

Chapter X

CO-ORDINATIVE ABILITIES

In the past, five motor abilities were recognised as components of physical fitness. These were strength, endurance, speed, flexibility and agility. But since one and a half decade the term agility has been gradually replaced by the term co-ordinative abilities (Martin 1979, Matweyew 1981, Hirtz 1985, Harre 1986, Meinel and Schnabel 1987). The reasons for this replacement are explained below:-

1. There was no agreement regarding the nature and definition of agility.
2. Though the term agility was used but it was explained as a complex of several coordinative abilities (Zaciorskij 1971, Hirtz 1973, Mattausch 1973, Meinel and Schnabel 1976). Different experts explained agility to be composed of a different number of coordinative abilities.
3. Because of lack of unanimity about the nature and definition of agility, it was difficult to adopt a uniform methodology to explore and study agility. It lead to considerable confusion and chaos.
4. It was difficult to provide a systematic and logical basis for the improvement of agility as it was not possible to clearly determine its nature and component factors.

It was increasingly felt that if the concept of agility can be discarded and replaced by the concept of co-ordinative abilities, it will be more scientific and practical and will help in clearing the confusion. Blume (1978) in his path breaking effort suggested that in place of agility there should be seven co-ordinative abilities which are important in sports. This will help in formulating the guidelines for improvement of each co-ordinative ability separately and will also help in better understanding of the role of co-ordinative factor in sports.

The theory of co-ordinative abilities is still in a stage of infancy. Though there is rapidly increasing acceptance of the term co-ordinative abilities yet there is no agreement regarding the number of co-ordinative abilities important for sports. The methodology of improving different co-ordinative abilities is also yet not available in full detail. But in the near future it is expected that a clear cut system of means and methods for improving each and every co-ordinative ability will be evolved.

Nature and Definition of Co-ordinative abilities

Co-ordinative abilities are primarily dependant on the motor control and regulation processes of CNS. The theory of motor co-ordination, therefore, is the basis for understanding the nature of co-ordinative abilities (Blume 1978, Meinel and Schnabel 1987). For each co-ordinative ability the motor control and regulation processes function in a definite manner. When a particular aspect of these functions is improved then the sportsman is in a better position to do a certain group of movements which for their execution depend on this type of CNS functioning pattern. This also explains the difference between a co-ordinative ability and motor skill. For a co-ordinative ability the control regulation processes are required to function in a particular manner whereas in case of a skill these processes are automatised to a great extent.

Motor co-ordination is a part and parcel of action regulation and is hence closely linked with the processes of regulation of cognitive, psychic (e.g., motive, drive etc) and movement execution aspects of an action. Hirtz (1985) and Meinel and Schnabel (1987) point out that these aspects of action regulation are important determinants of co-ordinative abilities. (See fig. 24)

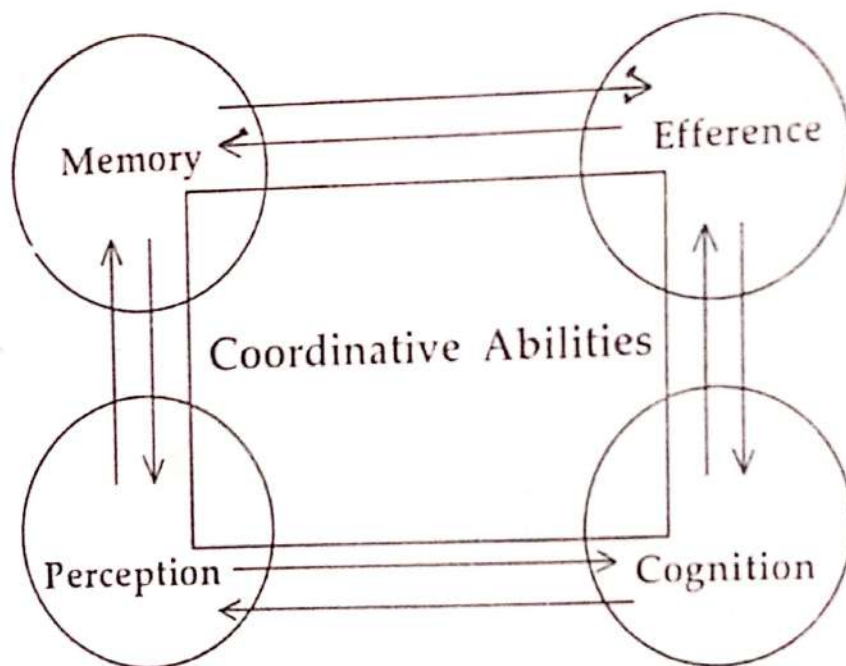


Fig. : 24 Factors Determining Co-ordinative Abilities

Co-ordinative abilities have also important and strong links with the motor skills as motor co-ordination forms the basis of both. Co-ordinative abilities become effective in movements only through the motor abilities and activity determined drives and cognitive processes (Hirtz 1985).

