a tendency to press the button. As the number of consecutive go response increases, the more likely the participant will be to respond in error when an X finally shows up (Casey et al., 1997). The longer the sequence of go trials, or higher the probability of a go response, the more difficult it is for a participant to start an inhibitory response that will overturn the processing that underlies the go trial. A number of fMRI studies suggest that response inhibition is a separate executive process, distinct from those considered so far. The critical contrast is between the regions activated on no-go trials (response inhibition required) and on go trials (no inhibition is required). As in other executive functioning tasks, the dorsolateral prefrontal cortex is activated. The anterior cingulate is also activated. It is argued that anterior cingulate plays a role in tasks requiring executive attention, while others suggest that it is active in tasks only when there is a need for inhibition at the response level.

Impulsivity and lack of response inhibition is widespread in young children. A substantial amount of behavioral and neural research has been conducted on development of inhibitory processes. Lot of this research is inspired by the belief that response inhibition is mediated by the prefrontal cortex (PFC) and by the fact that the PFC undergoes one of the longest periods of the development of the brain regions, taking almost two decades to reach full maturity in humans (Diamond, 2002). By the time children are 3 to 5 yrs old, they show some competency in tasks such as go/no-go. By the time they are 7 to 12, their neural patterns of activation on go/no-go are almost identical to those of adults, although they are not at adult levels of behavioral performance (Casey et al., 1997). There is a striking correspondence between the development of response inhibition and the maturation of PFC.

Sequencing involves coding information about the order of events in working memory. Making any schedule, rearranging activities of the day to accommodate friend’s request and several other activities require ability to sequence operations or events to accomplish a goal. The coordination of processes necessary for planning suggests that an executive process ‘sequencing’ is involved. What mechanism is used to code the temporal
order of a sequence of events? Three possibilities are considered. In the first, the participant forms directed associations between every pair of successive items presented. In one experiment, the participants were shown a short series of items to be remembered (for example, J G X R L B) followed by a pair of probe letters, both part of memory set (for example, G L). The participant’s task was to decide whether the probe letters are in the same order as they were in the memory set. With the above mentioned mechanism, the participant forms associations between every pair of successive items - J precedes G precedes X and so on (Burgess & Hitch, 1999). Thus, the farther apart the two items are in the memory list, the longer it should take to determine that they are correctly ordered because more associations have to be traversed (G L should take longer than G R). The second possible order mechanism is that we attach ‘order tags’ to the items - J is tagged as the first item, G is tagged as the second item, and so on. Here, there is no reason for the time to decide on the order of the probe items to depend on the distance between the two items in the input list. The third possibility is that the item is coded on the basis of familiarity. When asked if G preceded L, the participant may simply check the familiarity of the two items: presumably the representation that is less familiar has decayed more than the others, is less strong, and hence likely occurred earlier (Cavanaugh, 1976). There is behavioral evidence for all three mechanisms. How is sequencing of connected items done in the context of real life situations has also been studied. The critical distinction here is between familiar and novel items. A familiar real life sequence is ‘going to a restaurant’. So familiar is this sequence that it is dubbed as a script (Schank & Abelson, 1977). There is evidence that our representations of a script consists of direct inter-item associations. It has been found that the more the steps in a script are left out, the longer it takes to understand the story, as if the person has to fill in the missing steps before taking in the next one (Abbott, Black & Smith, 1985). Things are different when it comes to generating a novel sequence; say the sequence of activities needed to open a beauty salon. Some problem solving is required here, rather than just relying on associations (Schank & Abelson, 1977). The goal of opening a beauty salon must be broken into subgoals, the plans and sub plans must be generated. Normal participants have little trouble generating such novel sequences, but patients with damage to the frontal lobes, specifically the dorsolateral PFC have problems doing so.

Monitoring in the context of cognitive processing involves assessment of one’s performance on the task ‘while the task is been performed’. It is distinguished from the ability to assess (and improve) performance after the task is completed, either from the feedback received or on one’s view as to how things went. A self-ordering task (Petrides,
Alivisators, Evans & Meyer, 1993) assesses monitoring. In this task, trials are presented in blocks of six. On the first trial, a set of six objects is presented in blocks of six, the participant points at one object. On the second trial, the same six objects are presented in a different configuration, now the participant points at a different object than the first one. This goes on for six trials. To perform this task, the participant store their first choice in working memory; then, before making the second choice, inspect the contents of working memory so as not to make an error, store the second choice in working memory and so on. The task involves constant updating and monitoring of working memory and it is generally assumed that it is the monitoring part that is critical to success. Normal participants have little trouble with this task, as long as the memory load is in the capacity of working memory. Frontal damage patients are impaired on this task, although they are not impaired on the working memory task that requires reporting of six items presented. Presumably, the requirement to monitor is mediated by the PFC, the left PFC in particular. Another source of evidence for monitoring as an executive process comes from the studies that focus on errors. There is evidence that participants know when they commit an error in choice-response time tasks, with some studies indicating that it takes about 700 msecs (Rabbit, 1998).

2.4.3 Exercise and executive functions

Individuals often describe changes in their ability to perform mental tasks during and after exercise. For some, exercise leads to reports of increased mental acuity and clarity of thought. Others report feelings of mental disorientation and difficulty making decisions following exercise.

The relationship between fitness and mental function has been a topic of interest to psychologists, exercise physiologists, physicians and other scientists and practitioners for the past several decades. The logic behind these studies has been predicted on the assumption that aerobic fitness would translate into increased blood flow in the brain, which in turn would support more efficient brain function – particularly in older adults, for whom such function is often compromised. The pioneering research in the study of the fitness on mental function dates back to 1970s, with the studies by Spirduso and her colleagues. In a classic study, Spirduso and Clifford (1978) compared the performance of young and old racquet sportsman, runners and sedentary adults on simple, choice and movement time tasks. In general, these studies found that older athletes outperformed older sedentary adults on simple, choice and disjunctive reaction time tasks, as well as on movement tasks. Indeed, older athletes tended to perform these tasks as well as young sedentary adults, who often performed slightly poorly than young athletes. The superior performance obtained by older athletes in
these cross sectional fitness studies was confirmed and extended by subsequent research that has found that older, high fit individuals outperform older low-fit adults on a variety of perceptual, cognitive and motor tasks including reasoning, working memory, stroop, trails-B, symbol digits, vigilance monitoring and fluid intelligence tests (Abourezk & Toole, 1995; Clarkson-Smith & Hartley, 1990; Cook et al., 1995; Del Rey, 1982; Dustman et al., 1990; Emery & Gatz, 1990; Powell & Pohndooof, 1971; Shay & Roth, 1992; Stones & Kozma, 1989).

Human fitness training studies conducted over the past several decades have produced a varied pattern of results. Some studies find a positive relationship between fitness training and cognition while other studies fail to observe such a relationship. A meta analysis was conducted to examine the hypothesis that fitness training enhances the cognitive vitality of healthy but sedentary older adults (Colcombe & Kramer, 2003). Many studies, conducted from 1966 to 2001, with adults greater than 55 years of age were reviewed. Several interesting results were obtained. First a clear and significant effect of aerobic exercise training was found. Exercise training did have positive effects on the cognitive function of older humans. Second, although exercise effects were observed across a wide variety of tasks, and cognitive processes, the effects were largest for those tasks that involved executive control processes (i.e. planning, scheduling, working memory, interference control, task coordination). Exercise training programs also had a larger impact on cognition if the study samples included more than 50% females. Additionally, participants in the mid-old category seemed to benefit most from the exercise. Both clinical and non clinical population showed similar improvements with exercise, suggesting that exercise intervention can be equally efficacious for clinical and non clinical population. The meta analysis showed that aerobic fitness can have a robust and beneficial influence on the cognition of sedentary older adults. Meta analysis revealed that several other moderator variables influenced the relationships between exercise training and cognition. For example, aerobic exercise training combined with strength and flexibility regimens had a greater positive effect on cognition than aerobic exercise components alone.

Neuroscientists have focused on the mechanisms by which exercise may have an impact on cognitive functioning. Some researchers suggested that exercise may provide cognitive benefits because it increases cerebral blood flow, which brings important nutrients such as glucose and oxygen to the brain (Chodzko-Zajko, 1991; Madden, Blumenthal, Allen & Emery, 1989). Studies with human models have supported the hypothesis that exercise has an effect on cognitive functions in humans (Etnier, et al., 1997), an analysis that includes a
total 134 studies of acute and chronic exercise. Much of the research focused on older adults, a population that is of particular interest to researchers because older adults are more susceptible to cognitive decline due to age-related deterioration in brain function (Kramer, Hahn & McAuley, 2000).

