

A COMPARISON OF THE LEARNING
AND PERFORMANCE EFFECTS OF TWO
TECHNIQUES FOR TEACHING AN
ATHLETIC THROWING SKILL TO
ADOLESCENT BOYS.

by

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"And when on summer evenings from
hamlet and from hill,
The gallant Gaelic peasants pour to test
their strength and skill,
Where every rival mark o'er passed, the
verdant sod is torn,
Big Ned O'Grady's giant cast has long the
record borne."

James P. Kelly

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ABSTRACT

A comparison of the learning and performance effects of two techniques for teaching an athletic throwing skill to adolescent boys.

by

William Raymond Tancred.

The purpose of this investigation was to determine the relative effectiveness of two standard methods of learning and performing the shot putt among adolescent boys. It is commonly held that the O'Brien method of shot putting should be taught after the introduction of the 'step-back' method.

In the more complex O'Brien method, balance and strength seem to be important factors for effective learning and performance, whereas the 'step-back' method appears not to require the same degree of strength, balance and co-ordination, and is apparently easier to learn.

Ninety fourteen year old boys from a Nottingham school were randomly assigned to one of three groups, two of which were experimental groups and one a control group. The two experimental groups followed alternative learning and performance schedules according to either the O'Brien or the 'step-back' methods for a total of forty sessions. The schedule of learning and performance was divided into three stages. At the completion of each stage, a short weight training programme was interposed. Also included in the investigation for Stage 1 only, were one hundred and eighty schoolboys from Ipswich and Loughborough, all of whom were

treated in the same way as the Nottingham Schoolboys.

Two related but minor issues were investigated in the Nottingham school. In the first place, the opportunity was taken to collect further information pertinent to the relationship of body type (somatotype) to shot putt performance among boys. Secondly, the attitude of the subjects to sport in general.

The results indicate that in the learning phase the 'step-back' method is more effective, being easier to learn, gives essential earlier rewards and it is for this reason that the 'step-back' method is recommended by the investigator, when teaching in the initial stages of shot putting at school-boy level.

In the later performance stage the O'Brien method, capitalising on the power and strength of the individuals is to be preferred, because the subjects could apply better power from their added strength, to a mechanically efficient technique.

From the results of the attitude tests, it shows quite positively that all groups favoured physical activity for health and fitness and conversely, at the lower end of the scale, their choice was physical activity as games of chance.

The body type (somatotype) of the best shot putt performers were very similar to that of international standard shot putters, in that weight men tended to be high in mesomorphy and fell into the general classification of endomorphic mesomorphic range.

It is concluded that the 'step-back' method should be introduced immediately in the teaching of shot putting in schools, so that every schoolboy has the chance to perform at a reasonable level, not only in its simplicity of action, but throwing distance achieved. Only when strength is gained from some activity like weight training, should teachers of physical education encourage the O'Brien method. There is, after all, some transfer of training from the 'step-back' to the O'Brien methods of shot putting.

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CHAPTER 1

INTRODUCTION

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A teacher gains in coaching knowledge in proportion to his willingness to pay for it in hard study and careful thought. Perusal of a few neatly drawn illustrations of good technique with concise captions, such as might appear in a small book, may give one the illusion of knowing 'just how to do it'. Or again, to present a single point of view or a 'one best way' of performance in a few short paragraphs, neatly digested from the broad background and the understanding of a writer, may deceive the reader into believing that he too now has a similar background and understanding.

But this is all to little avail when the teacher goes on the field and listens to the implied or outspoken "WHY" of his most promising prospects. Now he needs a 'muscle and nerve' knowledge of things. Also, he requires the understanding of what present champions are doing, of why other teachers and athletes have discarded certain techniques and persisted in others, and of why his own teaching methods are best for this particular situation and for this particular boy. There is no easy way to such knowledge, and to assume otherwise is deliberately to deceive those in or intending to enter the teaching profession.

A second and similar assumption of this study is that the learning athletes as well as the coach need certain background knowledge, if they are to learn quickly and well. The validity of this assumption has been proved time and again in motor-learning experiments conducted for industry and education. Simple repetition of an action, without understanding of its HOW or WHY,

is a slow method of learning. But such repetition, supported by understanding and by the insight that comes from both speeds learning greatly.

After all, a teacher is an integral member of an educational institution and his best service does not lie in spoon-feeding his shot putters, in making all their decisions, or in doing their serious thinking for them. Rather his job is primarily to provide inspiration and adequate opportunity. Increasingly, as the members of his team move towards graduation, they should become independent of his leadership and coaching, and develop their own understanding and opinions. Much of the material here is presented with just this outcome in mind.

The aims of physical education cover a multitude of areas. One aim concerns itself with developing organic vigor and neuromuscular skills in the individual; another places significance upon self-expression and an opportunity for one to develop his own unique abilities.

Each activity, in order to develop organic potency and neuromuscular control, must involve basic body movements which are fundamental to our field. Glassow (1932) classifies these movements as:

1. Moving the body from one place to another.
2. Moving other objects by strength of the body.
3. Maintaining equilibrium of the body.
4. Stopping objects which are moving.

An activity that is often neglected in the physical education programme is track and field athletics. It not only contributes to the efficiency of the basic body movements more than any other activity, but it also permits one to develop self-expression and

individual uniqueness. This is evident when one looks at the composition of its events.

In a boy of a particular body build, a track and field event can be found which can utilise his particular attributes and can be further developed by the student to his success and satisfaction. For example, the sprints (50 yards, 100 yards and 220 yards) develop in the boy with long legs and narrow hips, speed, body control, and quick reaction time.

The long jump will develop poise in a sprinter plus a kinesthetic sense, whereas the high jump can achieve these attributes in the tall, awkward, and slow boy. In other field events we find a place for the short or tall, heavily built boy. From the shot putt and discus he develops grace, poise, body control kinesthetic perception, speed and agility.

Through the proper presentation of track and field, the movement potentials of each boy can be attained; and each boy, regardless of his limitations, can choose some event in which he can find recognition and a feeling of accomplishment.

For years, young physical educationists have come into teaching using as their code of reference the 'O'Brien' technique, the 'straddle' and the 'Hitch-kick'. The theory had to be unloaded on someone and children were the unfortunate recipients. This is not to say that the 'O'Brien' method of putting the shot is not the best technique yet discovered for this event. What is questioned is that this is necessarily the best technique for children in the class situation, and the same doubt can easily be expressed about almost all adult techniques. This is simply because these techniques were devised for and used by, trained athletes, athletes with the time, facilities and ability to perform them and profit by them. To attempt to graft these advanced

techniques on to children in the class-situation is almost invariably doomed to failure, as these techniques bear the same relationship to realistic class techniques as a double front somersault in gymnastics bears to a forward roll.

The teacher has plenty to teach before considering these advanced techniques. He has to teach what athletics is about and to teach realistic skills within the capabilities of his pupils as opposed to those more suited to trained athletes.

Track and field athletics is a minority sport in Britain. That is the situation despite the very great amount of technical knowledge that teachers have absorbed and passed on since the British Amateur Athletic Board initiated its coaching scheme. The sad truth is that very many boys and girls have rejected or abandoned athletics because they have not enjoyed it, and have not had a sense of achievement in it.

Every boy and girl must be given athletic tasks which they can do and from which they can derive satisfaction.

The shot putt event is a segment of track and field; consequently, it is not probable that the teacher will take the time to analyse the various styles to determine which will be more easily learned by his class. He might choose the style of the most recent champion and ignore other possible styles.

At local and national athletic meetings, one can see boys using the O'Brien method and others using the new discus type (spiral) technique for releasing the shot. Boys who have used the O'Brien style were quickly switched to the discus type technique, immediately after Oldfield (1975) broke the world professional record with a phenomenal 75 foot putt. A teacher

is not adequately analysing a method if he selects it merely because the person who holds the world's record uses it.

It is the investigator's hope that the teacher of a physical education class of track and field athletics for schoolboys will not merely teach the shot-putting style of the most recent champion, but will select the method most easily learned. It is hoped that this study will be of help to the teachers of this subject. Thus, he will better utilise the potentials of each member of the class and be able to fulfil other objectives that he might have, such as:-

1. A sense of accomplishment on the part of the boy.
2. A development of greater strength.
3. An increase of agility and co-ordination.
4. A greater mental concentration.

As there are many events in track and field, the physical educator is interested in the style which can best achieve these objectives for boys, but will not require extensive training and a great deal of time to accomplish them.

The method for shot putting which is commonly held to be the easiest to learn is that of the 'step-back' method, because it did not appear to require the same degree of strength, balance and co-ordination when compared to the O'Brien method which seemed more complex in the learning stages of the event.

The previous information sets up in our minds the problem to be solved in this thesis: Can the 'step-back' method or that of O'Brien be more easily learned by adolescent boys in a physical education class.

CHAPTER 2

AIM OF INVESTIGATION

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The purpose of this investigation was to determine the relative effectiveness of two standard methods of learning and performing the shot putt among adolescent boys.

Ninety, fourteen year old boys from a comprehensive school in Nottingham were randomly assigned to one of three groups, two of which were experimental groups following alternative learning and performance schedules according to either the O'Brien or 'Step-back' methods for a total of forty sessions. The schedule of learning and performance was divided into three stages. At the completion of each stage, a short weight training programme was interposed. Also included in the investigation for stage one only, were one hundred and eighty schoolboys from Ipswich and Loughborough, all of whom were treated in the same way as the Nottingham schoolboys.

Two related, but minor issues were investigated in the Nottingham school. In the first place, the opportunity was taken to collect further information pertinent to the relationship of body type (somatotype) to shot putt performance among boys. Secondly, the attitude of the subject to sport in general.

There is a psychological implication in this investigation. The interest of students in a physical education class can grow with increasing skill. If the style is too complicated the student will lose interest and become frustrated in attempting the skill. It is noted, when attempting a comparative analysis on the two methods concerned, that the step-back method has

fewer neuromotor components than the 'O'Brien' method, therefore it is less complex. As a result of this, the step-back method may possibly be learned with greater ease.

Hypotheses

Four hypotheses were tested, the first two being major ones and the latter two, minor ones. They were as follows:

1. There is a difference in the learning phase, that the step-back method is more effective than the O'Brien method, being easier to learn and gives better earlier rewards in distance thrown.
2. In the later performance stage, the O'Brien method, capitalising on the power and strength of the individuals is to be preferred because the subjects could apply better power from their added strength to a mechanically efficient technique.
3. The attitudes of the boys favoured physical education and recreation in a positive manner.
4. The body type (somatotype) of the better performers in the shot putt event tended to be high in mesomorphy and fell into the general classification of the endomorphic-meso-morphic range.

CHAPTER 3

REVIEW OF LITERATURE

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REVIEW OF LITERATURE

1. Technique Difference in Teaching the Shot

The most common method for introducing the shot event to school children is the O'Brien technique. Data on other methods can be found which have been primarily investigated in the U.S.A. but they are very scanty. Aussprung (1967) used two equated groups of 24 boys, 14 and 15 years of age, who putt the shot three times per week for four weeks. The groups were equated according to such individual factors as age, height, weight and standing putting distance. Each group was taught a different method of crossing the circle, prior to putting the shot: the Powell (side on) method and the traditional or O'Brien style method. Results showed in general, little difference between the groups in shot putting performance.

Pecchia and Grenfel (1955) used a top athlete to experiment with what they call the Drag-step-half-spin. Results showed that this new method was superior to the Fuch technique (side-on). Thompson (1959) compared the suitability of two shot putt styles for high school girls and found the side on (Fonville) style favoured them more than the accepted technique (O'Brien method).

Launder (1967) used the step-back technique in an attempt to eliminate the back glide in its hopping form. It appeared to have little advantage over the current technique especially at international standard.

Miller (1965) conducted an experiment in teaching shot putting. He randomly chose three physical education classes of

25 boys in each. He put them into three groups namely Group 1, (accepted technique), Group 2 (natural method), and Group 3, (control group). To each group he taught physical education for one hour daily, five times each week for three consecutive weeks. Initially each group was tested putting the 12 lbs. shot from a regulation circle but without instruction six times, and the best putt in each case was measured. At the end of the first, second and third weeks each member of each group was given six putts and each best distance recorded; Group 1 was taught and practised the O'Brien method (accepted technique) and was coached in it five periods each week as the physical education lesson. Group 2 was taught and practised the (natural method) step-back, and was coached in it five periods each week and Group 3 (control group) was given tumbling and strenuous calisthenics for the same period of time - but (except for the last four tests) took no part in shot putting. Results showed that Group 2 made the most progress followed by Group 1, and then Group 3.

The investigator felt that further research would be required to determine whether the O'Brien method or step-back method, was easier to learn in the 14 year old novice schoolboy, and it was for this reason that this investigation was to take place.

2. Mechanical factors Affecting the Learning and Performance of Skill.

A skill can be performed with a great deal of skill or with a little skill. Guthrie (1952) defines skill "as the learned ability to bring about predetermined results with maximum certainty, often with the minimum outlay of time or energy or both.

Learning has been defined by Gagne and Fleishman (1959) as the internal neural process assumed to occur whenever a change

in performance, not due to growth or fatigue, exhibits itself.

Within the past decade there has been a surge of interest in human movement in several professions which deal in the development of effective and efficient motor performance and it is felt therefore, to include just some of the literature for this chapter under sub-divisions of mechanics and psychological factors affecting the learning and performance of skill.

(A) Weight Training

Weight lifting is practised for three or four different reasons. Some individuals participate in this highly specialised form of physical activity because body-building is their objective. To these the size of the skeletal muscles is of paramount importance. The aim of the body builder is the attainment of a symmetrical hypertrophy of all muscle groups capable of being subjected to maximal shortening against heavy resistance. The training programme usually also develops skill in the ability to contract individual muscles at will. Both of the qualities can be augmented to an inordinate degree.

Other proponents of the sport are concerned only with the development of strength for competitive purposes. Presumably, the two forms of weight lifting are not identical. Indeed, much has been made of their differences, for example by MacQueen (1954). However, these may be more apparent than real; from the physiological point of view, both systems have much in common.

Weight lifting is also used as a form of conditioning exercise for maintaining or improving physical fitness, or increasing athletic power in general. Capen (1950) and Chui (1950) prefer to call this form of systematic exercise with bar-bells and dumbbells 'weight training' rather than 'weight lifting'. Its

chief virtue lies in the fact that quite severe exercise can be performed with comparatively simple equipment in short intervals of time.

Weight lifting of all types demands widespread equilibrating postural adjustments and the contraction of synergic and stabilising muscle groups as well as those subjected to direct training. The activity lends itself readily to systematic progression in the demands made on particular muscle groups *pari passu* with improvement in strength and endurance. Self-testing is an integral part of all weight lifting programmes. For many individuals genuinely interested in their physical status, this is a powerful motivational force because appreciable progress follows when the workout is hard enough to introduce some stress. Bannister (1954) points out that the body reacts to moderate stress by an improvement in stamina. Thus, as the weight lifter becomes inured gradually to the discomforts associated with stresses intermittently and voluntarily imposed, previous levels of strength power, and endurance are surpassed.

Athletes specialising in many different sports use weight lifting either as a form of conditioning exercise or as a means of augmenting the strength of particular muscle groups important to a high level of performance in their major activity. A summary of a few of the innumerable reports on weight-training is given here.

Hook (1959) conducted a number of experiments at Wake Forest College, that show a high correlation between strength and the throwing and hitting at a baseball. He uses a weight-training routine beginning six weeks before outdoor practice is started. Wickstrom (1959) studied the effect of a post season programme

of weight training exercise upon jumping ability. The players who participated in the experiment had followed a pre-season routine similar to that used and suggested by O'Connor and Sills (1956). The results of the post season programme were gratifying since the average increment for the players who participated, was one and one-half inches. O'Connor and Sills (1956) found that weight training was not only an important factor in respect to jumping ability, but also a favourable influence upon the players ability to take care of himself under the basket.

Neumann (1959), a football coach at the University of New Mexico, developed a mimeographed manual outlining a weight training programme and other pertinent information regarding over-all conditioning for football players. In addition to the physiological benefits of weight training. Neumann (1959) states the psychological effect of a player being measurably stronger, and more powerful is a significant attribute to his playing ability. Dietzel (1959) states that "...regardless of the programme presented, satisfactory results will not follow unless the individual has the tenacity to stay with the programme religiously.."

Coker (1960) says "...a pole vaulter can improve much faster through weight training..". Seven of his vaulters who cleared over fourteen feet in college, showed an average gain of one foot eleven inches. This improvement was attributed to improved vaulting techniques and the very important factor of weight training. In his article Coker (1960) presents a routine of exercises for the athlete who wishes to improve his performance in the pole vault.

Tuppeny (1959) makes the following statement - "... as I strove to become a better coach, the trail led to interviews with many

top athletes and coaches and wide reading on the subject. Slowly but undeniably it led me to believe that weights in all sports is a must..."