Because of the complex nature of Co-ordinative abilities, it is not easy to define co-ordinative abilities. On the basis of proposed definitions of Zimmermann (1983),

Hirtz (1985), Harre (1986) and Meinel and Schnabel (1987) the following definition is proposed:-

Co-ordinative abilities are understood as relatively stabilized and generalised patterns of motor control and regulation processes. These enable the sportsman to do a group of movements with better quality and effect.

Co-ordinative abilities should not be equated with motor skills, though both are interrelated and interdependent. Both are determined by the motor co-ordination process. The difference lies in the degree of generality of the co-ordinative processes. In a motor skill processes are largely automatised for the execution of a particular movement. In co-ordinative abilities these processes are just stabilised and perfected for the execution of a wide number of movements similar to each other. The learning of movements, however, has a positive effect on the co-ordinative abilities and vice-versa.

In the end the important characteristics of co-ordinative abilities are summarised in the following points:

1. The motor co-ordination processes form the basis of co-ordinative abilities. Hence co-ordinative abilities belong to the performance factor Technique/Co-ordination.
2. As the control and Regulation processes of motor co-ordination can only be influenced through the process of afference and reafference (i.e. feed back), therefore, the various sense organs involved in motor co-ordination are the necessary biological prerequisites for the improvement and perfection of co-ordinative abilities. The functional capacity of these sense organs determines the level of co-ordinative abilities to a great extent.
3. Co-ordinative abilities find expression in the quality of movement as well as in the ability to learn movements. The movements on the other hand are essential for the improvement of co-ordinative abilities.
4. Co-ordinative abilities always appear in a complex combination with one another as well as with the conditional abilities, and processes of will, cognition and other psychic factors involved in the process of action or behaviour regulation.
5. Co-ordinative abilities have general and specific aspects both.

Importance of Co-ordinative Abilities

Co-ordinative abilities are an expression of motor co-ordination which is of crucial importance in sports movements. The importance of co-ordinative abilities is discussed below in four points:-

1. The movement quality depends to a great extent on co-ordinative abilities. The rhythm, flow, accuracy, constancy, amplitude etc., of a

movement are expressions of motor co-ordination and hence highly dependent on co-ordinative abilities. In technical sports beautiful and graceful movements are a product of well developed technical skills and co-ordinative abilities.

2. ✓ The speed of learning of skill and its stability is directly dependent on the level of various co-ordinative abilities. Motor learning ability is a product of co-ordinative abilities. In all sports lesser or greater number of motor skills have to be learnt. Besides, the sportsmen are also required to learn the exercises needed for training and for recovery, relaxation etc. Well developed co-ordinative abilities, therefore, assume high importance in all sports. Their importance assumes very high significance in sports in which sportsmen are required to continuously keep learning more and more new movements with higher degree of difficulty e.g., gymnastics. The success of re-learning, frequently needed in many sports, depends on motor learning ability.
3. Co-ordinative abilities are also needed for maximal utilisation of conditional abilities, technical skills and tactical skills. Without the adequately developed co-ordinative abilities, a sportsman can not make maximum use of his psycho-biological capacities and reserves.
4. The co-ordinative abilities, to a great extent, determine the maximum limits to which sports performance can be improved in several sports especially the sports which depend largely on technical and tactical factors. Because of this reason assesment of co-ordinative abilities and the possibilities of their further development form an important part of the process of talent identification in sports.

Brief descriprion of Co-ordinative Abilites

In sports seven co-ordinative abilities are important. In different sports the relative importance of these abilities is, however, different.

I. Differentiation ability

It is the ability to achieve a high level of fine tuning or harmony of individual movement phases and body part movements. It finds expression in high degree of accuracy and movement economy. Differentiation ability depends on conscious and precise perception of temporal, dynamic and spatial parameters of movement execution and their comparison with the similar parameters of movement concept at different levels of control and regulation. The high level of differentiation ability depends on movement experience (i.e., motor memory) and the degree of mastery over motor action. It enables the sportsman to perceive micro-differences regarding the temporal, dynamic and spatial aspects of movement execution.