Kramer et al. (1999; 2000) suggested that in older adults, aerobic fitness would be related to selective improvements in executive control processes, such as coordination, planning, and working memory. This hypothesis was based on the literature that showed the part of the brain responsible for this type of brain activity tends to decline earlier in aging process (West, 1996). To test this hypothesis, researchers had sedentary older adults participate in a 6-month aerobic walking program or an anaerobic control group (Kramer et al., 1999). It was found that the adults in the walking group performed better than the adults in the control group on a variety of executive control tasks. Increases in the volume of anterior white matter and several gray matter regions, i.e., anterior cingulated, middle frontal gyrus, and superior temporal lobe were observed in aerobic but not in non-aerobic control group. The follow-up study using neuroimaging techniques showed that aerobically trained older adults had greater activity in the brain areas that are thought to support executive control functions (Colcombe, Kramer, McAuley, Erickson & Scalf, 2004). The results suggested that cardiovascular fitness is associated with the sparing of brain tissue in aging humans. Furthermore, these results also suggest a strong biological basis for the role of aerobic fitness in maintaining and enhancing central nervous system health and cognitive functioning in older adults.

Thus, these executive functions, part of “a control system allowing [people] to direct, and re-direct, their processing resources appropriately” (Eysenck & Keane, 2005), which include switching attention between tasks, allocating attention selectively, inhibiting prepotent processes, and updating and checking the contents of working memory (Smith & Jonides, 1999) are getting studied extensively. Since, these control functions are critical for the processes involved in cognitive learning (Bull & Scerif, 2001; Espy et al., 2004) attempts to improve the effectiveness of them have rapidly become a new focus of applied learning and memory research (Minear & Shah, 2008; Persson & Reuter-Lorenz, 2008). Also, now the relevance of executive functions for academic attainment is getting empirically documented. Bull and Scerif (2001) found seven-year-old children’s mathematical abilities were related to their performance in dual task coordination, inhibition, shifting, updating and text comprehension. Research has shown that central executive functioning supports adult readers in resisting distraction and interference (Whitney, Arnett, Driver & Budd, 2001).
Although the extent to which specific executive functions affect learning processes differentially remains to be determined, given the relevance of central executive functions in educational settings, efforts to enhance their effectiveness by means of cognitive training would seem warranted. A closer look at research on this issue reveals a wide variety of training interventions, some aimed at remediating deficits in executive functioning in specific subpopulations, such as older adults (Kramer, Larish & Strayer, 1995) or persons with psychiatric disorders (Bell, Bryson & Wexler, 2003) and in preschool children (Dowsett & Livesey, 2000; Rueda, Rothbart, McCandliss, Saccamanno & Posner, 2005).

In recent decades, numerous studies have examined the relationship between physical activity and cognitive functioning. Recent findings indicate that physical activity improves not only cognitive functioning in general, but performance in tasks that require effective executive functioning in particular (Barenberg, Berse & Dutke, 2011). Consequently, physical activity and exercise are frequently applied as interventions, with physical fitness as an outcome measure. The manipulation of physical activity can vary in terms of format, intensity, and duration. The format can vary from simple cycling or walking interventions to more complex aerobic training programs. The level of intensity is generally defined as a certain percentage of the individual maximum workload, as measured by assessments of oxygen uptake, heart rate, or lactate level, for instance. In terms of duration, two types of physical activity intervention can be distinguished: short-term and long-term interventions. The former consists of a single bout of physical activity, whereas the latter involves several weeks of exercise. Over the past decades, physical activity research has also begun to address the product variables of cognitive functions in general (Etnier, Chang, Gappin & Labban, 2008) and, more recently, executive functions in particular (Colcombe & Kramer, 2003). These researchers have hypothesized physical activity to cause physiological changes with beneficial effects for cognitive and especially executive functions. Neurobiological studies with animals and humans have provided evidence for at least three physiological mechanisms potentially underlying this relationship. The first physiological explanation focuses on cerebral blood flow (CBF). Physical activity has been shown to enhance volume and velocity of CBF in animals (Jørgensen, Perko & Secher, 1992) and humans (Suzuki et al., 2004; Timinkul et al., 2008), thus facilitating the oxygenation of brain areas relevant to cognitive functions. The studies with humans found an exercise-induced increase in CBF also in the prefrontal cortex, which is commonly associated with executive functions (Roberts, Robbins & Weiskrantz, 1998). The second physiological explanation concerns neuronal repair and plasticity of brain architecture, as modulated by neurotrophins. In several studies, physical
activity was found to lead to releases of neurotrophins in animals (Neeper, Gomez-Pinilla, Choi & Cotman, 1996; van Praag, Kempermann & Gage, 1999) and in humans (Gold et al., 2003; Winter et al., 2007), thus promoting the efficiency of neuronal processes. In the animal studies, the greatest effect was observed in the hippocampus, which is closely connected to the prefrontal cortex through efferent pathways. Further evidence for the impact of neurotrophins on executive functioning was found in a clinical study with Alzheimer patients (Potkin et al. 2002), whose executive functioning was improved by a medication based on neurotrophins. The third physiological explanation emphasizes the role of brain neurotransmitters, particularly norepinephrine and dopamine. Several studies with animals and humans (Hattori, Naoi & Nishino, 1994; Meeusen & De Meirleir, 1995; Winter et al., 2007) found that these neurotransmitters were upregulated by physical activity. The metabolism of norepinephrine and dopamine in the prefrontal cortex is thought to play a crucial role in executive control processes (Floresco & Magyar, 2006; Robbins & Arnsten, 2009). For instance, in patients with attention-deficit/hyperactivity disorder (ADHD), the modification of norepinephrine and dopamine levels has proved effective in reducing ADHD symptoms including executive dysfunction (Pliszka, 2005). In sum, the neurobiological mechanisms linking physical activity and executive functions are not yet fully understood, but this line of research gives an impression of how physical activity may affect executive functioning. Hall, Smith and Keele (2001) were among the first to postulate an executive function hypothesis. They identified three studies providing evidence “that aerobic exercise preferentially benefits executive functions”. In a meta-analysis of 18 intervention studies with older adults, Colcombe and Kramer (2003) examined which cognitive processes benefited most from aerobic exercise interventions by classifying the tasks applied into four categories: speed, visuospatial, controlled processing and executive control. According to the authors’ interpretation of their results, executive control tasks benefited particularly from physical activity. The research studies have limitations due to less generalizability to other populations, lacking an accurate operationalization of cognitive functions; attempts are getting made to systematically review experimental studies testing the hypothesis that physical activity supports executive functions. Questions such as (a) Does the empirical data substantiate the executive function hypothesis? (b) Is there empirical evidence that the effect is not restricted to older adults? (c) What are the open questions for further research and application? are getting addressed.