Councilman (1958) selected a few heavy-weight exercises which he considered of prime importance in the propulsive phase of swimming strokes. He, however, emphasised that caution must be exercised in using weights since muscle hypertrophy may become a handicap. Casidy, Allen and Sills (1959) prepared a set of weight training exercises for swimmers, whose events were analysed kinesiologically and specific exercises were recommended, so that improvement in performance could be made.

Under Wender's (1955) direction, a study was made to determine the effect of increased upper extremity and shoulder girdle strength on the velocity of a thrown baseball. The weight training period lasted twelve weeks, with tri-weekly workouts. There were twelve subjects in Group A, which was the weight training group, and ten subjects in Group B, the non-weight training group. The gain in velocity of a thrown baseball for Group A over Group B, was 7.5%. The average velocity of Group A increased 13.7%, while the average velocity for Group B increased only 6.2%.

Group B practised the activities that are normally used in baseball, such as running, throwing and batting, while Group A also executed the pull-over, forearm press, wrist curl, supine lateral raise, and sit-up. For all exercises, enough weight was selected so that the maximum effort was limited to less than ten movements. When ten lifts were executed, more weight was added at the subsequent exercise period.

Keller (1952) conducted a study to determine the effect of weight training upon performance in the high jump. The subjects were eight boys. Following eight weeks of intensive lifting, three times each week, the average increment for the eight boys was three and one half inches.

From 1946 to 1965 there were more than a dozen studies conducted at the State University of Iowa, regarding methods of developing strength, and the effect of strength development upon athletics performance. To mention a few, Allen (1954), Capen (1950), Chui (1950), Garth (1954) and Keller (1953) reported that weight training had a desirable effect upon physical performance; Asprey (1960), Larson (1953), Pickford (1955), Reede (1960), Sills (1957) and Murray (1965) reported that weight training was effective in the prevention and treatment of injuries commonly incurred through participation in athletics.

Pitman (1960) studied the effect of a weight training programme on 40 junior high school boys. They participated in the programme two days a week for a period of six months. Thirty seven boys served as control. Test items consisted of the Junior A.A.U. Physical Fitness Tests, anthropometric measurements and the California Test of Personality, Intermediate Form A.A. The experimental group registered a significant difference of the 5% level over the control group in anthropometric measurements and in five of the six physical fitness tests. No significant improvement was found in the personality test. Only one injury occurred during 1,824 exposures to weight training.

Unmacht (1959) experimented with forty-five members in a physical education class who were matched on the basis of height and weight and divided into weight training, shot putting, and

control groups. Eight-, 10-, and 12- pound shots were used in testing shot putting ability. Each subject had a higher final than initial score. The individual gains varied from 11 inches in the 8- pound shot putt (control group) to 10 feet 6 inches, in the 12- pound shot putt (weight training group). From the results it appeared that in conditioning junior high school boys for the shot putt, extensive practice in shot putting or weight training was more effective. Woodward (1959) concluded in his study of progressive weight training in physical education that progressive weight training when added to a physical education programme, significantly aided development of high school boys in strength, endurance, reaction time, and balance. This was also stated in studies by Harper (1960), Woodall (1960), Berger (1960), Campbell (1960) and Kelly (1960).

Edelstein (1964) used two groups of high school students matched on strength and body build, exercised the muscles of the upper right arm with weights daily or on alternate days for 6 weeks. The strength and girth of the exercised arm increased in both groups and the adipose tissue decreased, but the final mean differences were not significant.

Rallis (1965) compared three training programmes and their effects on five physical fitness components with 11 boys, participating in physical education. The following conclusions were based on significant t ratios: weight training was superior to regular physical education for improving muscle power and endurance of the arms and legs; isometric training was superior to the other programmes for improving muscle power and endurance of the arms.

Airington (1968) used three pairs of male twins with at least one year of shot putting experience, who were divided randomly into a weight training group and a shot putt training group. After an eight week training period, the shot putt training group had not improved significantly in strength or shot putt distance. The weight training group increased significantly on only one strength measure (elbow extension), but improved significantly in shot putt distance over their counterparts, even though they had not trained with the shot for the entire eight week period. Leach (1972) studied the effect of an eight week weight training programme upon leg strength and running speed in middle-school-age boys. His results indicated that the experimental group using weight training was superior in leg strength but there was no difference between the groups in running speed.

The preceding review of literature clearly indicates that weight training exercises have proven effective, in the conditioning and improvement in strength of athletes. The wide acceptance of weight training relating to many different sports is indicated by the recommendation for training schedules that have been proposed by outstanding coaches and by the research workers in the field of physical education.

The O'Brien method was employed by athletes who participated in weight training regularly and the investigator felt that the step-back method at school boy level, gave better earlier results. Only when weight training was applied, at school boy level the O'Brien method would prove the greater applicability in the performance of this event.

B) Somatotype

The American essayist Oliver Wendell Holmes, who was also Professor of Anatomy and Physiology at Harvard University from 1847 to 1882, once wrote - "... The outward form the inward man reveal, we guess the pulp before we cut the peel.." Indeed popular notions about the correlation between physical characteristics and personality can be found throughout recorded history (Rees 1965).

Theories that suggest a relation between physique and behaviour, antedate by many centuries the birth of academic psychology. The individual who is generally credited with having begun work in this area is Hippocrates (400 B.C.), who suggested a typology of physique as well as a temperament typology and a conception of humors that is highly congruent with the current emphasis upon the importance of endocrine secretions as determinants of behaviour (Hoskins 1941). Hippocrates designated two fundamental body 'types', the 'phthisic habitus' and the 'apoplectic habitus'. These were contrasting types, the former, with a narrow physique, was considered to be susceptible to tuberculosis, and the latter of broader stature, was thought to carry a pre-disposition to cardiovascular malfunctions.

It seems that in earlier years the physique mentality and behaviour of an individual were tacitly assumed to be related (Rees 1965) and certainly amongst artists and scholars, this tradition appears to have been perpetuated.

"Let me have men about me that are fat,
Sleek headed men, and such as sleep o' nights:
Yon Cassius has a lean and hungry look:
He thinks too much: Such men are dangerous".

The dichotomy suggested by Hippocrates formed in fact, the basic for the well known modern conceptions of asthenic and pyknic types as described by Kretschmer (1921).

However, a century earlier Rostan (1828) published a famous treatise in which he described three essentially different types of physical constitution, the type digestif, type musculaire, and type cerebral, the idea having first been introduced by another Frenchman, Halle in 1797.

The Italian physician, di Giovanni and his pupil Viola (1909) carried out extensive measurements of the body and classified individuals by means of combinations of certain body measurements. The school di Giovanni founded developed the hypothesis that differences in physique were due to differential development of trunk and limbs. They described a microsplachnic type with small thick trunk and relatively long limbs, a macrosplachnic type with large trunk and relatively short limbs, and a normosplachnic, merely an intermediate variation, each of the type being defined in terms of Viola's 'morphological index'.

A great impetus to research was given by Kretschmer (1921). He described relationships between different types of physiques and predispositions to different psychiatric illnesses. He considered that there was a biological association between manic-depressive illness and broad, body build, whereas schizophrenia was associated with a narrow physique. He also extended his theory to include the relationship between physique and normal personality types. Unfortunately his classification of physical types had the disadvantage of being based mainly on impression with a minimum of physical measurements (Rees 1965).

Sheldon et al (1940) elaborated on Kretschmer (1921) observations by attempting to classify 4000 university men students

on the basis of Kretschmer typology. They found that it was only possible to classify 12% as athletic, 9% as Asthenic and 7% as Pyknic. The remaining 72% appeared to be mixtures. Sheldon et al (1940) rejected Kretschmer's (1921) terminology, maintaining that his types were not examples of polar types, but rather extreme combinations of 3 distinguishable variations of body build. These three dimensions consequently became the core of the method for 'rating' physical structure.

The first component was endomorph - endomorphy, according to Sheldon means relative predominance of softness throughout the various regions of the body. When endomorphy is dominant in a physique, the digestive viscera are highly developed, and the fact that the functional elements of those structures develop primarily from the endodermal embryonic layer, accounts for the use of the term endomorphy.

The second component was mesomorph. A physique heavily developed in this component and showing a decrement in both the other components, is hard and rectangular, with a predominance of bone and muscle. The mesomorphic body is generally equipped for strenuous and exacting physical demands. The dominant portions of this physique develop primarily from the mesodermic embryonic layer, hence the term mesomorphy.

The third component was labelled ectomorph, and means a relative predominance of linearity and fragility, characterised by flatness of the chest and delicacy of the body. The ectomorph is usually thin and lightly muscled. Relative to his mass, he has more surface area than the other types of physique and also has the largest brain and central nervous system in proportion to his size; his bodily economy is relatively dominated by tissues derived from the ectodermal embryonic layer.

The somatotype then is the patterning of the primary components of physique as expressed by three numerals, as a result of assessing a photograph and measuring seventeen photographic diameters which yield ratio indices. The first of these numerals always refers to endomorphy, the second to mesomorphy, and the third to ectomorphy. The numerals range from 1 to 7 representing the absolute minimum of the component and the highest possible amount.

The problem of correlating physique has therefore been diligently pursued by a number of researchers, but perhaps the most revealing literature on the topic has been that by R.W. Parnell, who was Research Physician in the Constitutional Aspects of Psychiatric Medicine, at the Warneford Hospital, Oxford.

However, in trying to appraise physique he introduced a new method of somatotyping by introducing his M.4. Standard Deviation Chart. He was openly critical of Sheldon's method of somatotyping, suggesting that amongst other things, the technique was too subjective, too costly and far too tedious (Parnell 1954).

In his specially constructed standard deviation chart, there appeared standard scales for height, weight, and the ratio index; standard scales for two bone sizes, the bicondylar measurements of the humerus, and femur, for two limb girths around the biceps and calf muscles, and the three measurements of the subcutaneous fat and the total of these three measurements. The scales were plotted around the mean value taken from a large population and each column interval was equivalent to one half standard deviation. This resulted in a thirteen point scale. On these tables the appropriate value for each parameter was ringed and this resulted

in a profile which revealed the main characteristics of dominance in the physique. A set of tables was then required to assess and interpret the profile and to provide a more exact estimate of dominance. However, this latter problem was overcome by Parnell by refining his deviation chart so that the estimate of somatotype could be made directly from it.

Although his aim was to correspond as closely with Sheldon's (1940) estimate of somatotype (not technique), the components on the M.L. chart were termed Fat, Muscularity, and +Linearity in place of Sheldon's endomorphy, mesomorphy and ectomorphy. In using F.M.L. ratings, primary dominance was indicated by capital letters, secondary dominance by small letters, for example Fm in terms of Sheldon's estimate would be a dominant endomorphic component followed by secondary dominance in mesomorphy.

Harronian and Sugerman (1964) compared Sheldon's and Parnell's method on a sample of 102 normal male university students and found significant differences between all three pairs of somatotype components. They also drew attention to the merit of using a photograph in certain cases when somatotyping. For there is no other way of recognising dysplasia, other than resorting to the anthroposcopic method. Damon (1962) points out that errors in assessing skinfolds can be reduced also. For in coloured people the connective and elastic tissues binding the skin and subcutaneous fat to the underlying fascia is far tighter.

The Parnell method has been shown to read low in its estimates for mesomorphy. Because in the correction for fat in this component a high fat reading will give an ambiguously low second component reading. Harronian and Sugerman (1964) reported that it read on average one point low.

Heath and Carter (1966) compared Parnell's phenotype and Heath's method, and report a high degree of agreement between these methods.

Heath and Carter (1967) produced a modified somatotype method because they felt that Parnell's method "failed to modify the basic weaknesses of Sheldon's method ". They used a large mixed sample of ages 14 - 70 yrs and dispensed with the need for correction of age in their first component tables. For the second component he moved all of the height values in the table 1. column to the left, effecting a half point increase in mesomorphy.

Research into physical activity shows that most of those who took strenuous exercise were well equipped to do so. They fall mainly in sector M (mesomorphic) but it is noticeable that central linear types are commonly athletic too. Where Muscularity is rated less than 3, participation in sport becomes much less common, participation in rougher contact sports rare. (Oxnard 1953).

To state that physical strength depends on size and musculature may be an over-simplification, but it is not a big one, and it is surprising to realise how long it has taken research workers to demonstrate the truth. French anthropologists some 250 years ago started to use dynamometers to measure strength. Yet it is nearly true to say that the physical features underlying strength have been but half understood, in the sense that co-efficients of correlation between them and dynamometric measures have usually been about 0.3 and 0.5. In more recent work, for example Cureton (1957), special attention has been paid to body structure. Yet in Cureton's comprehensive account, there is a curious omission to single out height, as the important factor that it is, in contrast to the earlier anthropologists who correlated strength

with height and weight to the exclusion of structure. Jones (1957) showed with data from 80 schoolboys in California that 75% of the variance of their strength was controlled when muscularity was combined with measurement of size by height and weight. It has also been possible to demonstrate the influence of height and structure among healthy students (Moore 1955) using a dynamometer for lumbar pull, together with height, weight and skinfold fat measurements. Height was used as the measure of size but also in a two-dimensional classification of body structure in which fat measurements are plotted against the ponderal index (height in inches divided by the cube root of 3). Low fat scores combined with a low ponderal index (that is proportionately great weight for height) give the clue to muscularity and no more simple or straightforward use of these few measurements seems possible.

Athletic ability demands physical strength and it is interesting therefore, to note that in a study of Oxford University athletes (Oxnard 1951), all groups of athletes, whether sprinters, long distance runners, jumpers or throwers were taller than a group of 297 men (average 69.9 inches) of two colleges taken for comparison. The legs of the athletes were also longer. It seems that length of limb matters to an athlete, and it seems likely that the length of leverage as well as actual muscle bulk contribute to strength. If this is so, there is a conflict in characteristics, for extreme M types, such as 'Mr Universe' competitors, are shorter in average height (66 inches) and in spite of muscle bulk enhanced by weight lifting and progressive resistance exercises, may only occasionally reach top-class

performance in athletic events other than weight lifting or heavy field sports. Oxnard (1953) tested for strength, 550 male students comprising the entry to Birmingham University and found that the strongest lumbar pulls were exerted by M types, but it was noticeable that near central linear builds were again well represented, as they were found among those fond of strenuous exercise, indeed the whole distribution looked similar.

Oxnard (1953) and Tanner (1952) found that the greatest concentration of the best performers with the discus and shot were near types of 451, 461, 452, and 362. Men hereabouts reached distances of 47 feet with the shot and over 130 feet with the discus. To reach more than 150 feet with the javelin it seems more linearity of build may be required, and the median build for this event is near type 353.

Finally, Tanner (1964) stated that the shot putters tended to be high in mesomorphy and fell into the general classification of endomorphic - mesomorphic. Steven's and Tucker (1949) quote "...The body of the 353 is powerful and highly muscular but falls short of the extremely massive mesomorphic 6s. In youth the 353 belongs distinctly in the slender class. He is probably well the most common high school and college athlete..."

It was felt therefore that a minor related issue of this investigation, that of somatotype should be investigated to see whether any correlation existed between shot putting performance and body type at schoolboy level.

3. Psychological Factors affecting the learning and performance of skill.

The teacher is primarily concerned with learning, its mechanisms and function, its retention and transfer. The process of learning is still extremely complex. Although a tremendous amount of investigation has taken place, the area is complicated by numerous theories, counter-theories and postulations, each supported by a particular volume of research. One reason is the difficulty in controlling the many variables that influence the learning process, and isolating the experimental material.

The other problem is the hiatus between psychologists and teacher, some educators indicate that the learning process is the province of the psychologist, as opposed to the teacher, who merely exploits techniques and situations. They do not, however disprove that the teacher may expand his knowledge of techniques through an understanding of learning mechanisms. Another section of the educational community belittle the efforts of the psychologist; they emphasise the disparity between principle and practice, experimental situations and teaching realities.

Physical education reflects this conflict in learning. In its drive for academic status and recognition, it has tried to equate this conflict. As such, it has typified the bewildering array of theories of learning that currently enter vogue, before being dismissed in favour of another. This is particularly true in respect of teaching methods, distribution of practice, motivation and the acquisition of skill. The individuality of learning a skill, a paramount feature in numerous investigations, has tended to confound the scene still further, presenting variables which resist immediate or definitive solutions.

Considered in the widest sense the utility of learning theories to the teacher cannot be doubted. Teachers do operate on this basis - academic or empirical, or both. The ambient learning environment itself may form the basis of learning procedures, and this might be allied to techniques derived from experimental work. However, as frequently pointed out, the work of the psychologist does not directly provide teachers with methods of instruction, only the mechanism of learning. But since the work of both would be negated by division, the purposes of their work becomes more evident. The fact is that they must complement each other.

The teacher's job is characterised by two cardinal requisites: the ability to make sequential decisions about human behaviour, and the ability to base these decisions upon critical observations and analysis.

'Training is predominantly a normative area. The major questions which confront people who teach things are what to teach, how to teach it, and in what order. These are all normative questions. They have to do with schedules of training, forms of presentation teaching techniques, and transfer of training. Nevertheless, there are individual differences in performance in all parts of any training syllabus; and one of the jobs of the differential psychologist is to describe these differences and the relations between them.'