Differentiation ability is to be particularly stressed when the aim is to achieve high level of mastery over sports movements and their effective application in competition. High level of differentiation ability is expressed in different sports as a

feeling or sense of an implement or movement e.g., ball sense, movement sense, water feeling etc. The ability to execute highly skillful movements with hand, feet or head is also a special type of differentiation ability. Muscle relaxation ability is also a type of differentiation ability.

Differentiation ability appears in different forms in different sports as each sport puts different types of demands on the control and regulation processes. In gymnastics differentiation ability enables highly precise and accurate movements according to a given model of movement. In football it finds expression in dexterity of feet and head. In different sports, therefore, different means and methods should be adopted for the improvement of differentiation ability.

II. Orientation ability

It is the ability to determine and change the position and movements of the body in time and space in relation to a definite field of action (e.g., playing field, boxing ring, apparatus and/or a moving object (e.g., ball, opponent, partner). The perception of position and movement and the motor action to change the body position should be understood as a unity for the ability for space-time oriented movement regulation (Meinel and Schnabel 1987)

The demands on the orientation ability are vastly different in different sports e.g., team games, combat sports, technical sports. In gymnastics the position and movement of head and eyes is important for orientation. In wrestling, on the other hand, kinesthetic sense organs assume more importance for orientation. In team games vision, especially peripheral vision, is decisive for orientation.

III. Coupling ability

It is the ability to co-ordinate body part movements (e.g., movements of hand, feet, trunk etc.) with one another and in relation to a definite goal oriented whole body movement. Coupling ability is especially important in sports in which movements with a high degree of difficulty have to be done e.g., gymnastics, team games.

In a team game like football the foot movements for ball control or dribbling have to be coupled with the whole body movement of running, jumping etc. In gymnastics and also in wrestling the movements of hands, legs, trunk and head have to be successfully combined to achieve a certain goal. In sports, depending on the nature of activity, the movement coupling can be either successive or simultaneous.

The coupling ability primarily depends on the functional capacity of kinesthetic and optic sense organs. Orientation, differentiation and rhythm abilities are also closely related with the coupling ability.

IV. Reaction ability

It is the ability to react quickly and effectively to a signal. Reaction ability has been discussed in detail in the chapter on speed and hence it need not be discussed here again.

V. Balance ability

It is the ability to maintain balance during whole body movements and to regain balance quickly after the balance disturbing movements. Balance ability can be of two types :-

- (A). Ability to maintain balance during stationary position or slow movements (static balance). It depends primarily on kinesthetic, tactile and to some extent on vestibular sense organs.
- (B). Ability to maintain or regain balance during large range movements and during rapidly changing positions of the body. It depends primarily on the functional capacity of the vestibular sense organ.

Balance ability is a necessary prerequisite for all types of movements. Static balance is required for the execution of all movements whether slow or fast, part body movement or whole body movement. Static balance ability develops to a significant extent through various activities in childhood. Dynamic balance ability is important in sports in which frequent and rapid change of body position is required e.g., gymnastics, ski jump etc. In these sports the performance has positive relationship with dynamic balance.

VI. Rhythm ability

It is the ability to perceive the externally given rhythm and to reproduce it in motor action. It also denotes the ability to reproduce a rhythm, existing in motor memory, in motor action. In some technical sports like gymnastics, figure skating the sportsman has to perceive an external rhythm, given in the form of music, and to express it in his movements. In many sports rhythm is not given from outside. In these cases the sportsman has to make use of the rhythm stored in his motor memory. This is essential for effective motor learning as well as for high quality of movement execution.

The rhythm ability, like balance ability, is of fundamental importance in sports. This ability is not limited to the movement of the sportsman himself but extends to the perception of rhythm of other's movements also e.g., group rhythm. The ability to perceive the rhythm of movement of others is the basis for sound perception of technical errors by coaches. It also finds expression in the tendency to 'flow alongwith' the rhythm of some one else's action.

VII. Adaptation ability

It is the ability to adjust or completely change the movement programme during the movement on the basis of changes or anticipated changes in the situation. The situational changes may be expected ones or may suddenly take place. The movement adjustment in cyclic sports takes place primarily by the adjustment of the spatial, dynamic and temporal parameters of movement e.g., in running, cycling etc. This type of adjustment is possible when the changes in situation are not of large magnitude. But in team games and combat sports the changes in situation can be considerable enough to stop the movement and to start a new one.