It is getting indicated that, a single bout of physical activity may suffice to improve performance in an executive function task—particularly inhibition (Barenberg et al., 2011).
Repeated training or exercise is evidently not necessary to enhance inhibition processes. Exercise is the attempt to change the structure of organismic prerequisites for physical performance (fitness) by systematic and repeated training over weeks or months. Such structural changes in an individual’s organism do not seem to be a necessary condition for improving executive functioning. Instead, the physiological changes that normally occur when a person adapts to a one-time physical activity may suffice to improve executive functioning. That means that short-term interventions are an adequate research instrument to explore the underlying physiological processes—particularly when considering that in long-term studies, it is more difficult than in short-term interventions to control for confounding variables that may influence neurobiological processes and executive functioning (e.g., diet, motivation, or cognitive stimulation). The second main conclusion relates to defining executive control not as a global cognitive system but as a set of specific functions of attentional control, such as inhibition, updating, and shifting. Physical activity interventions do not affect executive functions uniformly. Thus, differentiating between specific executive functions may help to integrate recent results on the neurophysiological linking between physical activity and executive functions. Neuroimaging studies (Collete et al., 2005; Jurado & Rosselli, 2007) have shown that different executive functions activate common as well as specific brain areas. Thus, the physiological processes underlying executive functions are probably differential—at least in part—and could explain why physical activity may result in differential effects on executive functions. In addition, psychopharmacological studies have suggested specific links between types of drug and types of executive function (Montgomery, Fisk, Newcombe & Murphy, 2005; Verdejo-García & Pérez-García, 2007). One explanation refers to the specific impact of drugs on neurotransmitter systems (cocaine on the dopamine system). Thus, differential effects of physical activity on executive functions may be explained by links between specific executive functions and neurotransmitter systems. To summarize, both observations (one-time physical activity suffices to increase executive performance, but not consistently across all executive functions) further constrain the possible physiological explanations. First, the idea that executive functioning is enhanced primarily by increased cerebral blood flow is quite unspecific and cannot explain the differential effects observed across specific executive functions. Moreover, blood flow regulation under acute physical load is fast so that blood flow decreases rapidly when physical activity ceases. However, in most short-term interventions, the enhancing effects persisted for at least half an hour. Thus, the cerebral blood flow hypothesis is not strengthened. Second, the finding that neurotrophin release increases as an immediate effect
of physical activity (Winter et al., 2007) is compatible with the observation that single bouts of physical activity may suffice to increase central executive performance. However, researchers do not yet understand this process well enough to answer the question whether increased neurotrophin release can explain differential effects on specific executive functions. Third, changes in the regulation of the dopamine system seem to be the most probable explanation for the observed pattern of results. On the one hand, the production of neurotransmitters, in particular dopamine, is immediately stimulated by physical activity; on the other hand, dopamine takes some time to be metabolized, meaning that dopamine levels are sustained after physical activity has ended. As mentioned above, moreover, specific neurotransmitter systems are now known to be related to specific types of executive function (Montgomery, Fisk, Newcombe & Murphy, 2005; Verdejo-García & Pérez-García, 2007). Results on the role of the COMT Val158Met polymorphism point into the same direction. The different alleles of the COMT gene influence the activity of the enzyme catechol-O-methyltransferase, which is responsible for the metabolism of dopamine. Bilder, Volavka, Lachman and Grace (2004) speculated that the Val allele enhances cognitive flexibility (such as in shifting and updating), whereas the Met allele enhances processes that stabilize working memory contents (such as inhibition). The physiological processes mediating the enhancing effects of physical activity on executive functioning remain to be explored in detail. What are the consequences for future research? Although the implications of choosing short- or long-term interventions are discussed, little is known about the sustainability of the effects produced by either approach. In most cases, effectiveness was assessed directly after intervention, and not after longer intervals. It may be speculated that the physiological outcomes of long-term interventions—and hence their effects on executive functioning—are more sustainable than those of short-term interventions. However, Harada, Okagawa and Kubota (2004) found that the facilitating effect of a long term intervention decreased after its conclusion, suggesting that continued physical activity may be necessary to achieve sustained effects. In sum, studies systematically comparing the effectiveness and sustainability of short- and long-term interventions with respect to neurobiological processes and executive functioning are needed to address this issue. The second important research was related to choosing the appropriate duration and intensity level of physical activity. The three physiological mechanisms that have been proposed to link physical activity and executive functions (cerebral blood flow, neurotrophins, and brain neurotransmitters) may imply that a certain threshold of activation is needed to elicit these physiological processes and thus to improve executive functioning. In the long-term interventions considered in this review,
neither the duration nor the intensity level of physical activity seemed to affect the pattern of results across studies. However, dose-related manipulations of physical activity within two studies revealed advantages for high-dosed over low-dosed groups (Davis et al., 2007; Masley Roetzeim & Gualtieri, 2009). In the short-term interventions considered, there was even less variation in the duration and intensity level of physical activity across studies, so that no firm conclusions could be drawn on the respective effects. Moreover, manipulation of intensity levels in one study barely affected the pattern of results (Kubesch et al., 2003). Most of the short-term intervention studies fixed intensity at a moderate to intense level of 60% to 80% of maximum workload, possibly indicating an assumed prerequisite level of intensity.

Recent experimental research has shown that aerobic exercise at a moderate to vigorous intensity appears to promote children’s effortful and goal-directed cognition and behavior, commonly described as executive function (EF) (Best, 2010). The effects have been detected immediately following completion of single bouts of exercise (Budde, Voelcker-Rehage, Pietrabyk-Kendziorra, Ribeiro & Tidow, 2008; Ellemberg & St. Louis-Deschênes, 2010; Hillman et al., 2009; Pesce, Crova, Cereatti, Casella & Bellucci, 2009) and after chronic training (Davis et al., 2007; Hinkle, Tuckman & Sampson, 1993). Since EF is considered to be higher-order cognition, this finding indicates that aerobic exercise does not have a limited effect on lower-level perceptual or automatic cognitive processes (McMorris & Graydon, 1996) but instead impacts the complex cognitive abilities that permit humans to behave in an adaptive and goal-directed fashion. It is important to understand why aerobic exercise promotes children’s EF, how is it supported by the brain, how does it typically develop, what is the experimental evidence that aerobic exercise impacts children’s EF and what mechanisms underlie the link between aerobic exercise and EF. Although, there are only a few studies, they provide a sufficient base from which to examine specific mechanisms underlying the connection between aerobic exercise and EF and suggest directions for future research. Both EF and the underlying neural circuitry are still immature in late childhood and even adolescence, and therefore, certain experiences may facilitate their development or temporarily enhance their functioning. Aerobic exercise appears to be such an experience that would positively impact EF and the supporting neural circuitry.

2.4.4 Mechanisms linking aerobic exercise and executive functions

A number of studies have been conducted in the past decade that provide a larger database from which theory-based hypotheses concerning the effects of exercise on brain and cognitive function can be evaluated. Much of the research on the relation between exercise and cognition has tested predictions drawn from “arousal” theories. Three different
approaches have been taken to test predictions drawn from the arousal hypothesis. One approach has been to use experimental protocols that mimic the exercise regimens prescribed to recreational runners or cyclists. These protocols involve steady-state cardiorespiratory exercise designed to improve mood and increase feelings of well-being. The aerobic-running movement that emerged in the 1970s was grounded on purported physical and psychological health benefits of steady-state exercise (Folkins and Sime, 1981). The existence of these benefits has been supported by empirical evidence, in which individuals report positive changes in affect following moderate levels of steady-state exercise lasting at least 20 minutes. Predictions for experiments that have examined cognition following exercise have been driven by this finding. Maintenance of exercise-induced arousal was expected for a short period following exercise and cognitive performance was also expected to be facilitated during this time.

A second approach researchers have taken to examine the exercise–cognition relation has been to model experimental protocols on predictions generated from the inverted-U hypothesis and other arousal theories. Typically, cognitive performance was measured at multiple points during exercise that systemically altered participants' level of physiological arousal as measured by heart rate, oxygen uptake, RPE, or other biological indices. Cognitive performance was predicted to improve and peak as physiological arousal increased and then deteriorate as arousal levels approached maximal levels. Yet another approach to examine the influence of exercise on cognition has been to focus on the fatigue producing aspects of physical activity. Human factor researchers have long had an interest on the debilitating effects of physical fatigue on operational performance and exercise has been used to induce fatigue in many studies. Experimental protocols employed in these studies typically require participants to complete incremental-load exercise to voluntary exhaustion or to maintain a physically demanding steady-state exercise protocol for an extended period of time. In such studies, it has been predicted that participants' cognitive performance would be impaired both during and immediately following the termination of exercise. Thus, depending on the approach taken, researchers have expected exercise to either facilitate or impair cognitive function. Wide range of mental tasks, from those that measure basic processes such as perceptual organization, information-processing speed, and simple- and choice-response time, to tasks that measure memory and high-level executive control processes have been employed in these studies.

There are at least three general pathways by which aerobic exercise may facilitate EF in children: (1) the cognitive demands inherent in the structure of goal-directed and engaging
EI, Executive Function and Explanatory Style in Mallakhamb

exercise, (2) the cognitive engagement required to execute complex motor movements, and (3) the physiological changes in the brain induced by aerobic exercise (Best & Miller, 2010). Cognitive demands are inherent in exercise and physical activity, in fact many forms of exercise are cognitively-engaging activities. Researchers have suggested that this cognitive engagement inherent in exercise may help explain how exercise impacts cognition (Sibley & Etnier, 2003; Tomporowski, Davis, Miller & Naglieri, 2008; Tomporowski & McCullick, 2009). Much of children’s exercise comes through participation in group activities or sports that require complex cognition in order to cooperate with teammates, anticipate the behavior of teammates and opponents, employ strategies, and adapt to ever-changing task demands. Group activities such as soccer or basketball played by children in the studies conducted by Davis et al. (2007) contain many of those cognitive demands. Importantly, EF tasks place similar demands on children’s executive processes by requiring them to create, monitor, and modify a cognitive plan to meet task demands (Banich, 2009). Thus, aerobic games and EF tasks require a similar way of thinking and similar cognitive skills. Perhaps cognitive skills acquired during aerobic games transfer to EF tasks. If this is the case, participation in cognitively complex, yet sedentary, games should also positively impact children’s EF. Research has supported this proposition by showing that even computerized games created specifically to train EF are effective for young children (Rueda, Rothbart, McCandliss, Saccomanno & Posner, 2005; Thorell, Lindqvist, Bergman, Bohlin & Klingberg, 2008), older children and adolescents (Klingberg, Forssberg & Westerberg, 2002; Klingberg et al., 2005), and adults (Erickson et al., 2007; Jaeggi, Buschkuehl, Jonides & Perrig, 2008; Olesen, Westerberg & Klingberg, 2004; Persson & Reuter-Lorenz, 2008).