(Jones M.B. 1966).

It is hoped to include just a few of the psychological factors involved in this study, namely attitudes and learning theories related to motor skills.

A) Attitudes

One of the earliest investigations into attitudes was that undertaken by Thurstone and Chave (1929), in which they defined as attitude: as 'the sum total of mans' inclinations, feelings, prejudice or bias, conceived notions, ideas, fears, threats and convictions about any specific topic.'

More recently, Kerlinger (1964) has defined attitudes as: 'a predisposition to think, feel, perceive or behave towards a Cognitive object.'

This differs somewhat from the definitions of Thurstone and Chave (1929) since it includes a behavioural aspect.

According to Kenyon (1968) an attitude is "a latent or non-observable complex, but relatively stable behaviourable disposition reflects both direction and intensity of feeling towards a particular object, whether it be concrete or abstract".

From Kenyon's (1968) definition, it would appear that an attitude whilst having a complex makeup, in terms of observing exactly what it is, nevertheless has a certain quality of consistency about it, i.e. whilst there maybe some variation in the intensity of an individual's attitude towards a specific object, nevertheless, one would expect to find a tendency for that particular attitude to be occupying approximately the same position if placed along a continuum from positive through neutral to negative.

This review will be limited to part research into physical education and recreational physical activities in the U.S.A. and in Great Britain.

Research in the U.S.A.

American research began as early as the 1920's, but the first piece of work to be reviewed is that of Mary Baker (1940). It was aimed at discovering the factors which may influence the participation in physical education of girls and women at 15-25 years of age. The sample involved, 1,150 subjects from various educational establishments and data was collected by means of a questionnaire. The conclusions were that:

- 1) Girls and women appear to follow habit patterns of activity which are modified as girls mature, and tend to become less strenuous and more mechanised with the emphasis on the role of spectator.
- 2) Factors which produce these changes seem to be of a social and physical origin. The later the menarche, the longer the participation in physical education, which, however decreases with chronological age. Occupational environment is a strong determinant of participation in strenuous and competitive games and sports. Absence of school authority and of supervision reduces participation to a fraction of the already small amount characteristic of girls in college.
- 3) Attitudes and feelings concerning participation in physical education do not regulate it, so much as they reflect the influence of other causes which do.

- 4) The heterogeneous character of the activity patterns fosters a conclusion that the voluntary activity habits of girls and women are largely planned. For most of them participation in physical education is at best a 'capricious arrangement'.

Baker found that:

- a) preferences in physical education activities were characterised as non-competitive, individual and unsupervised.
- b) Girls who reached the menarche after the age of 15, participated more extensively in physical education activities than those who reached it earlier.
- c) Familiarity with an activity tends to increase participation in that activity.
- d) More attended the cinema than participated in any other activity.
- e) More swam than took part in any other physical activity.

The work by Baker (1940) was, to some extent a pioneer piece of research. Looking at it in 1974, it would appear that some of its findings need more scrutiny, although one ought to remember that despite it being 35 years old, much of the work is relevant today. However, greater affluence and a vast improvement in the facilities available would influence attitudes. There has also been a radical re-thinking with regard to the status of women, as well as a change in the general philosophy of education.

The investigation itself has limitations. A sample of just over 1,000 respondents may hardly be representative enough in a population of 160 million. The ages of the sample in this investigation range from 5 year old girls at school to 25 year old women. There are obviously many individual differences between adolescent girls of 15, in school, and mature women of 25. A number of Baker's conclusions are by no means clearly expressed. For example, it is difficult to understand clearly some of the terms used, e.g. there are times when reference is made to activities, at others, references are made to physical education activities.

A later investigation at least avoided one of the deficiencies in the last piece of research. By limiting the sample investigated, Broer and Holland (1954) investigated the physical education interests and needs of women students at the University of Washington, and discovered that swimming was the most favoured activity. This supports the earlier work by Baker (1940). Tennis, ten-pin bowling, golf, life-saving, diving, badminton, water safety, skiing and folk dancing followed in that order. Noticeably, the preferred activities included four water sports, but no team sports were mentioned in this top ranking list. A leading factor contributing to the women's interest was that those activities that offered 'date' possibilities were preferred. Such activities included sailing, skiing, ten-pin bowling, tennis, golf, dancing, ice skating, and riding. This investigation is better in two ways. Firstly, it reflects the responses of a narrower and more clearly defined field, the interests and the needs of one particular group. Secondly, the sample is more homogeneous, for it researches into interests and needs of young women at a

university. However, the fact that the research is at one university in one state, must seriously question its effectiveness as a representative sample. One further shortcoming emerges, when the needs of individuals are investigated. Dearden (1968) in his book 'Philosophy of Primary Education', points out the distinction between wants and needs, and in the investigation it is never made clear in what sense the word 'needs' is used.

Blumenfield and Remmers (1965) asked 1,036 high school students graded from 0 - 12 to list in order of preference, sports in which they regularly participated. The girls reported that their most popular sports to be swimming (58%) supporting previous findings, basketball (41%), baseball (34%) and ten-pin bowling and ice skating (32%). The boys listed football (57%), basketball (43%), baseball (41%) and swimming (39%).

Zimmerman (1954) tended to support Broer and Hollands work. Working with high school and college students, she found that for both in school and out of school activities, there was a strong desire for individual and dual sports, with swimming the most popular with the women students, and the most requested activity. Ten-pin bowling and tennis were also highly preferred. With regard to out of school activities, Zimmerman noted a strong preference for activities which were adopted for co-educational recreation and for in-school, for example social dancing.

Once again however, the sample used in the study is restricted to one group of students in one state institution.

Very early studies by Alden (1932) Bullock and Alden (1933), and Merritte (1952) to identify factors which influence the activities of college and high school students towards physical education, suggest the following possible reasons:

- a) The inconvenience of changing clothes for certain activities.

- b) the failure of the secondary school programme in physical education to develop adequate techniques and physical skills.
- c) too few hours allocated to physical education in the weekly programme.
- d) dislike for the required physical education programme in the school.
- e) a dislike for the physical education teacher on the part of the student.
- f) the lack of motor ability of the individual.

There is in the study, the possibility of a restriction in the range of physical education activities. In 1975 the number of activities offered in physical education are far greater than those offered in the 1930's or even in the 1950's.

Nowhere in this work is the difference between high school and college programmes made clear, although differences are likely to exist, if only because of the ages of the students.

Mistra (1968) studied the attitudes of college women toward the high school physical education programme, and made the following observations:

- 1) Women who represented the college at athletics and who took part in extra-curricular activities outside the school scored highly on an attitude test compared with those women who did not take part in any extra curricula activity.
- 2) College women who planned to become teachers tended to have a more favourable attitude towards physical education than others.

- 3) Women who had a home background of farming, had a more favourable attitude towards physical education than those who had not.

Several of these conclusions are more obvious. For example, one would expect that regular participants in physical activity would have a more favourable attitude towards physical activity than others. There are however, occasions where active participation at school level is not always followed by active participation at college.

Supporting earlier work done by Alden, Bullock and Alden and Merrett mentioned earlier, Broer, Fox and Way, using a Wear (1951) Attitude Inventory showed that women tended to avoid activities that involved changing clothes which required a lot of energy.

A modified Wear Inventory was used on college students by Moyer, Mitchen and Bell (1966). Their findings indicated not only a highly favourable attitude towards physical education by 73% of freshman and 58% of junior year women, but also a general preference for individual sports this confirming Baker and Zimmerman's findings mentioned earlier.

Perhaps the most significant research in this field of attitude measurement is that of Kenyon (1968). In looking at the problem in delineating objectives and outlining a method of analysis for physical activity he classified physical activity into initially six and then seven categories. These he defined as follows:

- 1) Physical activity as a social experience, this being based on Huizinga (1938) "Sharing physical activity as a social experience was characterised by those

physical activities whose primary purpose is to provide a medium social intercourse"

- 2) Physical activity for health and fitness - physical activity for the improvement and maintenance of one's health and fitness.
- 3) Physical activity as a pursuit of vertige - based on the pursuit of vertige hypothesis of Cailllois (1961). This involves those activities which consist of an attempt to to momentarily destroy the stability of perception and inflict a kind of voluptuous panic on an otherwise lucid mind.
- 4) Physical activity as an aesthetic experience - involve those activities which one conceived as having or possessing beauty or certain artistic qualities.
- 5) Physical activity as catharsis - physical activity providing for a release of tension precipitated by frustration and got rid of through some vicarious means.
- 6) Physical activity as an ascetic experience - physical activity involving long strenuous and other painful and stiff competition, which demand a determent of gratification.

To these six he later added:

- 7) Physical activity as chance - physical activity where there is an element of chance, and that this aspect of chance is seen and recognised by certain persons who wish to pursue this element above all others.

Kenyon (1968) carried out a cross-cultural study in Canada, England, Australia and the U.S.A. in which he examined 'values held for physical activity by selected urban secondary school

children'. The average age of children studied was about 15.5 years which meant that the English sample for the most part had not completed their full time compulsory, and were likely not to have experienced the complete physical education programme in their school. However, Kenyon's approach had many advantages over those already discussed, firstly it was cross-cultural. Secondly, it dealt with both sexes. A further point was that he used the semantic differential approach of Osgood, Suci and Tannerbaum (1965) - eight adjectival pairs of words were matched for example "good - bad", "sour - sweet", and each of these pairs was separated by a seven point scale. The scales were weighted and each attitude dimension was then able to generate a total score, the higher the score the more positive the attitude towards that aspect of physical activity. Kenyon's (1968) findings were as follows:

- 1) Physical activity for social experience - girls possessed a more positive attitude than boys ($p < .005$).
- 2) Physical activity for health and fitness - girls possessed a more positive attitude than boys ($p = .005$).
In the English sample there were more positive attitudes from those students of a lower level of educational attainment.
- 3) Physical activity for aesthetic experience - scores higher for upper level of educational attainment, and higher for girls than boys.
- 4) Physical activity for catharsis - girls slightly more positive than boys and group at upper level educational attainment, more positive than those of lower level educational attainment, but in England they were nearly alike.

- 5) Physical activity for asceticism - boys slightly more positive than girls, those with lower levels educational attainment slightly more positive than those of the upper level.
- 6) Physical activity as pursuit of vertigo - boys more positive than girls ($p=.005$).
- 7) Physical activity as chance - boys slightly more positive than girls.

In conclusion he found that with respect with age, older pupils expressed a more favourable attitude towards physical activity as an aesthetic experience and catharsis, whilst younger pupils were more positive with respect to the chance aspect.

The most positive aspects were those which related to social experience, health and fitness, aesthetic experience and catharsis, the least positive aspects were those related to the vertigo, asceticism and chance.

From the point of view of sex, he found that girls were more positive when activity was perceived as a social experience, health and fitness, and aesthetic and cathartic experience, whilst boys were higher on vertigo, asceticism and chance.

Kenyon(1968) study is perhaps the most significant in that his approach was certainly more precise and comprehensive than any previous researches and his analysis of physical activity much more meaningful than his predecessors. However, Layman (1972) has investigated the literature with regard to certain of Kenyon's (1968) aspects of analysis.

With respect to the health and fitness aspects, she found that a "...a preponderance of the evidence seems unconvincing to support the hypothesis of a positive relation between physical

fitness and emotional health, although some studies have not shown a clear cut relationship and a few have seemed to indicate no relationship."

The aesthetic aspect which embraces skills learning and aquisition, seems to be related in the main "to prestige and status in the peer group, and makes little positive contribution to emotional health."

The social experience aspect does appear to make a contribution towards both emotional health and acceptable behaviour patterns, BUT she added, the caveat that there appears to be little transfer of values and behaviour acquired in the course of physical activity being transferred to other situations".

The cathartic aspect appears from controlled studies to be significant in the "when aggression occurs in the presence of anger there is a decrease in the level of anger and a decrease in the tendency to be aggressive for a short period". Further that - " unless the individual has feelings of guilt because of the aggressive act, there will be a reduction of tension and an improved feeling of well being".

Virtually every piece of research undertaken in the field of attitude measurement in P.E. has its deficiencies however, this does not mean that it is of little use. Perhaps if more work was done in this field, more positive use would be made of research findings, especially in their application in the school situation, with the consequent benefit to both staff and pupils alike.

Research workers dealing specifically with attitudes towards physical education have generally noted highly favourable attitudes among respondents who are successful in physical education activities and hoping to become teachers. Those

respondents who did not participate in physical activity, do not have favourable attitudes, but do not appear to reject such activities as swimming and ten-pin bowling.

Great Britain

This part of the review will fall into two sections. The first will deal with examples of research covering the wider aspects of the whole field of physical activity and recreation, and the second part will be limited to a more detailed review of research into the degree of participation in the formal school based programme and into the attitudes and interests of the participants.

One of the earliest pieces of research into recreational physical activity, is that of Mary Stewart (1950). She investigated the leisure activities of grammar school children in a sample of 801 girls and 675 boys between the ages of 11 - 15 years, and found that a high proportion (47%) of the 15 year old girls preferred to read women's magazines and illustrated papers rather than indulge in physical activities. 48% of the boys preferred to read comics and war stories and few from either group preferred to read sports comics and periodicals. It was noticeable that over 60% of the girls in each of the 13, 14 and 15 year old age groups went to the cinema at least once each month. Radio was the chief mass audience medium. Although only 18 girls in all age groups listened to sport on the radio a great number of boys, as many as 84% listened to the football results. The most popular radio programmes for girls were romantic stories and thrillers. For boys and girls membership of youth clubs showed a rapid increase at age 15, and the greatest

interest was in mixed group activities. The most noticeable feature was at 14 years, when the membership was more than twice as great (29% in the case of the girls and 12% of boys) among the grammar school girls.

High membership of grammar school girls is probably due in part to the attitude of parents - but perhaps an even more important factor is that secondary modern children, owing to the earlier school leaving age, develop adult tastes in relation to dress and leisure activities, sooner than children in grammar schools. To a boy or girl about to leave school to earn money these organisations may seem childish. The fairly small interest in athletic club membership by boys and girls is indicated below:

15+	Age Group	12%
13-14	Age Group	10%
11-12	Age Group	8%

Of the favourite activities outside school, the most popular were:

Swimming	66%	Reading	65%
Cycling	47%	Tennis	38%
Walking	24%		

The popularity of swimming supports several American research findings. Expressive activities such as acting, writing and dancing were mentioned nearly four times as often by girls than boys, and non-participant entertainment (theatre, cinema) was mentioned twice as often by girls as by boys. Tennis was mentioned six times as often by girls in grammar schools than it was by secondary modern school girls. On the other hand,

the cinema and dancing were mentioned more often in secondary modern schools.

Mary Stewart's work was published in 1950. As with Mary Baker's many factors influence the conclusions. For example, television was not as widespread in the early 50's as it is at present. The whole concept of leisure activities has been greatly influenced by increased wealth, improvement in facilities and a national campaign of sport for all. The sample used was restricted to a grammar school. The educational change towards comprehensive education in the late 60's and 70's would enable a wider selection of opinion. Nowhere in the research findings, do we read of the extent to which the menarche or social class of the 801 girls were considered.

It will be noted that considerable attention in the comment on this research has been directed towards the participation of girls. The lack of female participation in physical activity in the 1950's seems to have been as serious a factor then as now, and this despite many efforts to obtain equality.

Whitehead (1966) investigated the leisure activities of sixth form pupils and young workers in the City of York. A questionnaire was given to 54 lower sixth grammar school girls and 64 sixth form boys. For the purpose of this survey, the analysis of the work will be confined to the grammar school respondents. A high percentage enjoyed games at school and also played games outside school, the most popular games outside school being:

Tennis 24%	Badminton 22%	Cricket 26%
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while the least popular activities were

Rounders 5%	Fencing 5%	Swimming 5%
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The most popular leisure activity for women was 'house work' and other tasks such as knitting, using make-up for beauty care, and playing records. Also, over 50% of the girls had spare time jobs, and this in itself would restrict sporting activity.

Whitehead came to the following conclusions:

- 1) Fewer working girls played games regularly as compared with their grammar school counterparts.
- 2) There was less listening to records by the young workers, yet more visiting of cafes and public houses, and generally more getting out of home. They have more money to spend when they do get out, and have no homework to keep them in.
- 3) Unless the young worker is a particularly good games player, she is less likely to join a sports club.
- 4) Reading, studying and hobbies were more important to the grammar school respondents than amusements and going out at night with friends.
- 5) There may have been a 'class difference' the way leisure time was spent. When asked what else they would do in their spare time, the young workers replied: more time to spend on sport, and more time to spend on social activities.

Whitehead concludes:

"If in the future most of the physical effort of 'workers' jobs is taken over by machinery, it is in the schools now that the interest must be inculcated for participation in activities, more mentally stimulating and physically healthy than those at present".