The adaptation ability depends considerably on the speed and accuracy of perception of changes in situation. It also depends heavily on experience. For starting a new movement the sportsman must be able to select an alternative programme and to execute it without breaking the movement continuity. The adaptation ability is closely linked with reaction and orientation ability. The playing ability needed in team games depends heavily on adaptation ability.

Improvement of Co-ordinative Abilities

It is not possible here to discuss the improvement of all the seven co-ordinative abilities separately and in detail. In addition to the limitation of space, the unsatisfactory level of methodology for the improvement of these co-ordinative abilities is the principal reason for this. The principles for the formulation of training for coordinative abilities are presented below:-

I. The principal method is varied practice and the principal means are learnt physical exercises

In spite of the fact that co-ordinative abilities are determined by the control and regulation processes, the best method for effective development of these abilities is practising physical exercises. The control and regulation processes are the processes of motor co-ordination and hence are best affected by doing gross motor movements. The movements, however, should be practised with enough variation. For best effects the movements to be used should have already been learnt to a sufficient degree by the sportsman. Unlearnt movements cannot be used for the training of co-ordinative abilities. During practice the movement should be done with several variations. The more variable is the movement execution the more effective it is for the development of co-ordinative abilities.

II. General and Special exercises should be used

Each co-ordinative ability has a general and special aspect. In the initial stages general exercises for the development of general co-ordinative abilities should be dominantly used. But later on special exercises should be used more and more to ensure best effect for performance improvement in a sport. For example, for gymnasts in the beginning general balance exercises are to be used but later balance exercises on the balance beam are indispensable to develop the special balance ability needed in gymnastics.

III. The movements should be done correctly and consciously

The execution of movement is made possible by control and regulation processes. Incorrect execution of movement will force the control and regulation processes to take place differently and hence to give a different sort of sensations and feelings to a sportsman. As a result he forms wrong associations between movement image and movement sensations and consequently is unable to correctly grasp and understand the verbal instructions of the coach or the teacher. It is, therefore, essential that movement is executed correctly. Each time the movement is to be done it must be

done consciously with the required concentration. It enables the sportsman to consciously involve the psychic, volitional and cognitive processes in the control and regulation of the movement. As a result these are also positively affected by movement practice. The net result is more effective training.

IV. Additional means for improving motor sense organs should be used

The co-ordinative abilities depend heavily on the functional capacity of various sense organs e.g., optic, acoustic, tactile, kinesthetic and vestibular. The functional capacity of these organs can be improved by doing exercises during which the sportsman remains comparatively physically passive. For example, exercises to improve peripheral vision from sitting or standing position; exercises on the turn table to improve vestibular functional capacity; exercises to improve tactile or kinesthetic perception by use of various types and intensity of touch signals or through use of tensiometer or dynamometer respectively. These exercises, however, should be used as additional exercises only. These serve to improve only the functional capacity of motor sense organs which is only a part of the total control and regulation processes determining coordinative abilities. Improvement of the functional capacity of a single motor sense organ will have a positive effect on several co-ordinative abilities as each co-ordinative ability depends, to a lesser or greater extent, on several motor sense organs.

V. Accentuated development of co-ordinative abilities

A physical exercise always has a complex effect. It will lead to improvement of several conditional and co-ordinative abilities. For example typical obstacle runs or agility runs are good for improving a number of co-ordinative abilities alongwith speed and strength. But a faster and effective improvement of a coordinative ability is possible if the exercise is modified to ensure the improvement of a single co-ordinative ability. Therefore, it is advisable to devise special exercises to ensure effective development of each co-ordinative ability. Obstacle runs or agility runs, however, are effective when used with children as they ensure effective development of a number of co-ordinative abilities.

VI. There should be a rich variation of exercises

For the improvement of co-ordinative abilities a limited number of exercises do not give desired results. Each set of exercises have their effect for a certain period of time. Therefore, the exercises should be changed frequently. A rich and continuous variation of exercises used is of utmost importance to ensure continuous development. As a principle sportsman should be continuously doing new and unaccustomed exercises for best effect. The use of same exercises seriously limits the generalisation of control and regulation processes-the basis of coordinative abilities.

VII. There should be a systematic increase in the difficulty of Co-ordination

To ensure continuous improvement in co-ordinative abilities the degree of difficulty of physical exercises should be systematically increased. There are unlimited

possibilities of doing this. The important methods of increasing the degree of difficulty commonly used in sports are described below in brief :-

(A). Variation in movement execution

The variation in movement execution can be achieved by bringing some change in the phases of movement or changing the complete movement to some extent. The temporal and spatial parameters of movement execution are changed more frequently e.g., doing the movement with slower or faster rhythm, increasing the movement amplitude; change in the starting position or end position.