There is strong evidence that challenging, yet sedentary games that require adaptive and goal-directed behavior can effectively train EF. One mechanism that may explain how participation in engaging games transfers and results in enhanced EF concerns contextual interference (Tomporowski & McCullick, 2009). Although skill acquisition occurs more rapidly when the components of a task are presented in a simple and repetitious manner, the retention and transfer of those skills are enhanced when there is contextual interference, i.e., the components are presented in a complex and quasi-random manner (Battig, 1972). Children’s participation in games, both sedentary and aerobic, often contains contextual interference. For example, in the game of basketball, the child may need to perform a bounce pass to effectively pass the ball in one specific scenario but need to dribble the ball in another. The particular pass needed at that time is not predetermined and is rarely repeated over and over, but instead, is determined by a myriad of factors that converge at a particular
moment. Contextual interference places demands on executive processes as a motor action plan must be created, monitored and modified in the presence of continually changing task demands (Brady, 2008). Thus, the processing of pertinent information is likely to be more effortful and elaborative, leading to greater learning (Carey, Bhatt & Nagpal, 2005). A recent fMRI study reports that this more effortful processing imposes demands on EF-related circuitry, greater frontal activation, compared to more widespread parietal, premotor and cerebellar activation in the absence of contextual interference (Cross, Schmitt & Grafton, 2007). The degree of cognitive engagement afforded by an activity surely varies across development.

The execution of complex motor movements also recruits neural circuitry associated with EF. Diamond (2000) reviewed several areas of research suggesting a close neural link between, and substantial co-activation of, the cerebellum, critical for complex and coordinated movement, and dorsolateral PFC (DL-PFC), critical for EF. It was concluded that the cerebellum seems to be important for complex cognitive functions as well as complex motor functions; likewise, the DL-PFC seems to be important for complex motor functions as well as complex cognitive functions (Serrien, Ivry & Swinnen, 2007). More recently, Diamond (2009) argued that the brain, and the mind by extension, operates on a global-default mode, and that both cognitive and motor activities that rely on non-automatic and selective processing require the effortful overriding of that default. The execution of bimanual coordination tasks, in which the individual does different things with each hand simultaneously, is a complex motor movement and appears to be an inherently cognitively-engaging task, whereas the execution of simpler repetitive exercise, such as walking once it has been mastered by the child, may be less so, instead relying on a global default mode of operation. Additionally, research with animals indicates that complex motor activity induces morphological changes to the brain whereas simple motor activity does not. In rodents and nonhuman primates, the execution of complex motor movement promotes neural growth in the hippocampus, cerebellum and cerebral cortices to a greater degree than repetitive motor movement (Carey, Bhatt & Nagpal, 2005; Jones, Hawrylak, Klintsosva & Greenough, 1998).

Thus, the findings now indicate that aerobic exercise engages EF and other higher-order cognitive processes by requiring goal-directed behavior and the coordination of motor movements. Additionally, the demands placed on the body’s cardiovascular system while exercising induces physiological changes in the brain to impact cognition and may interact with the cognitive components of the exercise to impact cognition.
Extensive research with rodents suggests that exercise induces changes in brain regions critical to learning and memory (Holmes, 2006; van Praag, 2006) that occur over several sessions of regular exercise (Cotman, Berchtold & Christie, 2007). These changes are mediated by up-regulation of several growth factors, including insulin-like growth factor-1 (IGF-1), vascular endothelial growth factor (VEGF), and brain-derived neurotrophic factor (BDNF) (Cotman, Berchtold & Christie, 2007; Dishman et al., 2006; Holmes, 2006; van Praag, 2006). BDNF, in particular, has been shown to be an important activity dependent modulator of synaptic transmission and, in turn, of synaptic plasticity (Schinder & Poo, 2000). Moreover, BDNF appears to mediate exercise-induced neurogenesis, i.e., the process by which new neurons proliferate and develop (Churchill et al., 2002). Exercise-induced neurogenesis has been observed in the hippocampus of adult mice following voluntary freewheel running (van Praag, Christie, Sejnowski & Gage, 1999), a finding consistently replicated over the past decade that correlates with enhanced learning and memory on tasks such as the Morris water maze and radial arm maze (van Praag 2006). A recent study manipulated the timing of a 2 week freewheel running program with respect to training on a Y maze task to demonstrate that exercise improves both the acquisition and retention of learning (van der Borght, Havekes, Bos, Eggen & van der Zee, 2007). These cognitive improvements were complemented by increased hippocampal neurogenesis. Although still a matter of contention, it is thought that the resulting newborn hippocampal cells facilitate learning and memory (Cotman & Engesser-Cesar, 2007; Kramer & Erickson, 2007). Much less contentious is the fact that exercise enhances short-term and long-term potentiation—the synaptic parallel of learning—in the hippocampus through the upregulation and interplay of IGF-1 and BDNF (Cotman et al., 2007).

Animal models of the impact of exercise on the juvenile brain are sparse (van Praag, 2009); however, few studies indicate that exercise has a similar effect on the developing brain as it does on the adult brain. Regular treadmill running results in enhanced visuo-spatial memory and hippocampal cell density—due to increased cell survival—in adolescent rats (da Silva et al., 2010; Uysal et al., 2005). One study on juvenile rats discovered that the impact of exercise on neurogenesis and on the expression of growth factors (e.g., BDNF) was intensity-dependent; that is, low- and moderate-intensity exercise (as determined by running speed) had a stronger impact than high-intensity exercise of equivalent duration (Lou, Liu, Chang & Chen, 2008). Thus, evidence that exercise positively impacts the developing brain is accumulating, and it may be that regular moderate, rather than intense, exercise is most beneficial (Ploughman, 2008). Fabel and Kempermann (2008) posit that exercise causes a
nonspecific neural activation that when combined with a engaging context leads to robust and enduring neurogenesis in the learning and memory centers of the brain. Thus, exercise in a complex and social environment may lead to greater morphological changes than exercise in a simpler context. Freewheel running in conjunction with group housing induces neurogenesis in the hippocampus to a greater extent than freewheel running individually (Stranahan, Khalil & Gould, 2006). Ekstrand, Hellsten and Tingström (2008) reported intriguing evidence that individual freewheel running promotes angiogenesis (i.e., the growth of new blood vessels linked to neurogenesis) in the hippocampus in comparison to a sedentary condition; an enriched environment promotes angiogenesis in both the hippocampus and PFC in adult rats. The enriched environment included several platforms, along with ropes, ladders, and plastic tubes to move among the platforms, and was reconstructed twice weekly in order to maintain its novelty. It may be that regular exercise in a complex and novel environment promotes EF via specific morphological changes in the PFC. Evidence is building that exercise’s impact on human cognition is mediated by similar mechanisms. For example, Pereira et al. (2007) found evidence that chronic aerobic exercise increases regional cerebral blood volume (CBV) in a specific area of the hippocampus in both mice and humans. This increased CBV, thought to be associated directly with angiogenesis, was shown to be a direct correlate of neurogenesis in mice and predicted effortful memory performance in humans. Further support that aerobic exercise promotes morphological changes in humans comes from a randomized controlled trial conducted by Colcombe et al. (2006). Older adults (aged 60–80) assigned to 6 months of aerobic training showed increased white and gray matter volume, based on structural MRI, compared to the no-activity control participants. This increased brain volume was most pronounced in frontal brain regions—regions implicated in EF. This increased brain volume may reflect cellular changes in synaptic interconnections, axonal integrity and capillary bed growth. Finally, there is some evidence that regular aerobic exercise in humans also has a direct impact on the neural substrate underlying cognition.

Aerobic exercise also induces immediate neurochemical changes (Meeusen, Piacentini & De Meirleir, 2001) that may prime the central nervous system for either concurrent or subsequent skill acquisition. In a rodent model of ischemia, aerobic exercise immediately preceding motor skill training led to greater skill recovery than either skill training or exercise alone (Ploughman, Attwood, White, Doré & Corbett, 2007). There was also marginally greater expression of mRNA BDNF in the exercise plus motor skill training condition, suggesting that up-regulation of growth factors may underlie the priming effect. A
study with humans further suggests that exercise has an immediate priming effect (Winter et al., 2007). Here, learning was superior following a short, intense running effort as compared to a longer, moderately intense run or period of relaxation. This behavioral effect was complemented by increases in peripheral levels of BDNF and monoamines (dopamine, norepinephrine and epinephrine) that predicted retention of the learned material (Ferris, Williams & Shen, 2007). A second human study examined whether the simultaneous engagement in exercise and a cognitive task leads to an interaction between the central and peripheral biochemical response (McMorris, Collard, Corbett, Dicks & Swain, 2008). Although the results did not clearly indicate that the combination of exercise and a challenging EF task boosts neurochemical levels more so than repetitive exercise alone, there was evidence that the greater the norepinephrine response to the combination of exercise and EF, the greater benefit to EF task performance. These immediate neurochemical boosts may transiently enhance the neural response to challenging tasks. Hillman et al. (2009) reported that acute treadmill walking results in enhanced P3 amplitude in preadolescent children, likely representing increased allocation of attention. Hence, exercise not only induces long-lasting morphological changes over time but stimulates immediate chemical changes leading to an increased state of arousal that may enhance cognitive performance. Consequently, both acute and chronic exercise may facilitate EF but through different physiological pathways.