A large majority of the jobs of workers, even at present, require little physical effort, and yet young workers still tend to prefer to spend their leisure time watching television or being spectators at matches..... However, the sample was a small one and could not have been considered representative of either the grammar school population of York, or its young workers. One factor that is surprising, is the apparent popularity of cricket! Always regarded as a man's game, the local popularity may be attributed to the enthusiasm in the Yorkshire League, and the growth of pockets of interest in the game among women. More surprising is the finding about the least popular activities, especially swimming. This would seem to run counter to all the research findings on participation in physical activities.

The second part of the review is limited to a more detailed look at research into participation in physical education programmes in terms of attitudes and interests. It is clear that investigations in the area of attitudes and interests relevant to participation must take into account sex differences. For example the menarche, and menstruation are limiting factors which have no counterparts among boys. In addition, there is the danger of over-generalising about boys and girls each being homogeneous groups. Although most girls appear to have a more aesthetic approach to physical education, there are others who tend to favour the 'challenge of a physical environment', as found in various forms of out door pursuits. Boys on the other hand still appear to prefer the team game e.g. soccer, rugby, and swimming. The early onset of puberty in girls with a 'rapid approximation to adult types of preference in relation to physical activities and choice of games' Meck (1966).

Parry (1966) using a questionnaire sought to ascertain the views of 638 adolescents on the programme of physical education in three schools. The most popular activity for all, was swimming, second in popularity amongst girls being netball. Among first year girls gymnastics was popular as was hockey, but both these activities declined in popularity with age. For summer games, tennis was certainly the most popular game, particularly for girls in the fifth and sixth form age groups. The most sought after activity was judo, and not surprisingly although almost ten years ago, there was a strong desire to play competitive football.

This research is interesting, because it highlights several factors, to do, for example, with prudence. Hockey, a game widely 'prescribed' for girls can be very dangerous, particularly for the unskilled player, a fact which was frequently expressed throughout Parry's (1966) work. "...I do not see the point of running around a wet muddy field, being hit by a lot of sticks.." Fourth year girl.

Judo was the most sought after activity, and the reason given by girls was the need to cope with 'undesireable' males and 'assaults'.

Altruism could have been the consideration of those who preferred swimming and life-saving. The popularity of netball and rounders given in the study, highlights again the possible 'safety factor' when comparing the games to hockey. The rising popularity of competitive football particularly amongst older girls could be related to the avid support that many teenagers give to football clubs, but more particularly, to the 'pop idol' of the soccer field. Pin-ups in football are as popular as

pin-ups in the world of pop music.

These brief points show the deeper complex issues in the whole field of attitudes and interests, and to this extent, the research outlined is most valuable. Parry (1966) concludes with a plea for more qualified teachers to teach individual activities and a much broader physical education programme in secondary schools aimed at allowing children to pursue their own interests.

The research, valuable at least to the extent that it investigated interests, is limited, in that interests tend to change and hence affect participation. What is obviously needed are longitudinal studies of interests, and one in this field was that of Wise (1963). Using preference tables, he made a study of the changing interests in physical education amongst adolescent boys in 1965. The main findings were that swimming and strenuous winter games remained popular, and that dual and individual activities became more popular with increasing age. This study also indicated that activities like gymnastics, athletics and boxing had a declining interest. The highest level of participation in four schools, occurred during the summer term. Many of the boys questioned had made no plans to continue any form of physical activity or sporting interest after they left school. This was not surprising ten years ago, but would be a matter of serious concern to those involved in the development of recreation and leisure pursuits among young people if it applied today.

It is necessary to reiterate the need for as flexible a programme of physical education as possible, for again the investigation highlights the desirability of individual choice within the programme. In contrast to the previous studies, Loader (1964) made a specific enquiry into attitudes of secondary school

boys towards athletics. The subjects of the investigation were 144 boys of a second year in a London comprehensive school. The boys had had a first year of athletic coaching as part of the physical education programme in the school. The test, conducted during the autumn and spring terms of the second year, was designed to discover attitudes towards athletics. The results of the enquiry indicated that boys who previously had shown an interest in athletics, did not score significantly higher than those who had previously shown no interest at all. The attitude of the less interested boys showed a marked deterioration. The conclusions drawn at the end of the enquiry was that attitudes to athletics appeared to be closely linked with success, and that in any system of grouping according to ability, there is some evidence to show that a positive attitude becomes more positive, and that a negative attitude becomes more negative.

This conclusion is much as expected in the light of previous comment. One or two further points need to be raised with regard to this investigation. Firstly, the timing of the test is important. The autumn and spring terms, as indicated by the investigation, were not the most appropriate times of the year for outdoor activity. The test was preceded by specific teaching over a short period of time: i.e. 10 x 30 minute periods over five weeks. One really would question the extent to which any useful programme of athletics can be achieved in so condensed a period of time, especially with boys so young. A final point concerns the nature of the athletics coaching. No indication is given of what activities were taught. The teaching of athletic activities is a complex matter. The range and variation of the activities is one thing, the skill, speed,

co-ordination and strength required are other relevant factors.

A more extensive study was that of Mason and Ventre (1967), who developed a Thurstone rating scale in order to investigate attitudes towards athletics in a large Yorkshire comprehensive school. 83 statements were evaluated by a panel of judges made up from lecturers and students of physical education. 1,132 boys from the first to the sixth years in the ten stream school completed the questionnaire. All the year groups in the school showed a positive attitude towards athletics. With the exception of the fourth year, there was a substantial decline in interest with increase in age. The response in the third year was not unexpected, for it was observed that a number of boys on reaching the age of 14 years, were becoming more aware of their potentials and their limitations in athletics. By the age of about 15 years, boys had come to terms with these activities, i.e. they were keen because they were aware that any potential had been realised, or they had decided that athletics was not for them. The fifth and sixth form boys displayed a lower attitude score, and this is not so surprising. It would appear that a number of boys in this 16-18 age group may well have decided that athletics was not an activity that they enjoyed, and that they preferred to take part in some other form of activity. Coupled with that is the fact that the investigation was of a highly specific activity and many factors affect attitudes towards athletics, not least achievement and success: Loader (1964).

This review shows clearly that much research work has gone into many aspects of physical education. In addition to the social reasons, there are a number of educational considerations to be taken into account. For example, ROSLA has meant that there are now thousands of adolescents staying at school for

an extra year. Many schools have devised special ROSLA year programmes, and it is important that appropriate physical activities be built into these programmes, appropriate that is, to their interests and needs about which, as has been shown, little is known. Another point is the increased number of adolescents entering sixth forms, further and higher education: this is an increasingly important group, but once again, little is known about this growing section of the adolescent population, except of course, for a fairly general lack of interest and involvement in physical activities.

B) Learning theories related to motor skills

There has been so much research conducted in this field, that under this section, just a short review will be displayed.

Priebe and Burton (1945) worked with 26 adolescent boys and came to the conclusion that the use of films in teaching high jumps, resulted in greater improvement and shortened the initial period of trial-and-error learning. Lockhart (1944) found that a group learning bowling in a skittle alley with the aid of film avoided plateaux and were still slightly advanced on the control group after seven weeks of instruction. Brown and Messersmith (1948) who used film of agilities performed by experienced gymnasts and also by members of the class itself, found indications that the experimental class made a little more progress than the control, but the superiority was not statistically significant. They also commented that the filming of the students in the class made them highly motivated. Nelson (1958) who studied the effects of slow-motion loop films on the learning of the golf swing using a number seven iron, found no

significant differences between the control group and the group which had the use of the films. All these studies were on small numbers and did not take the skill far enough.

Verbal directions must not be assumed automatically that these are beneficial. Since the beginner must have as clear an idea as possible of the skill he is to learn before he starts, a brief verbal description may be of value but the results of an experiment by Battig (1956) suggest that the value of verbal pre-training decreases as the complexity of the actual motor responses increase.

Goodenough and Brian (1929) conducted an interesting experiment in which twenty, $4\frac{1}{2}$ year old children divided into three sub-groups, were trained for fifty days in throwing rings over a post set at a distance of 4ft. 10ins. The ten children in Group A were given no instruction or criticism with regard to their methods of throwing; the six in Group B were given a brief preliminary demonstration and a subsequent verbal criticism of the general types of errors made. The four in Group C were given the same treatment as Group B, but they were also taught to follow a definite procedure in throwing and were not allowed to experiment. Results showed that the amount of improvement averaged least for Group A, only a slightly higher for Group B but very much greater for Group C. These results indicate that the best procedure is to enforce from the start a given effective method and to combine this with verbal guidance after the first attempt.

Guidance and instruction are generally beneficial, provided it is well informed and appropriate to the state of the learner. However, the learner must perform without the help of the coach and therefore, after the first few times, the instruction should be inter-spersed with longer and longer periods of practice without

technical help. Thus Whilden (1956) taught two groups of thirty-seven and thirty eight girls the rules, fundamental skills and basic tactics of basketball. After six periods of this one group was put completely on its own and the teacher served as consultant only, whereas the other group was completely under the control of the teacher. Four observers rated the players during the fifteenth class period and, after the sixteenth games were held. The teacher - dominated group received a higher rating on basic skills. The pupil - dominated group showed greater knowledge of the rules, performed better as a team and won three games out four played against the teacher - dominated group.

If a person practises without knowing the results of his action, improvement in his performance is unlikely. Thorndike (1927) demonstrated the need for knowledge of results. He induced two groups of people, known as subjects in experimental work, to draw many hundreds of pencil lines of 3, 4, 5, or 6 inches over a period of several days, afterwards measuring the size of the errors which they made. One group drew lines while blindfolded and so deprived of visual knowledge or results. The lines drawn by this group were less accurate at the end of the experiment than they had been at the outset. For a second group, also blindfolded, Thorndike (1927) provided verbal knowledge of results by saying "right" or "wrong" after each line was drawn; a line was considered right if it finished within a quarter-inch target area. These subjects unlike the first group improved considerably, as one might expect.

Trowbridge and Cason (1932) repeated this experiment using several different kinds of knowledge of results. Saying "right"

or "wrong" improved peoples performance, as did with Thorndike (1927), but telling them how much they were wrong by saying "plus two" or "minus seven" gave them even greater accuracy.

Many skills in physical education and physical recreation provide in themselves some knowledge of results. The tennis ball is hit or missed, the discus: is thrown 170 ft. or 90 ft., the goal is scored or it is not. But during the learning process in each and every case, one must ask if the information is given as soon as it can be and if it is specific as possible. This problem was put in a nutshell by Guthrie (1952) when he said that if only a golfer could receive a sharp pain at the point when he goes wrong in his swing, and slices the ball, he would stop doing it. But seeing the effects of the slice some moments after the swing is finished makes adjustment a much more difficult problem.

The effect of motivation has been shown by Schwab (1953), who was investigating fatigue. He measured the time in seconds during which individuals could hang suspended from a bar and found that, on average, subjects hung on for more than twice as long if offered a money reward. Strong motivation prevented fatigue from affecting results so soon, and performance was thus improved. Where a complex skill is concerned, however, very high motivation can sometimes affect performance detrimentally. The drive to win may be so great that tension is caused and the skill may break down. But unless a person experiences strong needs or drives, it is unlikely that he will put in the effort and attention which is required to perform the activity to his maximum capacity not to discover how to perform any particular skill to a high level in the first place.

Burnett and Pear (1925) state a person's interest in the pleasure which he derives from his kinaesthetic sensation is a motive force which has been called a 'muscular sensuousness' by them. The goal here is the immediate one of participation and might be termed intrinsic motivation since what the individual does or learns is solely for the sake of engaging in the activity itself. Play enables the individual to find out about himself and his environment helps him to satisfy his curiosity and widen his perceptions.

Mace (1931) has pointed out that since activities which are too easy, pall, and those which are too difficult are abandoned in despair, the popularity of a game seems to depend in part on determining the optimum degree of difficulty conducive to maximum satisfaction. Cartwright (1942) has found some indication that anticipation of failure reduces attractiveness more than the actual experience of failure, and that a person's view of the future is the primarily decisive factor in producing changes in attractiveness. Past failure does not always lead to an expectation of future failure. Cartwright (1942) also found that the conception of failure not only affected the particular activity concerned but also spread to other activities which the learner viewed as being of the same type. Thus failure in a ball game may make a child dislike all ball games, or all physical activity or even all school work, depending on the way the child categorizes the activity.

Gross bodily skills require a minimal time for practice, because of the need to 'warm-up' both in the physiological and psychological sense. Thus, an individual who is trying to improve his shot putt must get warmed up, so that his body is

able to make the necessary movements without strain and he must also get mentally set or immersed in the activity so that he can give the skill his full attention. This minimal time will depend on the nature of the skill and also a limit beyond which any practice period should not go. This will depend on the interest of the learner and on the fatigue engendered by the practice. But fatigue in this context does not depend solely on physical exertion. In some cases the limiting factor may be fatigue caused by physiological impairment of tissues but often, the fatigue is of a more psychological nature. This fatigue may be expressed in subjective feelings of tiredness or boredom, or in an increase in the number of errors and periods of inattention. So far as skill acquisition is concerned, it is useless to continue any practice once the individual ceases to be intensely interested in it.

Within the two limits of the minimum and maximum, it may be theorised that there is an optimal length of practice for a particular person learning a particular skill.

Travis (1948) for example, found indications that for the manual pursuit oscillator 4 minute practice sessions were inferior to 2 minute lengths when the inter-practice rests were constant at 3 minutes. He points out that much of the practice in the 4 minute period was a 'waste of time and actually deleterious to learning of this type'. In the field of gross bodily skills, controlled investigations into the length of practice period alone do not appear to have been carried out. Experiments where the length of rest was also varied have been reported by Knapp et al (1950). They found that, in learning to juggle three balls, groups of American high school boys and college students learned more quickly if they practised 5 minutes every day, than

if they tried for 15 minutes every other day. One minute of practice in the shorter session was worth 1.78 minutes and 1.8 minutes in the longer with boys and students respectively. The significance of the difference was at the 1% level of confidence. It is interesting to note too, that a higher number of those in the 15 minute group failed to reach the criterion of 100 consecutive catches than in the 5 minute group. Little and often seemed then to be the best method.

Various other studies concerned solely with the length of rest periods have produced inconclusive results. Cozens (1958) offered evidence that 'with the 100 yard sprint, the 120 yard low hurdles, half mile run, running broad jump, 12 lbs shot and discus throw, improvement is more marked when the practice periods are spread over a considerable period of time rather than concentrated'. This, he said, might lead to the conclusion that for track athletes, three periods per week of one hour spread over a year, is better than periods of one hour per day for six days a week for half a year. Scott (1954) found some indication that for beginners learning to swim four half hour periods per week, were more satisfactory than either two half hour periods or two 50 minute periods per week. The numbers in the groups were very small however, and results were not statistically significant. Young (1954) suggested that in archery, four days per week seemed to result in more rapid learning than a two day per week distribution, whereas in badminton where progress was measured by three skill tests the reverse appeared true.

Lashley (1918) has suggested that two stages in learning should be distinguished; the stage of exploration and adjustment, during which the right response is discovered, and the stage of fixation during which the right response is made more certain.

As a summary it may be said that, from the point of view of skill learning, a short period of intense effort and attention is better than a half-hearted longer period. Quality of practice rather than quantity is required. Mental practice during periods of no physical activity can be beneficial. What is a reasonable period of practice will depend on the activity and on the powers of concentration and the interest of the learner. Goodenough and Brian (1929) have summed up in the statement that the 'greatest efficiency may perhaps be gained by appropriate interruption of practice at times when the setting up of undesirable habits seems to be retarding progress'.

Where speed is vital to performance, speed is a part of form and should therefore be emphasised from the beginning. This would particularly appear to be so where the part of the body which is moving fast is free from muscular tension in the middle of its course, and is carried on by its own momentum. Hartson (1939) has stated that 'since the individual ballistic movement cannot be made slowly, it may be speeded from the onset'. A ballistic movement is one in which the contraction of the positive muscle group relaxes long before the end of the movement so that there is a momentum phase free of muscular action. The following actions have been included by various writers under this term: the football kick, the pitch in baseball, rapid walking and running and throwing. In skills when speed is all important, like discus and shot putting emphasis on speed is important. Clearly the learner cannot be expected to perform at the speed of the skilled performer for he has to exercise more conscious control, has difficulty

in selecting the more important external and internal signals and in differentiating between the necessary and unnecessary muscular contractions and he lacks the ability to anticipate. Nevertheless, he should aim for speed.

In the whole method, material is learned by going through it completely time after time. In the part method, the material is divided into portions and these are practised and then connected with each other.

Wickstrom (1958) compared the whole method with the whole direct repetitive method for teaching ten basic gymnastic skills to male students. In the latter method, the skill was demonstrated and described in detail twice so that the subjects understood the nature of the whole activity. They were then taught by the part method in which part 1 is learned, then parts 1 and 2 together and so on. In two of the skills however the last part was practised separately before being added. The results were not clear cut but the evidence was mainly in favour of the whole method.