(B). Variation in external conditions

Here the possibilities are practically unlimited. The change in external conditions to increase degree of difficulty is frequently achieved by (a) changing the weight, size, shape or height of apparatus/implement/ball (b) changing the surface (c) changing the partner (d) changing the distance between the equipments, players etc. (e) changing the ground dimensions.

(C). Combination of movements

Combination of two or more movements is very frequently used to increase the difficulty of co-ordination. Movement combinations can be successive or simultaneous combinations. Most common movement combinations are running and jumping, catching and throwing, running and throwing, running and dribbling and so on. Combining three or more movements is also possible and that too with some task of accuracy e.g., running, jumping, turning in the air and shooting at a target.

(D). Change in Information uptake

The co-ordination performances depend on the information uptake and synthesis. The sportsman receives information about the movement from his different motor sense organs. If these pieces of information from the important sense organ/organs are reduced, changed or completely stopped then the degree of difficulty increases manifold. The possibility of using this method in sports training is, however, limited. But it can be done in some exercises e.g., practise before a mirror, exercising while looking up or with closed eyes.

(E). Practice against time

If the exercise is required to be done with high speed then the difficulty of co-ordination increases considerably. But, for effective use of this method the sportsman should use only those exercises the technique of which he has already mastered. For effective use of this method the exercises should be done against time. The decrease in the duration to complete the exercise indicates an improvement in co-ordination.

(F). Practice under fatigue

Fatigue, whether general or specific, has a deteriorating effect on motor co-ordination. Hence co-ordinative abilities training under conditions of fatigue can be

effective. But, like in the earlier method, only thoroughly learnt exercises should be used. According to this method exercises should be done after some sort of strenuous training e.g., endurance training.

Exercises can also be done after producing specific type of fatigue of some motor sense organ. For example balance exercises after doing several forward or backward rolls or after spinning around for few seconds. The forward/backward rolls or spins produce specific fatigue of vestibular sense organs thus making balance exercise far more difficult. Similarly, several maximal muscle contractions can be done to fatigue the kinesthetic sense organs which make exercises demanding high accuracy or precision much more difficult.

Table 24

Some Examples of Co-ordinative Abilities Exercises

Method	Examples of Exercise	Co-ordinative ability mainly affected
1. Variation in movement execution.	<ol style="list-style-type: none"> 1. Practise with opposite side, hand, foot. 2. Movement execution with changed rhythm. 3. Change in starting or end position. 4. Increasing/decreasing range of movement of one or more body parts. 	<ol style="list-style-type: none"> 1. Coupling. 2. Rhythm. 3. Adaptation. 4. Differentiation.
2. Variation in external Conditions.	<ol style="list-style-type: none"> 1. Change in the surface. 2. Change in ht, wt., size, shape, pressure of equipment/implement /ball. 3. Change of partner. 4. Change in area of supporting surface. 	<ol style="list-style-type: none"> 1. Adaptation. 2. Differentiation 3. Adaptation. 4. Balance.
3. Combination of movements.	<ol style="list-style-type: none"> 1. Running and throwing. 2. Catching and throwing. 3. Dribbling while pulling the opponent. 4. Dribbling with two balls. 5. Ball bouncing and walking on a balance beam. 	<ol style="list-style-type: none"> 1. Coupling. 2. Coupling. 3. Coupling, Adaptation. 4. Coupling. 5. Balance.

Method	Examples of Exercise	Co-ordinative ability mainly affected
4. Change in Information uptake	<ol style="list-style-type: none"> 1. Practise in front of mirror 2. Dribbling with eyes closed. 3. Catching/receiving without looking. 4. Exercises for peripheral vision. 	<ol style="list-style-type: none"> 1. Adaptation 2. Differentiation, orientation. 3. Orientation 4. Orientation.
5. Practice against time.	<ol style="list-style-type: none"> 1. Reaction exercises. 2. Agility runs. 3. Exercise on balance beam against time. 	<ol style="list-style-type: none"> 1. Reaction 2. Complex effect 3. Balance
6. Practice under fatigue	<ol style="list-style-type: none"> 1. Balance exercise after several spins. 2. High accuracy exercise after strength exercise 3. Any co-ordinative ability exercise after hard training. 	<ol style="list-style-type: none"> 1. Balance 2. Differentiation. 3. Depends on the nature of exercise.