To summarize, evidence from a variety of research disciplines indicates that aerobic exercise may impact EF through multiple pathways. Which of these pathways apply depends on the nature of the exercise. Participation in aerobic games likely requires many of the same cognitive processes as more traditional EF tasks, such as strategic and goal-directed behavior in the face of a novel game experience, and those skills gained during aerobic game participation may transfer to EF tasks. Aerobic games also require skilled and complex movement, which directly relies on the prefrontal neural circuitry supporting EF. Finally, aerobic exercise causes not only general physiological changes to the body (e.g., increased blood flow) but also specific changes in the brain. Acute exercise promotes an immediate neurochemical response that may enhance cognitive performance, and chronic exercise induces morphological changes to brain regions critical to learning. Supporting the results of experimental studies with children, there is intriguing evidence that exercise in a cognitively-engaging context has a stronger impact on the brain. Probably, exercise that impacts EF through multiple pathways would have a stronger effect than exercise that works through fewer pathways. For example, chronic participation in aerobic games ostensibly would
impact EF via more pathways (i.e., goal-directed thinking, skilled and complex movement, and chronic physiological changes) than regular walking (chronic physiological changes).

Studies on infants and preschoolers (Robertson & Johnson, 2009; Campbell, Eaton, & McKeen, 2002) indicate that within the first few weeks of life a tight coupling of action and the rudiments of EF emerges. It appears that the complexity of the action and of the EF component increase with development. Early bursts of gross motor movement are coupled to basic attentional processes. Later, locomotion and exploration connect with adaptive and flexible ways of thinking. Toddlers’ personal experiences with goal-directed actions facilitate their understanding of others’ goal-directed actions. Older children’s participation in structured aerobic games, which require even more complex movement and coordination, facilitates further EF development, including the sophisticated abilities to selectively attend to stimuli and to withhold prepotent responses in favor of other responses. Thus, the link between physical activity and EF found in children may be traced back to infancy. The regular engagement in these physical actions likely stimulates regions of the brain, inducing critical morphological and functional development.

It is thus important to study EF as it is critical to nearly all forms of behavior and is a cornerstone of development. EF is important to classroom behavior (Riggs, Blair & Greenberg, 2003) and to emotional self-regulation, which is particularly important for school readiness and success (Blair & Diamond, 2008). In fact, self-regulation (e.g., following directions and controlling attention) seems to be more closely linked to success during kindergarten than the acquisition of specific academic skills (e.g., knowing the letters of the alphabet) (Blair & Diamond, 2008). Physical activity and aerobic exercise more specifically, have the potential to promote multiple facets of development through its direct impact on EF (Diamond, Barnett, Thomas & Munro, 2007). Student-centered, action-based classrooms may lead to increased positive play behavior (Lillard & Else-Quest, 2006). In older children, aerobic exercise interventions may be effective in several populations. Overweight children, because they typically are inactive, arguably should be the highest priority target population of aerobic exercise interventions. In fact, because the human body evolved to support regular physical activity, some of the health problems associated with childhood overweight actually may to some extent reflect children’s inactivity rather than their overweight per se (Booth & Lees, 2006; Vaynman & Gomez-Pinilla, 2006), overweight in children is related to poor academic achievement (Dwyer, Sallis, Blizzard, Lazarus & Dean, 2001; Taras & Potts-Datema, 2005) and to sedentary behavior (Must, Bandini & Tybor, 2007; Must & Tybor,
Moreover, school time dedicated to recess has dwindled (Story, Kaphingst & French, 2006), and few children receive the recommended amount of exercise (CDC, 2007).

Thus, regular exercise has the potential to bolster not only children’s physical health but also their cognitive health and may be effective in clinical interventions. Advances in the video gaming industry offer a novel manner by which to implement exercise e-based interventions and to increase children’s physical activity while playing cognitively-engaging interactive games. Exergames (a portmanteau of “exercise” and “games”) are a new generation of video games that stimulate a more active, whole-body gaming experience. Because of their recent emergence, empirical research with exergames is limited, but the few current studies report the potential of exergames to promote physical activity. First, caloric expenditure from exergame playing is significantly greater than from sedentary video game playing (Graves, Stratton, Ridgers & Cable, 2007) or television watching (Graf, Pratt, Hester & Short, 2009). Second, evidence suggests that exergame based interventions may be an effective manner to increase regular physical activity. For example, Warburton et al. (2007) reported that young adults assigned randomly to an exergame condition demonstrated greater physical activity adherence compared to young adults assigned to traditional exercise training (stationary cycling). Moreover, the exergame group showed significantly greater increases in aerobic capacity (VO2 max) and decreases in resting systolic blood pressure in comparison to traditional aerobic training group. Similarly, Mhurchu et al. (2008) found that children provided with exergame equipment demonstrated increased physical activity and marginally decreased waist circumferences compared to controls. Thus, there is promising early evidence that exergames can have a salutary effect of physical health by promoting physical activity. Exergames have several attributes that make them ideal for intervention research. Exergames are relatively inexpensive, are widely available, require a small amount of space, can be played alone or with others, adjust to one’s skill level and are perceived as enjoyable by children (Papastergiou, 2009). These same attributes also may make exergames ideal for use by low-income children, who may have limited access to safe recreational space and equipment, and by children with psychosocial impediments to physical activity engagement (e.g., children, especially overweight ones, with low physical activity self-efficacy and enjoyment, or negative perceptions of exercising around others). Importantly, these games can be designed to impose significant cognitive demands on the children and to adapt to the children’s performance so that children’s cognitive health benefits as well. Furthermore, cognitively-engaging exergames and sedentary games can be compared in experimental
research to determine whether cognitively-engaging games alone (i.e., without any aerobic component) impact cognition.

Most of the research studies on executive functions have focused on adults, thus it would be interesting to see how organized sport activities enhance executive functions in children. Involvement in regular exercise and physical activity programs that improve skill, knowledge, fitness and health are linked to enhanced self perceptions (Fox, 1997). These changes may then generalize to more favorable views about the self, leading to an improved sense of well-being (Berger & McInman, 1993; Morgan, 1985).

Youth sports experience can have lifelong effects on the personality and psychological development of children (Weinberg & Gould, 2003). It would be interesting to find out how winning, losing, sharing and other varied experiences influence the explanatory style of the player.

2.5 Explanatory Style

There are three basic predictions for sports. First, other things being equal, the sportsperson with the more optimistic explanatory style will win, as he will try harder, particularly after defeat or under stiff challenge. Second, in team game, the more optimistic the team, more the chances it will win, the phenomenon more apparent under pressure. Third, very important, as the sportspersons explanatory style changes from pessimistic to optimistic, they tend to win more, particularly under pressure (Seligman, 1990).

2.5.1 Optimism and Pessimism

These two people have two different ways of looking at the world. When something bad happens- a tax audit, marital squabble, a frown from the employer- the first one imagines the worst: bankruptcy and jail, divorce, dismissal….he is prone to depression, has long hours of listlessness, his health suffers. The second one, on the other hand, sees bad events in their least threatening light. They are temporary and surmountable, challenges to be overcome. After a reversal, comes back quickly, regains his energy, his health is excellent. The first is a pessimist and the second one is the optimist.

The defining characteristic of pessimist is that they tend to believe bad events will last a long time, will undermine everything they do, and are their fault. The optimists, who are confronted with the same hard knocks of this world, think about misfortune in the opposite way (Seligman, 1990). They tend to believe defeat is just temporary setback, that it causes are confined to this one case. The optimists believe defeat is not their fault, circumstances, bad luck or other people brought it about. Confronted by a bad situation, they perceive it as a challenge and try harder. These two habits of thinking about causes have consequences.
Pessimists give up more easily and get depressed more often. Optimists do much better in school and college, at work and on playing field. They regularly exceed the predictions of aptitude tests. When optimists run for office, they are more apt to be elected then pessimists are. Their health is unusually good. They age well and are much freer than most of us from the usual physical ills of middle age. They may live longer.

2.5.2 History: From Learned helplessness to Explanatory style

Learned helplessness was first described by psychologists studying animal learning. The dogs were exposed to series of electric shocks that could be neither avoided nor escaped. Twenty four hours later, the dogs were placed in a situation in which electric shock could be terminated by a simple response. The dogs did not make this response, just sat passively, enduring the shock. This behavior was in marked contrast to that of dogs in a control group, which reacted vigorously to the shock and learned readily how to turn it off. It was proposed that the dogs had learned to be helpless. When originally exposed to uncontrollable shock, it learned that nothing it did mattered (Maier & Seligman, 1976). The shocks came and went independently of the dog’s behaviors. Response-outcome independence was represented cognitively by the dogs as an expectation of future helplessness that was generalized to new situations to produce a variety of motivational, cognitive and emotional deficits. These deficits that were seen in the context of uncontrollability came to be known as the ‘learned helplessness phenomenon’ and the associated cognitive explanation as the ‘learned helplessness model’. According to this model, learning that outcomes are uncontrollable results in three deficits- motivational, cognitive and emotional. The motivational deficit consists of retarded initiation of voluntary responses and is seen as a consequence of the expectation that responding is futile. The cognitive deficit consists of difficulty in learning that responses produce outcomes. The depressed affect is a consequence of learning that outcomes are independent of responding.