In an experiment by Knapp (1952) into his learning to juggle three balls, the trend favoured the whole approach. For teaching boys and girls aged $7\frac{1}{2}$ to $9\frac{1}{2}$ years to swim, Niemeyer (1958) reported that Lewellen found a whole method superior to a part method. Niemeyer (1958) himself conducted experiments with male students in regular physical education classes on the relative effectiveness over a period of nine to ten weeks of whole and part methods of learning swimming, badminton and volleyball. Both groups in each activity received instructions, the fundamental difference between the groups

being that the whole method group never practised parts though parts were demonstrated and explained to them. In the case of swimming Niemeyer (1958) found that the students in the whole method group learned to swim sooner, farther and faster and showed better form.

If games are now considered, it is found that there is very little experimental evidence and most of what there is can be strongly criticised for one reason or another. Three separate investigations into basketball concluded that a part method procedure was superior to a whole method. Of these, Hause's (1957) experiment was with very small groups and only dealt with shooting, and Kimball's (1958) was carried out in such a way, that the whole method group received no instruction and was tested on parts whereas the part method group was taught and tested on parts. The third investigation, which was carried out by Cross (1937) was with 15 year old boys and found that the whole method was more effective in teaching simple unitary functions like passing and catching but that the whole-part-whole method was better for some of the more complex skills. The serious weakness in this study was that the whole method group was not given instruction.

It seems so far as individual type activities, in which the performer acts on his own... are concerned, the evidence though not conclusive, is predominantly in favour of the whole method for beginners. So far as games are concerned the evidence is scanty and unsatisfactory but what there is, indicates that some form of part method may be better. In this connection it is of interest that Cross (1937) comments

'probably the practice of the parts, proved most valuable as much because of the simplifying of the intellectual concepts, as because of the simplifying of the motor co-ordination.'

Rodgers (1936) has pointed out that no attempt should be made to teach 'part-game' skills until students have been exposed to the whole game and recognise the need for these skills. In teaching practice many different methods and combinations of methods are used.

It is possible then to sum up this very difficult question of whole and part learning by saying that until such time as detailed experimental evidence concerning each skill is produced, it is probably wise in the learning of skills in physical education and physical recreation to begin with the whole method while feeling free to concentrate at any time in the case of a particular individual on any part where there is some difficulty or weakness impeding the production and perfecting of the whole skill.

This finally completes the review of literature and the balance of this thesis will now be presented in the following chapters containing , (1) Method, (2) Procedures (3) Results, (4) Discussion and (5) Summary and Conclusions.

CHAPTER 4

METHOD

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METHOD

An important component of the skill learning programme was concerned with the exploitation of different instructional aids. A validation of the factors determining the effectiveness of instructions is vital, although it is not directly within the range of this investigation to review these aids.

With reference to instructional aids and principles, Wolffe (1966) stated that: "Present knowledge of the principles of learning is largely of a qualitative sort. Properly conducted research will contribute quantitative information on the limits of each principle, its optimal conditions of application and the nature of its interaction with others". (p 1284).

Four vital instructional aids were used in the skill learning programme in this investigation:

1. Utilisation of film loops
2. The relevance of mechanical principles
3. Utilisation of demonstration
4. Differential methods used in teaching

1. Utilisation of film loops

Film loops were used on three occasions (at the start of each stage of learning) in the experiment. Subjects were shown both the O'Brien method (demonstrated by O'Brien) and the Step-back Method (demonstrated by Neider) of shot putting, and an analysis made between the various phases of the movements. The films were also used in conjunction with comments on mechanical principles involved.

The advantages and disadvantages of film loops has been succinctly evaluated by Lawther (1968), "...they are of real value in giving the learner the general idea of the action pattern if the teacher is not completely competent at demonstration. Moreover, they may add to the learners motivation. Second, slow motion pictures will sometimes reveal the precise form when the act itself cannot be performed in slow motion as a demonstration device. The live slow motion demonstration actually incorporates different movement patterns from those used in acts which must be performed rapidly to be functional in normal performance. Third, moving pictures of the learner may help him discover constant errors, and maybe quite helpful in form analysis at high skill levels....."

The availability of numerous data to suggest that supplementary aids which stress the difference(s) between the learner's performance and expert technician facilitates learning. (Priebe and Burton 1945); Lindahl (1945); Howell (1956); Annett (1959). From a number of distinguished authorities empirical support has been forthcoming - Skubic (1949), Stevenson (1953), Friedrich (1957), Jordon (1957), Mortenson and Cooper (1959), Docherty (1960), and Skinner (1962). Of a more academic nature, additional support has been highlighted by the works of Ruffa (1935), Lockhart (1942) and Murnin et al (1953). For this very reason film loops of skilled performers were utilised.

2. The Relevance of Mechanical Principles

Three, twenty-five minute lectures were designated to the explanation of the mechanical principles engaged in the skill,

at the commencement of each stage. (There were three stages in all). The first of these lectures was essentially concerned with a mere explanation of the methods involved (O'Brien and Step-back): the remaining two were devoted to the mechanical aspects of the movements.

Evidence that questions the value of such guidance does appear but the general consensus of data, verify its advantages. "...Learning is generally greater if the learner understands the principles underlying the task on which he is working...." Wolffe (1966). The first leading authority to pursue this area was Judd (1908). His classic experiment looked into the transfer of knowledge on a refraction task, the subjects attempting to hit submerged targets to a depth of 12 and 4 inches. While the **first** group showed no appreciable difference, the second group suggested that those with a knowledge of principles had an increment in performance. Hendrickson and Shroeder (1941), verified this experiment with a similar investigation and concluded that: "...success in the type of problem presented is probably conditioned by other factors in addition to knowledge of theoretical principles as formulated by the teacher....."

Numerous other studies have looked into this problem by using mechanical and mathematical puzzles. For example, Ruger (1910) established that subjects who hit upon the basic principles for the initial solution transferred this knowledge to further problems. However, subjects who failed to identify the underlying principles tended to be less triumphant.

Cox (1933) in conducting his experiment of subjects dismantling and assembling electrical apparatus, showed that a knowledge of basic principles helped to ease training.

Many mathematical studies have investigated similar areas. A bead drawing game conducted by Peterson (1928), in which simple solutions provided a common theme for other task problems. A high degree of transfer was discovered in those groups who discovered the underlying principle. Waters (1920), used three varying degrees of complexity when he reiterated the experiment and concluded that a knowledge of principles was effective in initial learning, but only slightly advantageous in the solution of subsequent problems.

Using mathematical problems Thiele (1938) and Overman (1950) also discovered that subjects gained from generalities outlined before the tests; while holding reservations Hendrix (1947) however, accepted that there was some indication of transfer. Olander (1931) could not verify these conclusions in his study concerning addition and subtraction, and Babitz and Keys (1939), reached a similar point of view in the teaching of chemistry.

Katona (1940), in a series of card playing experiments stated that "... understanding a theory taught in a structurally adequate way and organised according to the requirements of the material appeared to yield wide ranges of transfer...." Hilgard (1953) duplicating Katona's experimental theme stated that whereas the group which had learned by rote, reduced the time to learn than the instructed group, the transfer to task involving problem solving, favoured the latter group. However, the presentation of material in a method easily grasped by the subject is an essential consideration in the degree of utilisation. "General principles are one of the most important vehicles of transfer, but the acquisition of a principle does

not guarantee that it will be used wherever it is applicable..... The probability that it will is much higher if the subject is taught, or given a set to apply the principles learned and is taught to analyse similarities between old and new situations....." (McGeoch 1942).

3. Utilisation of Demonstration

In the acquisition of a motor skill, there seems to be very little evidence supporting the values of demonstration. A conclusion by Cozens (1933) stated that there was no evidence to suggest that observation assisted the acquisition of motor skills. 'Apparently we learn only by doing'.

Wickstream (1952) modified this conclusion by scrutinising various methods of teaching tumbling and gymnastics and recommended that verbal instruction and demonstration must be used suitably and if demonstration is used the subject must be told specifically what to watch for.'

In her research into eye movement Mott (1954), contradicted this. She stated that 'individuals tend to observe without instruction to do so, those body parts and movements essential to success in actual performing'.

Demonstrations were used frequently in the practice sessions both in shot putting methods and weight lifting exercises of the half-squat and bench press, and attention was given to the simplification of verbal guidance. Verbal reasoning is a function of intelligence and after the study of Goodenough and Brian (1929) in which it was discovered that guidance was interpreted in varying degrees, it was decided to reduce verbal

exposition to the most simplest terms.

Learning was facilitated only in the early stages by demonstration and this was put forward by Ragdale (1950). Woodworth (1940), made the comment that the early stages of learning leaned mostly upon visual demonstrations. Commins and Fagin (1954), added specific reference to the area when they stated "the correct form of the skilled act should be taught in the beginning by demonstration, diagram or moving pictures with sufficient analysis or attention to detail, to permit an effective scheme of organisation".

By stating that demonstrations were of valuable assistance to the learner, Bartlett (1947), was less accommodating, noting that while some people depended virtually upon vision as a media of initial learning, others relying on the 'feel' of the movement.

Emphasis was placed upon the need to reproduce the speed and pattern of movements throughout the demonstrations. For example, Howland (1941) made the point that, 'the correct pattern must be practised from the very start, if at all possible' and in Fulton's (1942) and (1945) analysis of ballistic movements, speed of movement proved to be essential. The demonstration method further required the subject to engage actively and as quickly as possible. Based on Gates and Taylor's (1932) hypothesis, this active involvement, was planned to exploit the maximum use of activity and precision of movement.

4 Differential Methods Used in Teaching

In aiming to allow for an optimum learning situation, the shot putt method was taught using the 'whole' and 'whole-part' method of teaching. Facts stressing the value of these two

methods has generally agreed that the relative supremacy of either, is dependent upon the difficulty of task and degree of component interaction.

As a broad comparison, a large number of instructional studies support the 'whole' method. The 'part' method generally has been found to be a waste of time, if the 'whole' method suffices (Niemeyer 1958). A very small number favour the 'part-continuous' method as postulated by Barton (1921), and Seymour (1924). This method specifies the component construction of a task, each phase substantiating the preceding stage(s).

For optimum learning in the shot putt skill and weight lifting, both requirements were selected and used.

The data supporting inclusion of the 'whole' method is conclusive. Mc Geoch (1931) was sure of the efficacy of using various methods and he was supported by Gates (1953) several years later - but experimental studies into specific motor skills have confirmed that the 'whole' method is by far the most beneficial, for example gymnastics (Shay 1934), juggling (Knapp and Dixon), target shooting (Mc Guigan and Mac Caslan 1955; Mc Guigan 1960), tennis (O'Donnell 1956), golf (Theunissen 1955), swimming (Niemeyer 1958).

Other investigators using non sports type skills, found the same findings. Brown (1928 and 1933) in a series of piano playing experiments, stated that the 'whole' method proved the best significantly. Briggs and Naylor (1962) investigated the relative efficiency of four training methods, pure part, progressive part, simplified whole and whole task, using a three dimensional tracking task. The results indicated that the 'whole' and 'progressive part' methods were superior

to the other methods. Subsequently, a later experiment (Naylor and Briggs 1963), using task complexity, task organisation, and training methods were merged factorially and broadly confirmed the superiority of the 'whole' method. The superiority of 'whole' over component practice has been confirmed by other investigators - Briggs and Brogen (1955); Chambers (1957); Gagne and Foster (1949).

It seems apparent, therefore, that where individual type skills or activities are concerned in which the performer acts on his own, the evidence though not conclusive, is in the main in favour of the 'whole' method for beginners.

5. The Format of Lectures

In the three stages of learning and performing, the following material is the basis of the lectures received by the subjects before the start of each stage. The material dealt solely with the broad outlines of the skill(s) involved: while it aimed to be informative, it restricted itself to an elementary explanation of the techniques involved, rather than an academic description of body mechanics.

A. An Analysis of the Step-back Method

Throughout the discussion, all references to the subjects involved in this investigation, is assumed to be right-handed. A description of the skill referring to technique is best given under five rubrics, namely:

1. Grip
2. Initial Stance
3. Step-Back
4. Delivery Action
5. Reverse

1. Grip

There are several types of handholds based on the distribution of the fingers, the best being that the implement is supported on the thumb and first three fingers. The remaining finger acts as ^{an} agent of support. The first three fingers also add impetus to the put, by pushing and 'flicking' away underneath the shot during the delivery action. The novice must remember that these are holds employed by experienced putters, and beginners are advised to carry the shot lower down in the palm, until the musculature of the hand is sufficiently developed to carry it higher. Finger development it will be noted, is a highly important practice objective.

The shot may be held in the cradle formed by the neck and shoulders, on the neck close to the cheek, or directly above the shoulder at a distance ranging up to eight inches from the right ear. Those athletes who adopt the away-from-the-ear plan, claim that the method permits them to apply pushing force to the shot for a longer period of time during the delivery. Those who prefer to hold the shot against the neck, contend that this technique aids them in obtaining adequate relaxation, and a stable position during the step-back. They believe that intentional imbalance permits the gaining of the body momentum in the step-back. (See Fig. 1, p 83).

2. The Initial Stance

The majority of shot putters assume a relaxed standing position when stepping into the rear of the circle. The trunk and shoulders are held at right-angles to the direction of the putt. The left arm may be either extended upward or bent at approximately a right angle. The left foot , (which

will support most of the subject's bodyweight) rests against the circle boundary and will travel across the circle parallel to the line of delivery, through an arc of 180° .

Some 18 inches behind the left foot, the toe and ball of the right foot touch the ground lightly for balance. The left leg is 'athletically' straight, but the right leg just flexed at the knee. The head is facing the rear of the circle with the eyes focussed on an object 10 or 15 feet to the rear of the circle. The idea of this fixed object is to maintain a rear facing position as long as possible, throughout the step-back.

3. Step-back

The subject attempts to gain momentum through a state of imbalance, permitting the body to fall in the direction of the put. At the optimum point in the body fall, a vigorous push is applied by the left foot, and the left leg is extended fully from the toe to the hip. Simultaneously the right leg drives/kicks across the circle to land approximately half-way along the direction line and must be grounded before the left foot comes into contact with the circle. The shot's trajectory if possible, should be kept low during this phase. The left foot should follow this quickly and lands near the front of the circle in a slightly flexed position for the final drive, when the mass of the subject passes from the right to the left foot.

When executing the step-back, the centre of gravity reaches a point above and beyond the centre of the circle. This action is a phase of intentional imbalance and is designed

to help move the weight of the body forward toward the stop board, a desirable position for the ensuing drive from the right leg and foot.

The head and eyes, with respect to the body, have not changed position throughout the step-back. Any attempt to anticipate the movement will reduce torque. (The importance of this fact is stressed). Fig. 1d p 83).

As the step-back is concluded, the left foot is planted slightly to the left of the centre of the stop board and usually 'flush' against it. This placement affords a vaulting action by the left leg, subsequently employed in the delivery to aid in applying upward-forward momentum to the torso and the shot.

The degree of bend of the right knee at the conclusion of the step-back depends upon the physical qualifications of the individual. Good shot putters attempt to obtain as much bend in the right knee as their putting techniques permit. Frequently, the tall shot putter employs the deep knee bend to less advantage than his shorter competitor. Finally, there should be no delay between the step-back and the delivery.

4. Delivery Action

Simultaneously with the conclusion of the step-back, the right knee is bent, so that it is in a desirable position to contribute a vigorous upward-forward thrust when later, it is straightened speedily (See Fig 1e p 83).

The hips are rotated rapidly to the left. The correct timing of the hip thrust is very important; if the hip rotation is delayed, a reduction in leg force may result. At the

other extreme, if the hips are rotated too soon, there may be a loss of force in the upward thrust.

During the delivery, as the push from the right foot continues, it is pivoted so that it points approximately in the direction of the put. The right foot retains contact with the circle, thus providing support when pushing the shot upward and forward.

The left leg contributes a vaulting action that checks the momentum of the lower extremities and increases the momentum of the torso (including the shot).

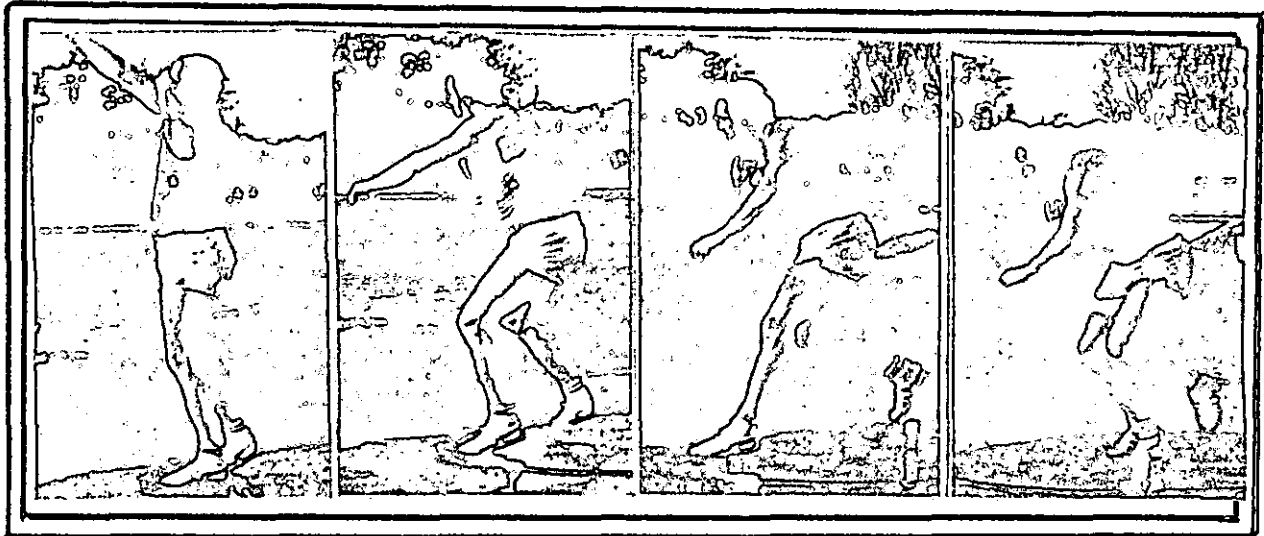
The position of the shot after the execution of the step-back is either on the neck or close to the chin. In the delivery, while explosive force is applied in the arm push, leg straightening, and trunk rotation, the shot is propelled upward and forward in line with the right shoulder.

The left arm at the onset of delivery is moved from a flexed to an extended position while the trunk is rotated, thus contributing aid in maintaining balance. At the time when the shoulders are rotated to the front during the final effort, the left arm again is bent at approximately a right angle.

During the delivery, the weight of the body, which previously rested chiefly over the right leg, is transferred to the left leg at approximately the instant of release.

5. The Reverse

While the release is executed, the head is tilted backward and the eyes are focused in the direction of the flight of the shot. The angle of release of the shot, with

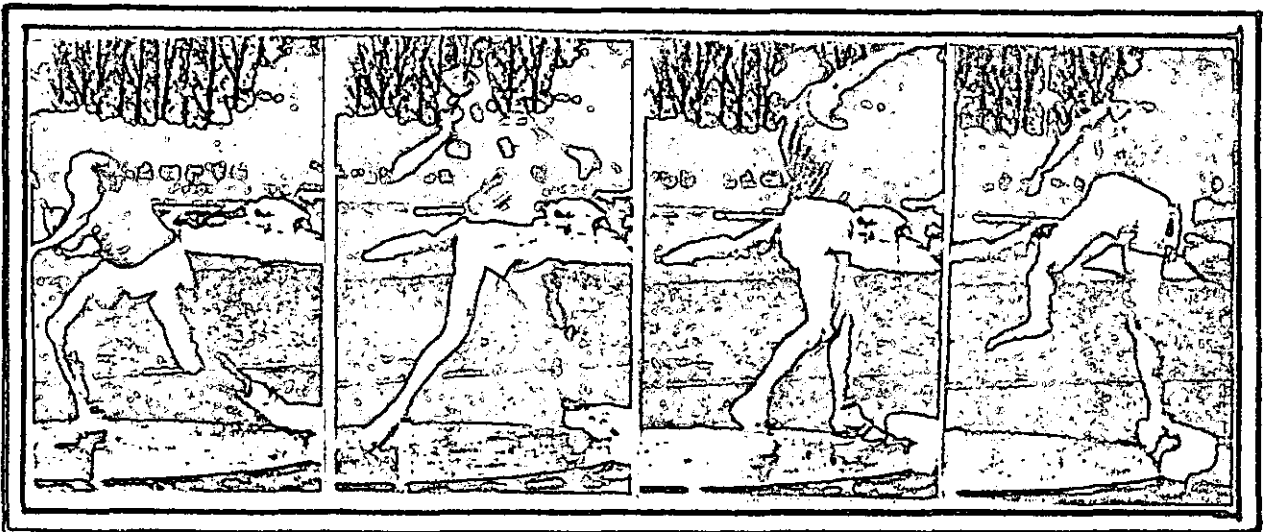
THE STEP BACK METHOD.W. R. TANCRED (AAA INDOOR CHAMPION 1969, 1976).

(a)

(b)

(c)

(d)



(e)

(f)

(g)

(h)

FIG. 1

respect to the ground, ranges from 37 to 42 degrees.

After completing the release, the shot putter concerns himself with gaining body balance in the recovery phase of the putt.

Since the rules of the event permit the putter to touch the side of the stop board, he reverses the position of the feet so that the right foot is swung rapidly against the stop board. This is one of the techniques possible to help maintain balance. The left leg is swung backward to the right and upward to the level of the hips, thus helping the athlete to stay within the circle. When he bends the right knee, he lowers the centre of the body weight - a further aid in solving the problem of balance (Fig 1h p 83).

B. An Analysis of the O'Brien Method

Again, throughout this discussion it is assumed that the subject is right-handed. A technical description of the shot putt skill is suitably summarised under five rubrics namely:

1. Grip
2. Initial Stance
3. Glide
4. Delivery of Action
5. Reverse

1. Grip

The grip is identical to the step-back method.

2. Initial Stance

An erect relaxed initial stance is recommended, with face, shoulders, hips and feet directed to the rear of the circle at 180° to the putting direction (Fig. 2a and b). The inside edge of the right foot is parallel to and close to the 'direction line', its toes up to the inside edge of the back of the circle. This foot carries the bodyweight. The ball of the left foot rests lightly near the other edge of the

'direction line', some 18 inches nearer the circle front, towards which both heels point. The left knee is slightly bent, the left arm limply aloft, the eyes fixed on a point a little to the rear of the circle, on which they remain directed through the glide and early part of the delivery effort, to assist balance and sense of direction.



Side View
(a)

Figure 2

Starting
Position



Front View
(b)

3. Glide

The action itself starts by bending the trunk forward from the hip joints till roughly parallel to the ground, so that the shot is carried by a foot or more behind the circle, before its forward journey starts. Simultaneously, the left leg, with the knee a quarter flexed, swings well up behind the athlete, i.e. towards the front of the circle and up, till the heel is level with the now horizontal back. (fig. 3a and f).

Without pause, the left leg still somewhat bent, drops again, and at the same time, the right knee bends more, lowering the trunk till chest and thigh may meet, the limit

of lowering coinciding with left toes momentarily touching the ground again. This ground contact enables the direction of left leg movement to be changed without the disturbance of balance, liable to be caused if it is dispensed with (fig.3g). Again without pause, the left leg once more swings high, backwards and towards the front of the circle, while simultaneously a powerful extension of the right knee launches the athlete on a fast, low, backward facing glide across the circle.

Three factors co-ordinate to initiate this:

1. the athlete allows his centre of gravity to pass behind his right foot base, effectively starting to fall backward towards the front of the circle.
2. coincident with this, is a very powerful thrust backwards from the right foot.
3. the left leg kick also helps in drawing the body across the circle.

The rapid low footed snatch of the right legs brings the right foot to ground at approximate mid-circle, well underneath the combined centre of gravity of man and shot, so that the immediate explosive right leg drive produces a great upward lift as well as a forward motion (fig.3c). The right foot may land in an approximately 45° 'knee back - toes back' position (knee and foot must point in exactly the same direction) with the instep straddling the direction line, which will indicate some anti-clockwise rotation of the pelvis during the glide, though the right hip will still be 'tucked' i.e. partly flexed, and twisted (to the left of the circle) (fig.3i). In order to secure a long range of action on the shot during

the coming delivery effort (for building up maximum velocity) there must be a very marked body leaned towards the rear of the circle as the right foot lands (fig.31). This 'lay-back' is a position made vastly more powerful by use with right 'knee back - toes back', as this brings the front part of the right foot, by which power is applied from the ground, splendidly underneath the combined centre of gravity of man and shot. (Good technique could be defined as movement with great body momentum through a series of strong positions).

4. Delivery Action

For efficient 'lift' from the right leg, the point of application of right foot power on the ground, the right hip and also the shot, must all be in the vertical plane (and it should be the plane cutting the direction line). To comply with the principle, 'lay-back' must be rearwards only and the right hip must not protrude to the left of the circle.

From 'lift' the putter goes into the delivery action whereby the hips lead the shot over the braced (but not straight) left leg (Fig.31 and K).

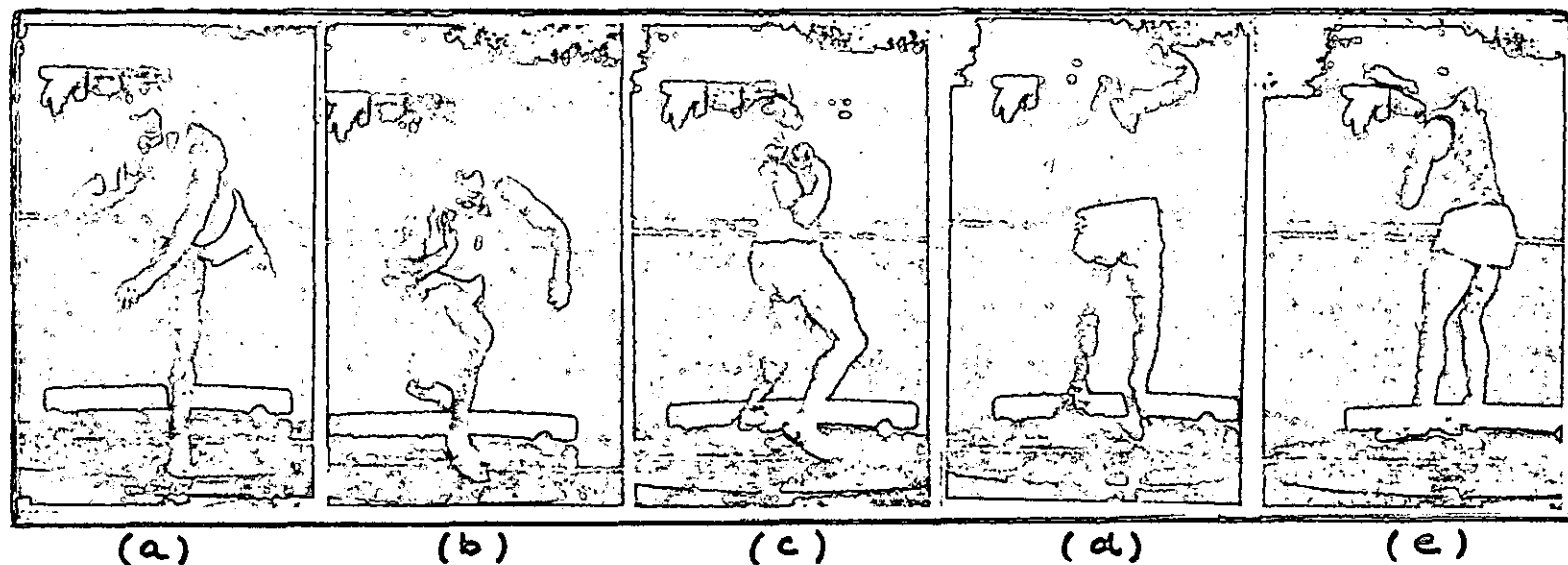
5. Reverse

The reverse is the same as the step-back method. Pearson (1963) says of the world classed shot putters, "the technique of such men is nearing perfection, which means that they (O'Brien through to Matson) possess with a mechanical efficiency of approaching 100%. So when that stage is reached, only small progress is possible by further technical improvement, unless of course some improvement on the orthodox is discovered".

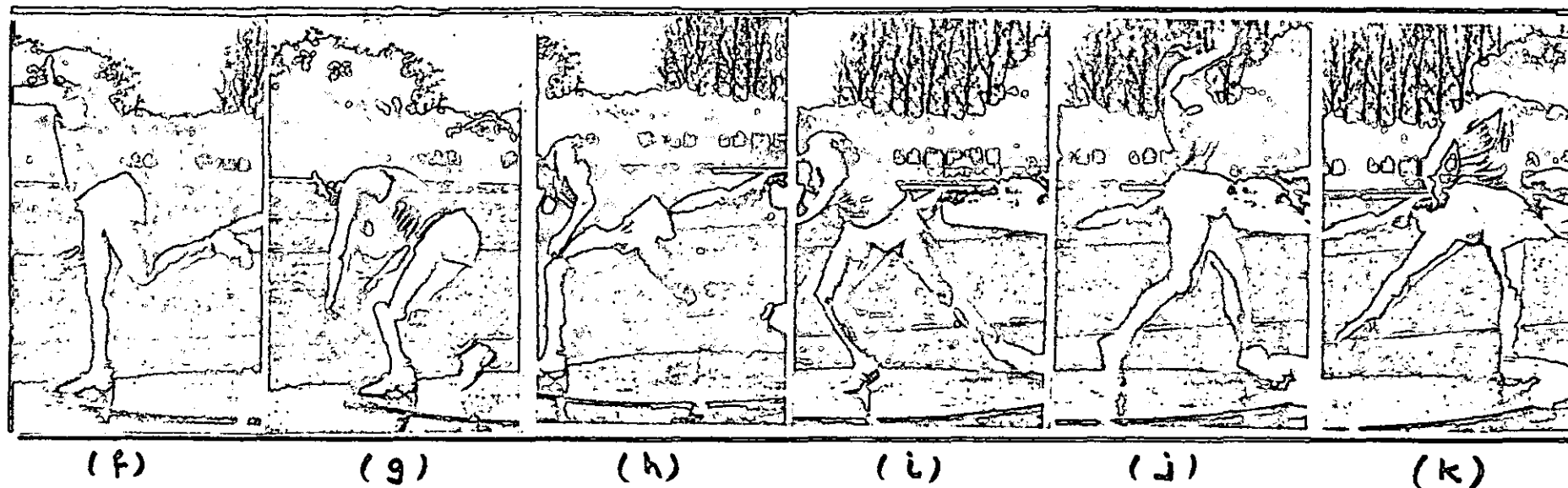
FIG. 3

O'BRIEN METHOD.

W.R. TANCRED (AAA INDOOR CHAMPION 1969, 1976).



ANTERIOR
VIEW



LATERAL
VIEW.

Some throwers have tried the shot putt with a discus turn and although greater speed is possible, control is very difficult and the principle of linear direction is sacrificed. It appears, therefore, that the O'Brien technique is more favourable for top class competitions.

(5c) The skill of weight lifting exercises, namely the bench press and the half-squat. (Nottingham school).

These were given at the start of stage 2 (session 13) and stage 3 (session 27). The first lecture was merely a definitive address covering the relevant mechanical data and safety factors involved, for example, keeping the back straight when attempting to half squat, and pressing both arms straight on the completion of the press on the bench. The remaining lecture was pertinent to the mechanical aspects of weight-lifting in the bench press and half-squat respectively.

CHAPTER 5

PROCEDURE

CHAPTER 5

PROCEDURE

The purpose of this investigation was to determine the relative effectiveness of two standard methods of learning and performing the shot putt among adolescent boys, namely the O'Brien and Step-back methods.

Two related but minor issues were included in the investigation. In the first place, the opportunity was taken to collect further information pertinent to the relationship of body type (somatotype) to shot putt performance among boys. Secondly, the attitude of the subjects to sport in general.

Subjects

In order to discover which shot putt method can be more easily learned, ninety normal healthy, fourteen year old schoolboys from a comprehensive background in Nottingham, were allocated into three groups of thirty in each, namely the O'Brien, the step-back, and the Control groups. They were equated randomly by the use of names on cards, the value of this method is that each person in the sampling population stand an equal chance of being selected.

Each of these groups were to progress through similar theoretical and practical stages (three stages in all) but, the control group could use either method of shot putting, with minimum motivation given to them during the actual testing.

Two other comprehensive schools, Ipswich and Loughborough assisted in this investigation for Stage 1 only, and the one hundred and eighty subjects were allocated into identical groupings as above, their ages and health being similar to the Nottingham school. Above all, all subjects expressed willingness to participate in this investigation.

Fundamental Assumptions of the Investigation

1. The investigator's knowledge as a Polytechnic lecturer and an Olympic participant qualified him as a suitable teacher of the selected motor skill.
2. During the practical sessions, the assistance given by another colleague was of a similar standard and nature. Previous discussion and practice certainly gave the impression that the procedure followed was identical.
3. Practice by the subjects was limited to the experimental sessions.
4. Through thoughtful presentation and teaching/coaching, the investigator was able to equate the motivation given to each of the step-back and O'Brien groups.

Apparatus

The shot's used in this investigation weighed 4.54Kg (10 lbs) and were 115mm ($4\frac{1}{2}$ ") in diameter respectively. In the weight training tests, the following pieces of equipment were used:

1. Weight Lifting bars
2. Squat racks and pins

3. Benches (for bench press activity)
4. Discs of 25lbs, 50lbs, 10lbs, 5lbs and single 1 lbs.

In somatotyping, the spido weighing machine, the stadiometer, sliding steel calipers, a steel centimetre rule and subcutaneous tissue calipers were used in this investigation. For the attitude questionnaire, Kenyon's (1968) approach was used.

The Experimental Design

The experimental design comprised of administering two standard methods of shot putting with weight lifting exercises performed after each stage completed.

All groups less the control groups received lecture demonstrations and practical instructions. Motivation and general overall encouragement was given on a group and an individual basis.