Using a three group experimental design, the triadic design, it was shown that the uncontrollability of shocks is responsible for the deficits shown. Here, animals in first group are exposed to shock that they are able to terminate by making some response. Animals in second group are yoked to those in the first group and exposed to identical shocks, with the only difference being that animals in the first group control their offset, whereas those in the second do not. Animals in the third group are exposed to no shock at all in the original situation. All animals are then given the same task. Animals with control over the initial shocks typically show no helplessness when subsequently tested. They act just like animals with no prior exposure to shock. Animals without control become helpless. Only inescapable
events produced giving up, because the identical pattern of shock, if it was under the animal’s control, did not produce giving up. Animals can learn that their actions are futile, and when they do, they no longer initiate action, they become passive. The animal’s sensitivity to the links between responses and outcomes imply that they are able to detect and represent the relevant contingencies. Thus, a cognitive explanation is more appropriate.

The behaviorists were skeptical about this explanation. Behaviorism maintained that the only thing an animal could ever learn is an action or motor response; it could never learn a thought or an expectation. So they argued that something happened to the dogs to reward them for lying there, somehow the dogs must have been rewarded for just sitting still. The dogs, while getting inescapable shock, happened to be sitting as the shock ceased. The cessation of pain at those moments was a reinforcer and strengthened sitting. The dogs now would sit even more, the shock would stop again and this further reinforced sitting. A clever experiment was set up to test this hypothesis (Maier, 1990). The sitting-still group consisted of dogs which would experience shock that would cease only if they stayed motionless for 5 seconds. Thus, they could control shock by sitting still. The second group was the yoked group, would be shocked with the sitting-still group and the shock would cease only when it ceased for the sitting-still group. The third group was the control group; it was the No-shock group. The second part of the experiment involved taking all the dogs to the shuttle box to learn to jump away from the shock. The behaviorists would predict that when shock came on, the dogs both in sitting-still group and the yoked group would stand still and appear to be helpless, because both the groups were previously rewarded by experiencing relief from shock while staying still. Of the two groups, the sitting-still group would be more intently still, because they had been consistently rewarded for stillness, while the dogs in yoked group only occasionally had been. According to behaviorists, the No-shock group would remain unaffected. It was hypothesized by Maier (1990) that the sitting-still group, learning they had control over when shock ceased, would not become helpless. When they had a chance to jump over the barrier in the shuttle box, they would readily do so. The yoked group would become helpless; the No-shock group would be unaffected and escape the shock by jumping over the barrier. This is what actually happened. The majority of yoked group just lay there; the No-shock group dogs were unaffected. The sitting-still group dogs, stood motionless for a few seconds, waiting for the shock to stop. When it didn’t, they danced around a bit, trying to find some other passive way to turn the shock, and when they couldn’t find any, they promptly jumped over the barrier.
Support for the cognitive interpretation of helplessness also appeared in studies showing that the animal can be immunized against the debilitating effects of uncontrollability by first exposing to controllable events. Presumably, the animal learns during immunization that events can be controlled; this expectation is sustained during exposure to uncontrollable events, precluding learned helplessness. It was also found that the helpless dogs can learn to overcome helplessness. The dogs were dragged back and forth across the shuttle box, over the barrier and back again, until they began to move on their own and realized that their own actions worked.

The first studies on learned helplessness model were done on dogs, then on rats and finally people replaced rats. All the studies had the same form. They were experiments with three groups of subjects. One group was allowed to bring some event or item - noise, shock, money, food - under its voluntary control. The second group, ‘the helpless group’ was yoked to the first and got exactly the same amount of the event, but nothing it did mattered. The third group was left entirely alone. The results were consistent. The helpless group gave up. They became so passive that even in new situations, they didn’t try. Rats just sat there, without even trying to escape. People gazed at easy anagrams and made no attempt to solve it. The group that was able to control events remained active and chippers, as did the group that was left alone. The rats ran briskly out of shock, and people unscrambled the anagrams in few seconds. The symptoms of learned helplessness could be produced in several ways. Defeat and failure generated the same symptoms as uncontrollable events did. Being defeated in fight by another rat produced symptoms identical to those caused by inescapable shock. Being told to control noise and failure to do so produce the same symptoms as unsolvable problems or inescapable noise did. So learned helplessness seemed to be at the core of defeat and failure. Learned helplessness could be cured by showing the subject his own actions would now work. It could also be cured by teaching the subject to think differently about what caused him to fail. It could be prevented if, before the experience of helplessness occurred, the subject learned that his actions made a difference. The earlier in life such mastery was learned, the more effective the immunization against helplessness.

Historically, the work on learned helplessness in humans grew out of the original findings with animals. With more research on humans, it became clear that the original learned helplessness explanation was an oversimplification. The model failed to account for the range of reactions that people display in response to uncontrollable events.

In an attempt to solve discrepancies in the theory, Abramson, Seligman and Teasdale (1978) reformulated the learned helplessness model. This reformulation came in as the
original theory encountered two major problems. Firstly, it could not distinguish between cases in which events are uncontrollable for all the people (universal helplessness) and events which are uncontrollable for some people (personal helplessness). The first is seen in a parent caring for fatally ill child and the second is seen in a student who is unable to solve math problems, but his classmates can. Secondly, the theory could not explain when helplessness deficit will generalize. The original theory implied that it is highly general, although there is no research for the same. The reformulated learned helplessness model included causal attributions. When something happens to us, we ask why that event happened (Abramson, Metalsky & Alloy, 1989; Abramson, Seligman & Teasdale, 1978). The answer to this ‘why’ question is our causal attribution for the event. The attributions we make for events can influence our behavior and emotions because they influence the meaning we give to events and our expectations for similar events in the future. For example, if we attribute a friend’s rude behavior to temporary situational factors (he is under lot of pressure), then we do not evaluate the friend too harshly and we do not expect the friend to act rudely again in future. However, if we attribute friend’s rude to personality factors (he is a mean guy), then our evaluations of the friend will be more harsh and we will expect the friend to act rudely again. A personality attribution for the friend’s behavior might want us to avoid the friend or break up the relationship, whereas a situational attribution would not. The revised theory suggested that people differ in terms of how they habitually explain events. This ‘attributitional style’, was later called as ‘explanatory style’ by Peterson and Seligman (1984). Explanatory Style is the manner in which people habitually explain oneself why events happen. The explanatory style can range from optimistic to pessimistic explanatory style. People who usually explain bad events by causes that are stable in time (“it’s going to last forever”), global in effect (“it’s going to undercut everything that I do”), and internal (“it’s me”) and who explain good events with unstable, specific, and external causes are said to have a pessimistic explanatory style. People with the opposite attributional pattern are said to have an optimistic explanatory style. A positive explanatory style stops helplessness, whereas a pessimistic explanatory style spreads helplessness.

2.5.3 Dimensions - Explanatory Style

The three crucial dimensions to the explanatory style are,

1. Permanence: People who give up easily believe the causes of the bad events that happen to them are permanent. The bad events will persist; will always be there to affect their lives. People who resist helplessness believe the causes of bad events are temporary. If a person think about bad things in always’s and never’s and abiding traits, the person has a
permanent pessimistic explanatory style. If a person think in sometime’s and lately’s, if he uses qualifiers and blames bad events on transient conditions, then the person has optimistic explanatory style. The optimistic style of explaining good events is just the opposite of the optimistic style of explaining bad events. Optimists explain good events in to themselves in terms of permanent causes, the traits, abilities, always’s. Pessimists name transient causes, moods, effort, sometime’s.

2. Pervasiveness: People who give universal explanations for their failures give up on everything when a failure strikes in one area. People who make specific explanations may become helpless in that part of their lives yet march stalwartly on in the others. An optimist believes that bad events have specific causes, while good events will enhance everything he does, the pessimist believes that bad events have universal causes and that good events are caused by specific factors.

3. Personalization: When bad things happen, we can blame ourselves (internalize) or we can blame other people or circumstances (externalize). People who blame themselves when they fail have low self-esteem as a consequence. They think they are worthless, talent less and unlovable. People who blame external events do not lose self-esteem when bad event strike. On the whole, they like themselves better than people who blame themselves do. The optimistic style of explaining good events is internal rather than external.