The carefully instructed information provided portions of information between periods of practical work. The experimental groups were taught in similar environmental and climatic conditions. The groups who came to participate in the practice sessions, were helped in such a way that they covered the practice over a morning's programme. This limited the possibility of a group practising every morning at the same time, which would have resulted at a considerable disadvantage to those groups working from 9.00 am - 10.00 am.

The experimental period covered over 40 sessions which included demonstrations and theoretical lectures respectively. Each session had a duration of one hour. The investigation

started in February and climaxed at the end of June. Pilot studies were completed earlier for the Ipswich and Loughborough schools.

Restrictions and Rules of the Shot Putt Skill

1. The skill must start from a stationary position.
2. No device of any kind, e.g. taping of the fingers, which in any way assists a performance is allowed.
3. The trial is made from within the confines of a 7' (2.13 metre) diameter circle.
4. It shall be a foul trial if the subject, after he has stepped into the circle and started to make his putt, touches with any part of his body, the ground outside of the circle, the top of the stop-board, **or** the top of the circle. The subject must not leave the circle until the shot has touched the ground.
5. During the trial(s) the subject may rest his feet against, but not on top of the stop-board.
6. The shot must be projected from the shoulder with one hand only. At the time the subject takes a stance in the circle to commence a putt, the shot shall touch or be in close proximity to the chin, and the arm shall not be **dropped** below this position during the time of putting. The shot must not be brought behind the line of the shoulders.
7. All putts to be valid putts must fall within the inner edge of the lines marking a sector of approximately 45° set out on the ground, so that the radii lines touch with their edges the extremities of the stop-board and cross at the centre of the circle.

The Skill Acquisition Programme

General Format of Work

The programme extended over a total of 40 hours. The format of the work was organised into the following design:

Stage 1

- | | |
|--|-------|
| 1 Initial introduction, demonstration, practical | 4 hrs |
| 2 Eight practical testing sessions | 8 hrs |

END OF STAGE 1

Stage 2

- | | |
|--|-------|
| 3 Weight training, film loops and practicals | 6 hrs |
| 4 Eight practical testing sessions | 8 hrs |

END OF STAGE 2

Stage 3

- | | |
|--|-------|
| 5 Weight training, film loops and practicals | 6 hrs |
| 6 Eight practical testing sessions | 8 hrs |

END OF STAGE 3

40 hrs

Production of the Material used for instruction

The instructional material in the general programme, was designed deliberately so that it could be easily comprehended by the subjects. Based upon Bruner's (1964) concept of maximal learning, development themes ^{were} used, i.e.:

- (A) The mode of representation - the overall presentation of material information and organisation.
- (B) The economy of learning - to ease learning, the selection of relevant items of information.

- (C) The effective power - in order to comprehend and produce existing themes of work and skill, the collation of relevant information.

Factors involved in the Development of Skill Acquisition

1. There would be individual differences of learning rate and that some teaching aids would help some subjects more than others.
2. Since no single teaching aid would equally facilitate learning, utilisation of variety of aids would be necessary.
3. Although careful guidance and instruction would be developed, every opportunity would be given to broaden the individual vocabulary of work.

Teaching Method

Previous information has been described which suggests the superiority of 'whole' over 'part' and 'progressive' teaching. The skill sessions were organised in such a way to facilitate the optimum use of the 'whole' method. During both periods of exposition and demonstration, importance was placed upon this fact and when reference was made towards a specific part of the skill, it was at all times integrated within the complete skill.

Guidance

At each stage of the learning and performing programme, emphasis was placed upon specific, teaching aspects and many times reiterated during further practice sessions. Some forms of guidance however, may have inhibited rather than

assist the performance and this fact was noted by the investigator. For example, in the use of demonstrations, careful preparations were used to exhibit both skilled and unskilled performances. Motivation may be given to some subjects by a skilled performance, others might be inhibited; it may also do less to facilitate 'insight' into the specific integrity of the shot skill. Therefore, demonstrations were used of both skilled and unskilled subjects, and notice drawn to the reasons for resultant technique. Cues of a kinesthetic nature were given to arouse subjective and objective attention.

The skilled performers were drawn from international athletes including the investigator.

Technique was on most occasions the result of optimum performance and care was taken to stress this fact; "...there is often a conflict between competitive and demonstrative technique. Once demonstrations are adjusted to emphasise any particular aspect of skill, once the sequence pattern of co-ordinated movements is slowed down for class observations, once actions are mimed, the subtle differences of technique occur which may mislead so far as the final performance of the skill is concerned. Time and motion study has shown that a slowed demonstration is in reality a different skill.." (Randall 1966).

Demonstration was given at the beginning of each stage namely periods 2, 15, and 29 respectively.

Demonstration (Shot Putting)

The Organisation

1. To make observation easier to the subjects, normally

a half-circle formation was adopted.

2. Demonstrations not only by the investigator but an international athlete.

The Development

1. Verbal exposition reduced to such terms, that it was easily interpreted by the subjects.
2. References made both to the general configuration of movement and a specific point of the skill.
3. Present to the subjects, concise and relevant instructions.

Attention to the type of distribution of film loops were given. Film loops (16mm) were all black and white and could be projected by a 'spectoanalyser' at normal speeds/slow motion. Two champion athletes were displayed: Parry O'Brien (Olympic Champion 1952/6), and Bill Neider (Olympic Champion 1960), who demonstrated the step-back method. To facilitate unobstructive viewing, the screen was hoisted and projection of the films took place in a class room.

Two film loops of novices performing the O'Brien and Step-back methods, were shown at the start of Stage 1 (period 3). They demonstrated incorrect grip, poor initial stance, lack of trunk/leg co-ordination, poor glide/step, retarded range and weak release. Film loops (O'Brien/Neider) were shown at the start of each stage, namely periods 2, 15 and 29 respectively.

The content of teaching material in addition, the method for Somatotype, weight training and attitude questionnaire.

The experimental procedure consisted of three stages of learning, and each stage, should be dealt with accordingly.

Stage 1

This applied to the schools of Nottingham, Loughborough and Ipswich.

Session 1 - The introduction and explanation of elementary techniques involved in shot putting (60 mins).

Session 2 - Film loops showing skilled and unskilled performers with simple verbal exposition given (60 mins).

Session 3 - General warm up and practical. (Warm up consisted of jogging and mobility work - 10 mins). The practical skill consisted of the following:-

- (a) Development: Subjects experienced themselves with the shot.
- (b) Exposition: Subjects were told of the differences between putting and throwing. Emphasis was placed on the correct delivery action.
- (c) Activity: The practice of the shot putting action, and getting used to putting within the 7' circle.
- (d) Exposition: An analysis for the mechanical reasons for the superiority of the shot putt movement.
- (e) Demonstration: Depending on group, the O'Brien method or step-back method.
- (f) Activity: Practice of methods introduced.

It must be assumed that throughout the three stages of learning, the control groups took part in lectures/demonstrations, but during practical testing sessions, received no motivation or skill advice from the investigator.

Organisation: The subjects worked in pairs for the shot putting skills, putting towards each other, two lines 70' (21.33m) apart (50 mins)

Session 4 - Last preparation for the first testing period, total time for the duration and format of lesson - (60 mins)

- 10 mins warm up
- 20 mins film loops
- 30 mins skill practice

Introduction: (A) The experimental groups shown film loops of skilled and unskilled demonstrations of shot putting.

(B) A general warm up including jogging, callisthenics, and lifting activities.

Development: Free practice with implements (Activity)

Reference points to film loops shown (Exposition)

Activity: Practice of the shot putt skill above.

Exposition and Demonstration: Importance of the following specific points:

- (1) In the throwing position, the correct feet placing (wide base)
- (2) Range of movement of paramount importance.
- (3) Correct putting action in the delivery phase
- (4) The importance of leg/trunk contribution stressed.
- (5) Head and shoulder position with eyes fixed at an object.

Activity: Practice of method(s).

Organisation: As in earlier sessions

Session 5 - Practical Test no 1. (Warm up and the best of three trials taken as the best result) (60 mins).

Session 6 - Practical test no. 2 (60 mins).

Session 7 - Practical test no. 3 (60 mins).

Session 8 - Practical test no. 4 (60 mins).

Session 9 - Practical test no. 5 (60 mins).

Session 10 - Practical test no. 6 (60 mins).

Session 11 - Practical test no. 7 (60 mins).

Session 12 - Practical test no. 8 (60 mins).

(Completion of Stage 1).

During this phase, an attitude questionnaire booklet which contained three attitude tests towards Physical Education and recreation was handed to each of the 90 Nottingham subjects for their answering. (Kenyon's 1968 attitude measurement questionnaire). Attitude test no. 1 included the following concepts: (see overleaf.)

you should check as follows:

fair 1 2 x 4 5 6 7 unfair

or

fair 1 2 3 4 x 6 7 unfair

The direction toward which you check, of course, depends upon which of the two ends of the scale seem most characteristic of the thing you are judging. If you consider the concept of the neutral on the scale (that is, both sides of the scale seem equally associated with the concept). Or, if the scale makes no sense (that is, it is unrelated to the concept) then you should place your check mark in the middle space:

safe 1 2 3 x 5 6 7 dangerous

Important.

1. Place your check mark in the middle of spaces, not on the boundaries.

THIS NOT THIS
 — : — : — : x : —x:
2. Be sure you check every scale for every concept - do not omit any.
3. Never put more than one check -mark on a single scale
4. The numbers under each scale are merely to assist in analysis of the data by computers. You do not need to pay any attention to them.

Sometimes you may feel as though you have had the same item before on the test. This will not be the case, so do not look back and forth through the items. Do not try to remember how you checked similar items earlier in the test.

Make each item a separate and independent judgement. Work at a fairly high speed through the test. Do not worry or puzzle over individual items. It is your first impression the immediate 'feelings' about the items, that we want. On the other hand, please do not be careless because we want your true impressions.

Attitude test no. 2 included seven questions on Classification of sports.

Attitude test no. 3 included thirteen questions on Classification of Physical Activity, which comprised many questions on family, fathers, attitudes to the above.

The opportunity also arose for the investigator to take somatotype measurements of the 90 subjects at the Nottingham school, during the lunch intervals, in which the Heath-Carter Somatotype Ratings were used.

Heath-Carter Somatotype Ratings

A Somatotype is a description of present morphological conformation. It is expressed in three numeral ratings in the order of endomorphy, mesomorphy and ectomorphy. These are the three primary components of physique, which describe individual variation in human morphology and composition.

Endomorphy = 1st Component. This refers to general fatness and hence to the relative leanness of the individuals physique.

Mesomorphy = 2nd Component. This refers to the musculoskeletal development. This component can be thought of as the lean body mass, which consists of the musculoskeletal system, the soft organs and the total body fluids. In other words, the whole body, less non essential fat (Behnke, 1955)

Ectomorphy = 3rd Component. This refers to the relative linearity of individual physique. It is based mainly on height/weight ratios and the low ratings imply elongated or linearity of body segments. Therefore the 3rd component ratings evaluate the form and degree of longitudinal distribution of the first and second component.

The Heath-Carter ratings have been arrived at through the interpretations of studies of body composition. These include estimates of total body fat, total body water and lean body weight. (Behnke 1953, 1959, 1961, 1963; Keys and Brozek 1953). In the majority of cases, ratings tend to be nearer to the mid-range than at the extremities of the scales.

Procedure for obtaining Heath-Carter Somatotype Ratings

- 1) Record the subject information
- 2) 1st Component, F-Scale. Sum the three skinfolds (t, ss, si). Circle the closest value in the F-Scale and then circle the rating value for that column.
- 3) 2nd Component M-Scale. Mark the point of the subject's height on the height scale. For each bone diameter, circle the figure in the proper row which is nearest to the exact measurement. Subtract t' skinfold from the biceps girth, and the 'c' skinfold from the 'c' girth, before circling the figure in the proper row which is nearest to the measurement. Dealing only with columns, mark the point that is the average of the circled figures for the diameters and girths only. Count the number of columns (and fractions) by which this average deviates right or left from the marked height, then move this number of columns right or left from the four in the second component rating and circle the closest rating value.

- 4) 3rd Component, L-Scale. Using the nomograph to find the height/weight ratio, record it by circling the closest value on the L-Scale. Circle the rating value for that column.
- 5) Record the final ratings in the appropriate columns at the foot of the form.

HEATH-CARTER SOMATOTYPE RATING FORM																									
NAME <u>J.B.</u>		AGE <u>45-2</u>		SEX: <input checked="" type="radio"/> M <input type="radio"/> F		NO: <u>135</u>																			
OCCUPATION <u>Teacher</u>		ETHNIC GROUP <u>Caucasian</u>		DATE <u>11 Nov 1966</u>																					
PROJECT: <u>A.T.D.</u>		MEASURED BY: <u>J.C.</u>																							
Skinfolds (mm):		TOTAL SKINFOLDS (mm)																							
Triceps = <u>13.0</u>	Upper Limit	10.9	14.9	18.9	22.9	26.9	31.2	35.8	40.7	46.2	52.2	58.7	65.7	73.2	81.2	89.7	98.9	108.9	119.7	131.2	143.7	157.2	171.9	187.9	204.0
Subcapular = <u>15.3</u>	Mid-point	9.0	13.0	17.0	21.0	25.0	29.0	33.5	<u>38.0</u>	43.5	49.0	55.5	62.0	69.5	77.0	85.5	94.0	104.0	114.0	125.5	137.0	150.5	164.0	180.0	196.0
Suprailiac = <u>9.9</u>	Lower Limit	7.0	11.0	15.0	19.0	23.0	27.0	31.3	35.9	40.8	46.3	52.3	58.8	65.8	73.3	81.3	89.8	99.0	109.0	119.8	131.3	143.8	157.3	172.0	188.0
TOTAL SKINFOLDS = <u>38.2</u>																									
Calf = <u>9.8</u>																									
FIRST COMPONENT		1/2	1	1 1/2	2	2 1/2	3	3 1/2	<u>4</u>	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	8	8 1/2	9	9 1/2	10	10 1/2	11	11 1/2	12
Height (in.) = <u>67.1</u>		55.0	56.5	58.0	59.5	61.0	62.5	64.0	65.5	67.0	68.5	70.0	71.5	73.0	74.5	76.0	77.5	79.0	80.5	82.0	83.5	85.0	86.5	88.0	89.5
Bone: Humerus (cm) = <u>6.8</u>		5.19	5.34	5.49	5.64	5.78	5.93	6.07	6.22	6.37	6.51	6.65	<u>6.80</u>	6.95	7.09	7.24	7.38	7.53	7.67	7.82	7.97	8.11	8.25	8.40	8.55
Femur = <u>9.27</u>		7.41	7.62	7.83	8.04	8.24	8.45	8.66	8.87	9.08	<u>9.29</u>	9.49	9.70	9.91	10.12	10.33	10.53	10.74	10.95	11.16	11.37	11.58	11.79	12.00	12.21
Muscle: Biceps (cm) = <u>31.7</u>		23.7	24.4	25.0	25.7	26.3	27.0	27.7	28.3	29.0	29.7	30.3	31.0	<u>31.6</u>	32.2	33.0	33.6	34.3	35.0	35.6	36.3	37.1	37.8	38.5	39.3
• (triceps skinfold) = <u>34.7</u>		27.7	28.5	29.3	30.1	30.8	31.6	32.4	33.2	<u>33.9</u>	34.7	35.5	36.3	37.1	37.8	38.6	39.4	40.2	41.0	41.8	42.6	43.4	44.2	45.0	45.8
• (calf skinfold) = <u>9.8</u>																									
SECOND COMPONENT		1/2	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	<u>5</u>	5 1/2	6	6 1/2	7	7 1/2	8	8 1/2	9						
Weight (lb.) = <u>147.0</u>	Upper limit		11.99	12.32	12.53	12.74	12.95	13.15	13.36	13.56	13.77	13.98	14.19	14.39	14.59	14.80	15.01	15.22	15.42	15.63					
Ht. / $\sqrt{Wt.}$ = <u>12.76</u>	Mid-point		and	12.16	12.43	12.64	12.85	13.05	13.26	13.46	13.67	13.88	14.01	14.29	14.50	14.70	14.91	15.12	15.33	15.53					
	Lower limit		below	12.00	12.33	12.54	<u>12.75</u>	12.96	13.16	13.37	13.56	13.78	13.99	14.20	14.40	14.60	14.81	15.02	15.23	15.43					
THIRD COMPONENT		1/2	1	1 1/2	2	<u>2 1/2</u>	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	8	8 1/2	9						
FIG. 4		Anthropometric Somatotype		FIRST COMPONENT		SECOND COMPONENT		THIRD COMPONENT		BY: <u>J.C.</u>															
				<u>4</u>		<u>5</u>		<u>2 1/2</u>																	
		Anthropometric plus								RATER: _____															
		Phenoscopic Somatotype																							

Fig 4

showing method form of Heath-Carter, to enable somatotype rating results. (from Heath & Carter 1967). A modified somatotype method. Am.J.Phys. Anthropol., 27, 57-74.)