Optimism, conceptualized and assessed in variety of ways has been linked to positive mood and good morale, to perseverance and effective problem solving, to achievement in variety of domains, to popularity, to good health, and even to long life and freedom from trauma (Snyder & Lopez, 2002). Optimists are people who expect good things to happen to them; pessimists are people who expect bad things to happen to them. This folk wisdom which has been held for long, has received much support in contemporary research. Optimists and pessimists differ in several ways that have a big impact on their lives. They differ in how they approach problems and challenges, and they differ in the manner- and the success-with which they cope with adversity. When people confront adversity or difficulty, they experience a variety of emotions, ranging from excitement and eagerness to anger, anxiety and depression. The balance among these feelings appears to relate to peoples degree of optimism and pessimism. Optimists are people who expect to have positive outcomes, even when things are hard. This confidence should yield a mix of feelings that are relatively positive. Pessimists expect negative outcomes. This doubt should yield a greater tendency toward negative feelings-anxiety, guilt, anger, sadness or despair (Scheier & Carver, 1992).
Relationship between optimism and distress has been examined in diverse groups of people facing difficulty or adversity. The focus is on people who are undergoing truly serious crises rather than ordinary problems of daily life. Included here are the studies of people, who have survived missile attack (Zeidner & Hammer, 1992), people dealing with childbirth and abortion (Carver & Gains, 1987; Cozzarelli, 1993), and progression of AIDS (Taylor et.al., 1992). Optimism is found to have positive effects not only on the psychological well being of people with medical problems, but also in the caregivers (Given, et al., 1993).

Differences in coping methods used by optimists and pessimists have been found in a number of studies. Optimism is found to be related to problem focused coping, especially when the situation was controllable. It was also related to the use of positive reframing and tendency to accept the situation’s reality, especially when the situation was uncontrollable. Also, optimism related negatively to the use of denial and the attempt to distance oneself from the problem (Scheier, Weintraub & Craver, 1986). These findings provided the indication that optimists use more problem centered coping than pessimists. They also use a variety of emotion focused coping techniques, including working to accept the reality of difficult situation and putting the situations in the best possible light. These findings hint that the optimists may have a coping advantage over pessimists even in situations that cannot be changed. Sizable body of evidence indicates that pessimism can lead people into self defeating patterns. The result can be less persistence, more avoidance coping, health damaging behaviors, and potentially even an impulse to escape from life altogether. With no confidence in future, there may be nothing left to sustain life (Carver & Scheier, 1998). Thus, explanatory style, one cognate of optimism tells how people habitually explain the causes of events that occur to them.

2.5.4 Human Helplessness

Psychologists were quick to see the parallels between learned helplessness as produced by uncontrollable events in the laboratory and maladaptive passivity as it exists in the real world. Helplessness was produced in the laboratory much as it was produced in animals, by exposing them to uncontrollable events and observing the effects. Unsolvable problems usually were substituted for uncontrollable electric shocks, but the critical aspects of the phenomenon remained. In other studies, researchers documented similarities between the animal phenomenon and what was produced in the human laboratory. Uncontrollable bad events made anxiety and depression more likely. Previous exposure to controllable events immunized people against learned helplessness. Also, forcible contingencies reversed helplessness deficits (Snyder & Lopez, 2002).
2.5.5 Difference between Animal and Human Helplessness

Uncontrollable bad events seem much more likely than uncontrollable good events to produce helplessness among human beings, probably because people are able to devise coherent accounts for why good things happen to them. Thus, the intriguing phenomenon of appetitive helplessness has no reliable counterpart among people because they can readily create contingency interpretations. More generally, people differ from animals in sophistication of assigning meaning to events.

A second asymmetry is what can be termed as vicarious helplessness. Problem solving difficulties can be produced in people if they simply see someone else exposed to uncontrollability (Brown & Inouye, 1978). The significance of vicarious helplessness is that it greatly extends the potential ways in which helplessness behavior can be produced in the natural world. The full parameters of this phenomenon have not been investigated and questions arise as to whether we can immunize people against vicarious helplessness or undo its effects via therapy.

A third difference is that small groups of people can be made helpless by exposure to uncontrollable events. So, when a group works at an unsolvable problem, it later shows group problem-solving deficits relative to another group with no previous exposure to uncontrollability (Simkin, Lederer & Seligman, 1983). But this group helplessness is not the function of individual helplessness produced among group members. When working alone, individual members of helpless group show no deficits. Perhaps these results can be generalized to larger groups, including complex organizations or entire cultures. Again, the real life implications of this phenomenon are intriguing and future research into this phenomenon is indicated.

In another line of work, researchers have proposed various failures of adaptation as analogous to learned helplessness and investigated the similarity between these failures and learned helplessness. Peterson, Seligman, Yurko, Martin & Friedman (1993) proposed three formal criteria, to judge the goodness of an application.

Objective non-contingency- The contingency between the person’s actions and the outcomes that are experienced by him should be taken into account. Learned helplessness is present only when there is no contingency between actions and outcomes. Learned helplessness must be distinguished from extinction (where active responses once leading to reinforcement no longer do so) and from learned passivity (where active responses are contingently punished and/or passive responses are contingently reinforced).
Cognitive mediation - Learned helplessness also involves characteristic way of perceiving, explaining and extrapolating contingencies. Learned helplessness is not present if these processes are not at work.

Cross-sectional generality of passive behavior - Learned helplessness is shown by passivity in a situation different from the one in which uncontrollability was first encountered. Learned helplessness gets demonstrated by passivity in new situations. Other consequences also may accompany the behavioral deficits that define the learned helplessness phenomenon: cognitive retardation, low self esteem, sadness, reduced aggression, immunosuppression and physical illness.

According to the attributional reformulation, explanatory style is not a cause of problems, but a dispositional risk factor. Helplessness will tend to be long lasting or transient, wide-spread or circumscribed, damaging to self-esteem or not, all in accordance with the individual’s explanatory style.

2.5.6 Origins of Explanatory style

What sets explanatory style in place? Isolated studies by various researchers document diverse influences on explanatory style.

Genetics - Explanatory style is influenced by genetics. Schulman, Keith & Seligman (1993) found explanatory styles of monozygotic twins were more highly correlated than that of dizygotic twins (r = .48 vs r = .00). Genes may be indirectly responsible for the concordance of explanatory style of monozygotic twins through attributes such as intelligence and physical attractiveness.

Parents - Relationship between explanatory styles of parents and their offspring was explored. Attribution by mothers and their children is usually the focus. Explanatory style of children can be affected by their parents through simple modeling. Children are attuned to the ways in which their parents interpret the world and they therefore may be inclined to interpret their environments in similar manner. If, for example, children repeatedly hear their parents give internal, stable and global explanations for negative events, they are likely to adopt these pessimistic interpretations for themselves. Another type of parental influence involves parent’s interpretation of their children’s behavior. Criticisms implying pessimistic causes have a cumulative effort on how children view themselves (Seligman, 1990). For example, if a child says that she cannot find her house key, the parent may admonish the child as being careless, thus providing an internal, stable and global explanation of the child’s behavior. Alternatively, a parent may respond by saying that the child needs to work on becoming more organized, thus providing an internal, unstable and specific attribution. One response
enforces a pessimistic view of a relatively minor event, whereas the other response allows a more optimistic view. Another type of influence is indirect but quite important, whether a safe and coherent world is provided for the young child. Children from happy and supportive homes are more likely as adults to have an optimistic explanatory style (Franz, McClelland, Weinberger & Peterson, 1994). Parental encouragement and support diminish fear of failure and enable children to take the risks necessary to find and pursue their real interests and talents. Success and confidence are generated, which in turn lead to the expectations of further success. Thus optimism is fostered through a series of confidence-building experiences.

Teachers - When teachers give feedback about children’s performance, their comments may affect children’s attributions about their success and failures in the classroom. In a study by Heyman, Dweck and Cain (1992), kindergarten student’s role played scenarios in which one of their projects was criticized by a teacher. Thirty-nine percent of students displayed a helpless response to the teacher’s criticism: exhibiting negative affect, changing their original positive opinions of the project to more negative ones, expressing disinclinations toward future involvements in that type of project and were also more likely to make negative judgments about themselves that were internal, stable and global.

Media - Do the media play a role in producing explanatory style? Levin (1977) reported that the CBS and NBC newscasts modeled helplessness 71% of time, thereby offering ample opportunity for the vicarious acquisition of helplessness. Televisions have a tendency to magnify stories of violence in a self-serving way that may slant factual presentation. It is not in the interest of networks to place temporal or specific parameters on a story. Instead, they benefit from interpreting a story from a pessimistic vantage, specifying the stability and globality of its impact, thereby enlarging the story’s import. Unfortunately, the distortions in permanence and pervasiveness that serve the interest of the network do not serve the best interests of the young viewers who may adopt the pessimistic explanatory style to which they are repeatedly exposed.

Trauma - Trauma also influences explanatory style of the child. Bunce, Larson and Peterson (1995) found that college students who reported experiencing a significant trauma such as death of a parent, rape, incest at some point in their childhood or adolescence currently had a more pessimistic explanatory style than those students who had never experienced trauma. Gold (1986) found that women who had been sexually victimized during their childhood or adolescence were more likely to have pessimistic explanatory style than were women who had not been sexually victimized.
A great deal is known about the consequences of an optimistic versus pessimistic style of explaining the causes of events, far less is known about the origins of explanatory style. Is the typical person an optimist, a pessimist or exceptionally neutral? Is optimism simply a developmental default, deep wired into human beings by evolution? (Tiger, 1979). Is pessimism the default? Or perhaps the child is a blank slate, equally able to become an optimist or a pessimist, depending on idiosyncratic influences to which he or she is exposed throughout life.

2.5.7 Measures of Explanatory style

Explanatory style typically is measured with a self report questionnaire called the Attributional Style Questionnaire (ASQ). In the ASQ, respondents are presented with hypothetical events involving themselves and then are asked to provide ‘the one major cause’ of each event, if it were to happen. Respondents then rate these provided causes along dimensions of internality, stability and globality. Ratings are combined, keeping separate those for bad events and those for good events. A second way of measuring explanatory style is with a content analysis procedure called CAVE (Content Analysis of Verbatim Explanations), which allows written or spoken material to be scored for naturally occurring causal explanations. Researchers identify explanations for bad or good events, extract them and present them to judges, who then rate them along the scales of the ASQ. The CAVE techniques makes possible longitudinal studies after the fact, so long as spoken or written material can be located from early in the lives of individuals for whom long-term outcomes of interest are known.

Optimism, as a personality construct, has been measured in two general ways: as a set of expectations regarding the likelihood of positive and negative outcomes and events and as a method of explaining positive and negative outcomes. The former definition, typically referred to as dispositional optimism, is best characterized by Scheier and Carver’s (1978) Life Orientation Test (LOT); the latter definition has relied primarily on the Attributional Style Questionnaire (ASQ) (Peterson et al., 1982) and other more specialized measures that use the general format of the ASQ. This measurement technique asks respondents to supply an explanation for negative and/or positive events and then rate the explanation supplied on the following dimensions: locus, stability, and globality. The shifting focus from understanding and alleviating negative states to a focus on enhancing positive states and subjective well-being can be seen in the current trend toward research on the antecedents of optimism as opposed to the causes of depression. The discovery that people can develop different forms of attributional or explanatory styles played a significant role in this shift.
Explanatory style has now become a part of Positive psychology. In his role as the 1998 American Psychological Association President, Martin Seligman called for psychology to be as focused on strength as weakness, as interested in building the best things in life as in repairing the worst and as concerned with fulfilling lives of normal people as with healing the wounds of the distressed. He called this new focus Positive psychology.

In most explanatory style research, the focus has remained on outcomes of interest to the helplessness model: depression, illness and failure. A valid criticism of explanatory style research is that it has looked much more at correlations between explanatory style and distant adaptational outcomes than at the mechanisms that lead from explanatory style to these outcomes. Especially as explanatory style researchers join the positive psychology movement, greater attention to mechanisms is needed. Likely mechanisms are to be found on a variety of levels. Kamen-Siegel, Rodin, Seligman and Dwyer (1991) showed that optimistic explanatory style is correlated with vigor with which immune system responds to an antigen challenge. Emotional mechanisms also deserve attention, given the extensive research literature showing an optimistic explanatory style to be incompatible with depression (Sweeney, Anderson & Bailey, 1986). There are probably several cognitive pathways that link explanatory style and outcomes. Someone’s explanatory style is not an isolated belief, but rather a part of a complex knowledge system that can influence well-being in numerous ways. Dykema, Bergbower and Peterson (1995) showed that individuals with optimistic explanatory style see world as less filled with hassles than do their pessimistic counterparts; in turn, this tendency is linked to better health. Peterson and de Avila (1995) found that optimistic explanatory style is associated with the belief that good health can be controlled, maintained and promoted. They reported that optimistic explanatory style is positively correlated with what has been described as an optimistic bias in risk perception, i.e. the tendency of people to see them as below average in likelihood to fall ill. This correlation was completely accounted for by the belief that one was able to do things to reduce risk, suggesting that the bias may not have been simply wishful thinking.

Another explanation of why optimistic thinking is related to outcomes entails a social pathway. People with pessimistic explanatory style often are socially isolated (Anderson & Arnault, 1985), and social isolation predicts poor adaptation in a wide variety of realms (Cohen & Syme, 1985). Conversely, people with an optimistic explanatory style may reap the benefits of rich social networks and appropriate social support. Peterson (1988) found that an optimistic explanatory style was associated with a variety of health practices, such as exercising, drinking in moderation and avoiding fatty foods. In one recent study of optimistic
explanatory style and physical well being, more than 1000 individuals were looked at for more than 50 years (Peterson, 1988). Pessimistic individuals had an increased likelihood of early death, and the large sample size made it possible to investigate associations between explanatory style and death from different causes. Although it was expected that death by cancer and cardiovascular disease would be especially linked to pessimistic thinking, it was found that pessimistic individuals were more likely to die accidental deaths. This effect was particularly pronounced for men. It is speculated that optimistic individuals may be more likely than pessimists to enter settings in which good things can and do happen.

2.5.8 How optimism works

First, Optimism is a source of motivation. It is easier to initiate action when it is believed that our actions will lead to positive outcomes. This is particularly important when a person faces obstacles that may tax his persistence. In face of disappointments, optimism energizes continued action, while pessimism may lead to giving up. The explanatory style of optimists offers one reason for these motivational benefits. By interpreting bad events as temporary and limited to specific situations, optimists protect themselves from strong negative emotional reactions that might undermine confidence and interfere with effective coping (Carver & Scheier, 2002). Optimism results in much better coping. Optimists are better at dealing with stress (Ness & Segerstrom, 2006). They are more likely to use active coping strategies aimed at confronting and solving problems. In a study on college students' adjustments to the stresses of college, Aspinwall and Taylor (1992) found that optimistic students set to work finding ways to deal directly with the challenges of attending class, preparing for exams, writing papers and developing new relationships. Studying, preparing for tests, talking with other students and planned use of time were among the active stress reducing approaches used by optimistic students. More pessimistic students tended to avoid problems by pretending they did not exist, wishfully thinking that they would somehow go away and reducing, rather than increasing social interaction with fellow students.

2.5.9 Why study optimism?

Before World War II, psychology had three distinct missions: curing mental illness, making the lives of people more productive and fulfilling, and identifying and nurturing high talent. Right after the war, two events – both economic – changed the face of psychology. In 1946, the veterans Administration was founded and thousands of psychologists found out that they could make a living treating mental illness. In 1947, the National Institute of Mental Health was founded and academics found out that they could get grants if research was about pathology. This resulted in huge strides in the understanding of and therapy for mental
illness. But the downside was that the other two fundamental missions of psychology were forgotten. Psychology’s empirical focus then shifted to assessing and curing individual suffering.

The positive psychology movement began to work on the other two missions of psychology. It reminded that psychology is also a study of strength and virtue, about work, education, insight, love, growth, play and building what is right. In the last decade, psychologists have increasingly become concerned about prevention of psychopathologies. It is realized that the disease model does not move us closer to the prevention of serious problems. Indeed, the major strides in prevention have largely come from a perspective focused on systematically building up competency, not correcting weakness. It has been realized that there are human strengths that act as buffers against mental illness: courage, hope, perseverance to name a few. Optimism is one of these strengths. It is found to effectively prevent depression and anxiety. It is a skill which can be built up by training and people can be taught about when to use it. Attributional training for optimism inoculates children against depression. Learned optimism training (Seligman, Reivich, Jaycox & Gillham, 1995) is designed to transform negative thinking into positive cognitive processes that promote flexible thought and resiliency. Here, the three components of explanatory style (i.e. permanence, pervasiveness and personalization) are modified with cognitive techniques so that people are able to respond in a healthier manner to both positive and negative outcomes of daily events. The evidence for this came from a study of 70 fifth and sixth grade students who were at risk for depression. These children were taught techniques for changing their style of explaining situations. In comparison with children in control group, the children who completed the learned optimism intervention experienced a significant decrease in depressive symptoms immediately following the study. In a 6 month follow up for 2 years subsequent to the training, children were half as likely to develop depression.

Benefits of sports participation are multifaceted. Practice of variety of traditional Indian sport appears to give all these benefits. Mallakhamb is a very artistic and very demanding sport, in terms of both, physical and psychological skills and it is important to document the benefits which are experienced by the participants in this sport. Thus, an attempt is made here to study Emotional Intelligence, Executive Function and Explanatory Style as a function of participation in competitive Mallakhamb.