STAGE 2

This applied to the Nottingham School only

Session 13 - Demonstration lecture of Weight training methods of Bench Press and half-squat -(10 mins)

Introduction : 10 mins warm up comprising of jogging and general strengthening, callisthenics etc. (10 mins).

Development: Exposition: Recapitulation and reiteration of the fundamental aspects of weight/lifting technique.

Activity Free practice of the skill, with specific attention to safety factors. (40 mins).

Organisation: As for previous sessions - in pairs, but in sports hall in half circle configuration.

It is perhaps convenient to explain the method(s) of the bench press and full squat respectively.

(1) Bench Press - Starting position. Supine position on bench with head on bench. Using pronated grip slightly wider than shoulder width, hold bar at arm's length above chest.

Movement: Inhale, then lower the bar to the chest, touching lightly; with a vigorous arm, shoulder and chest drive, (no bounce or heave permitted) press to the starting position and exhale. When bench pressing maximum, lower the bar softly so as to permit complete control of the weight at all times. Throughout the pressing movement, the buttocks must remain in contact with the bench, with the elbows positioned either in at the sides or pointed outwards; practice will determine the most comfortable position.



Fig 5 Press on Bench

- (2) The Squat (half) - This develops leg strength - the full squat should never be used, (Klein and McDonald 1971) support this theory.) The half squat to a position with thighs parallel to the floor is suggested. The use of a bench behind the person squatting to control the depth of the squat, is a useful aid. Manoeuvring a heavily loaded bar into position for a squat can be a difficult operation without squat-racks (which are advisable for any school, where advanced weight training is conducted as a club activity) and the following method of lifting was used.

The lifter takes up a position between the squat rack. During the squat, weight is support on the shoulders resting directly on the trapezius muscle or on a towel or pad for greater comfort. The back must be kept

straight and as the knees are flexed, they should go forward and slightly outwards. Where the lifter (subject) has difficulty in maintaining balance, he should start the exercise with the heels resting on a plank 1-1½" thick or on weight lifting discs.

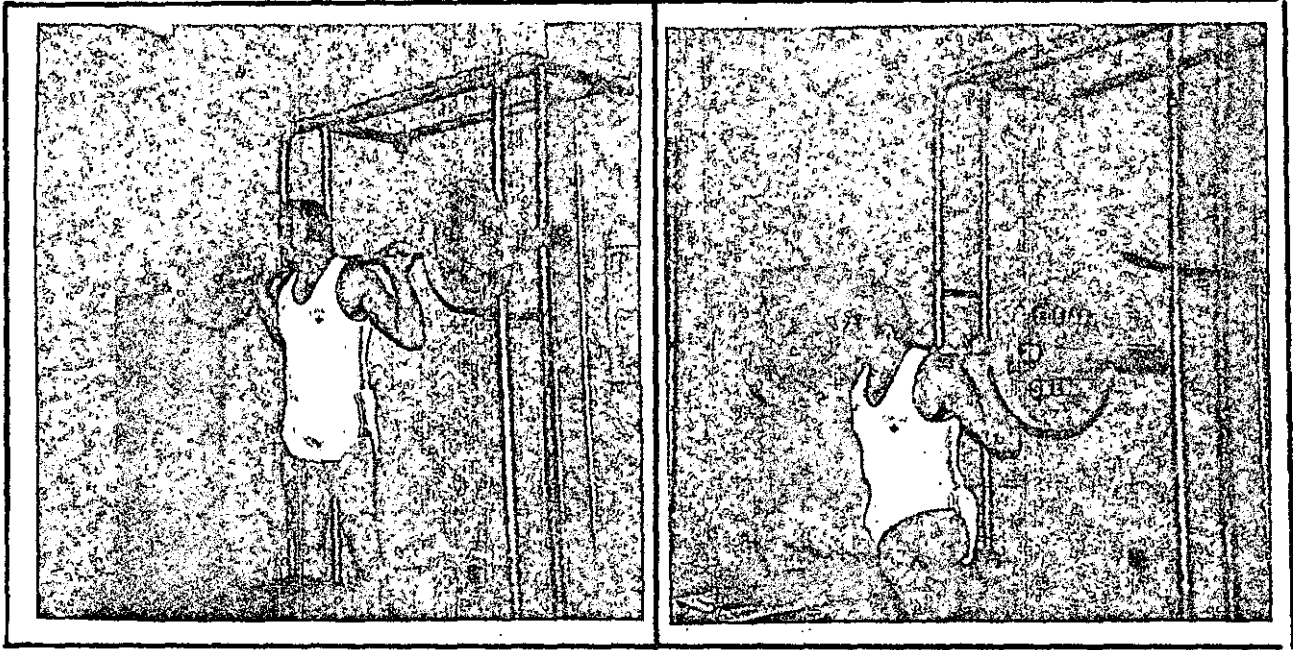


Fig 6 The Half-Squat.

- Session 14 - Weight Training (warm up, bench press and half squat.) (60 mins).
- Session 15 - Film loops of shot putting skills (15 mins)
Weight training (warm up, bench press and half squat) (45 mins)
- Session 16 - Shot putting skill practice (30 mins)
Weight training (bench press and half squat)(30 mins)
Shot putting was included first in the lesson, because no break down of skill aquisition would occur. If weight training was first, the

investigator felt the shot putt session would bear limitations on the skill for example, timing of the throwing action.

- Session 17 - As session 16 (60 mins)
- Session 18 - As session 16 (60 mins)
- Session 19 - Practical test no. 1.
(Warm up and the best of three trials taken as the best result) (60 mins)
- Session 20 - Practical test no. 2 (60 mins)
- Session 21 - Practical test no. 3. (60 mins)
- Session 22 - Practical test no. 4. (60 mins)
- Session 23 - Practical test no. 5. (60 mins)
- Session 24 - Practical test no. 6. (60 mins)
- Session 25 - Practical test no. 7 (60 mins)
- Session 26 - Practical test no. 8. (60 mins)

(Completion of Stage 2)

STAGE 3

This again applied to the Nottingham School only.

- Session 27 - Identical format of demonstration/lecture and activity as session 13 (start of stage 2)
(60 mins)
- Session 28 - Weight training (warm up, bench press and half squat) (60 mins)
- Session 29 - Film loops of shot putting skills (15 mins)
Weight training (warm up, bench press and half squat) (45 mins)
- Session 30 - Shot putting skill practice (30 mins)
Weight training (bench press and half squat) (30 mins)

<u>Session 31</u>	- As session 30	(60 mins)
<u>Session 32</u>	- As session 30	(60 mins)
<u>Session 33</u>	- Practical test no. 1.	
	(Warm up and the best of three trials taken as the best result)	(60 mins)
<u>Session 34</u>	- Practical test no. 2	(60 mins)
<u>Session 35</u>	- Practical test no. 3	(60 mins)
<u>Session 36</u>	- Practical test no. 4.	(60 mins)
<u>Session 37</u>	- Practical test no. 5.	(60 mins)
<u>Session 38</u>	- Practical test no. 6.	(60 mins)
<u>Session 39</u>	- Practical test no. 7.	(60 mins)
<u>Session 40</u>	- Practical test no. 8.	(60 mins)
	(Completion of Stage 3)	

This finally concluded the experimental design to determine the relative effectiveness of two standard methods of learning and performing the shot putt among adolescent boys.

Experimental Design (statistics)

The study was designed as a factorial experiment, the factors and levels being as follows:

<u>Factor</u>	<u>Levels</u>
Schools	3 (Nottingham, Loughborough, Ipswich)
Methods	3 (Step back, O'Brien, Control)

The number of observations at each level of each factor was 30.

Data on the distance achieved prior to training (test 1) and after eight sessions of training (test 8) was recorded.

Analysis

The analysis used was an analysis of covariance for a

factorial design. This was chosen because it was expected that there would be a strong correlation between the test 1, and test 8 values. A similar linear relationship was observed in all nine groups. The method used is described by Snedecor G. W. and Cochran W.G. (1968) by the Iowa State University Press, Chap. 14, pages 419-446 in Statistical Methods, 6th Edition. The values collected at test 1, were used as the co-variates. Details of the analysis are given in Tables 1 to 3 in the results section.

Product moment correlation co-efficients were administered for performance and somatotype in the Nottingham School only. Student 't' test was applied to see whether any significant differences arose in the factors of height, weight, distance putt, bench press and half squat respectively, in the Nottingham School only, (Tables 6,7,11,12,13, and 14,), including the Stages 1,2, and 3 in this investigation.

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CHAPTER 6

RESULTS

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CHAPTER 6

RESULTS

The results of the three phases of experimental work are presented separately in three parts, into which this chapter is sub-divided.

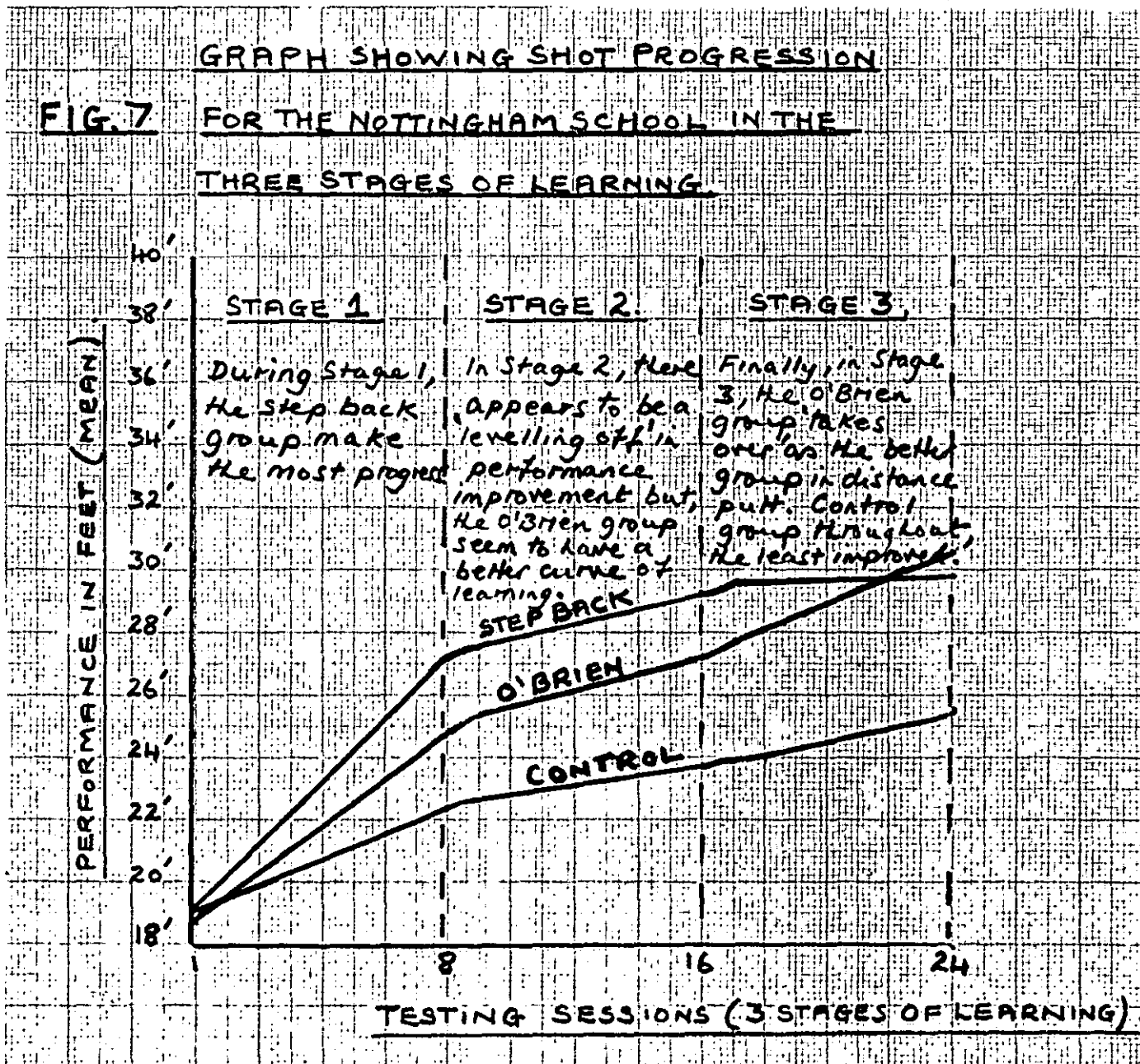
The investigation as a whole has been concerned with the relative effectiveness of two standard methods of learning and performing the shot putt among adolescent boys. Two related but minor issues were investigated and that included firstly, the relationship of body type (somatotype) to shot putt performance and secondly, the attitude of the subjects to sport in general.

The subjects were divided at random into three groups at each school - two experimental and one control. All groups participated in identical teaching programmes, and received the same initial lecture/demonstration. Only the experimental factors (i.e. O'Brien v Step-back v Control) differed among groups. Scores were recorded after each practical session in the three stages of learning. (Stage one consisted of tests 1-8; Stage two consisted of tests 9-17; Stage three consisted of tests 18-26 respectively).

It is now appropriate to analyse the results, beginning with Stage one. Stage one was the experimental period of learning and performance from the beginning of the experiment up to, and including test 8, during which subjects were measured in distance thrown using either the O'Brien or step-back method of shot putting. Data for tests 1 and 8 were

analysed to ascertain possible sources of variation, by schools and by experimental method.

To aid the reader, a graph at this point has been included of the Nottingham school's progression in shot putt distance, from test 1 to test 24, which covers the three stages of learning and performing the shot putt event.



Also included below, is a table of the statistical symbols used in this investigation.

<u>Table 1</u>	
<u>Statistical Symbols</u>	
df	Degrees of freedom
ss	Sums of squares
ms	Mean squares
F	Snedecor's F value
sd	Standard deviation
b	Regression coefficient
ns	Not significant ($P > 0.05$)
LSD	Least Significant differences (standard error of differences between 2 means $\times t$).

STAGE 1 (Performance of shot putting in Nottingham, Ipswich and Loughborough schools respectively)

Initially the results were analysed both at practical test 1, and at practical test 8, using an analysis of variance, as shown by Snedecor and Cochran, (1969) sixth edition of Statistical Methods, published by the Iowa State University Press, chapter 10, page 258. This analysis is discussed below.

1. ANOVA: The means for main effects of the schools and methods are shown in Table 2, for both test 1 and test 8. In the tables LSD = least significant difference at either 5% or 1% level of significance (page 272 of statistical methods by Snedecor and Cochran 1969).

At test 1, there was no significant difference between schools or between methods of training and no significant interaction between the two.

At test 8, there was again no significant difference between schools. However, both the step-back and O'Brien gave significantly higher mean values than the control, and in turn those subjects using the step-back were significantly higher than those using the O'Brien method.

In teaching this event at schoolboy level, it has proved significantly, that the step-back method is the better of the two in distance putt. (It would be appropriate to see the graph representation showing the Stage 1 effects of the Nottingham school).

Table 2

Main Effect Table (Shot Putt Distances)

SCHOOLS/METHODS	TEST 1	TEST 8
	Means in shot Distance (feet)	Means in Shot Distance (feet)
Loughborough school	18.25	23.60
Nottingham school	19.06	24.82
Ipswich school	18.64	23.59
LSD (.05)	1.23	1.20
LSD (.01)	<u>1.62</u> ns	<u>1.57</u> ns
Step Back Method	18.80	26.18
O'Brien Method	18.69	24.70
Control Method	18.45	21.13
LSD (.05)	1.23	1.20
LSD (.01)	<u>1.62</u> ns	<u>1.65</u> s
OVERALL MEAN	18.65	24.00
sd (261 df)	4.201	4.093

Using ANOVA in Table 3 below, there is no significant difference between schools, between methods and the interaction between schools and methods at test 1.

However, at test 8, there is a significant difference between methods at the .001 level, which statistically proves again that the step-back method is the better of the two in distance putt. There is no significant difference between schools and the interaction between schools and methods.

Table 3

Test 1. Shot Putting Scores

	df	ss	ms	F
Between schools	2	29.5876	14.7938	0.84 ns
Between methods	2	5.7562	2.8781	0.16 ns
Interaction s x m	4	10.6906	2.6726	0.15 ns
Within groups	261	4605.51	17.6456	

TOTAL 269 4651.5444

Test 8

	df	ss	ms	F
Between schools	2	89.8256	44.9128	2.68 ns
Between methods	2	1212.4637	606.2318	36.2
Interaction s x m	4	43.2261	10.8130	1 ns
Within groups	261	4373.4460	16.7565	

TOTAL 269 5718.9614 *** P = < 0.001

2. Analysis of Covariance

Since each subjects throwing distance was measured as in both test 1, and test 8, an analysis of covariance using test 8 as the variate, and test 1 as the covariate would be additionally more revealing. Hence, an analysis of covariance was carried out giving another statistical comparison. (The method used was that of Snedecor and Cochran's Statistical Methods, Sixth Edition 1969, Chapter 14 page 419.)

F-tests were used to test the significance of the three effects and were significant for schools and methods ($P < .05$, $P < .01$ respectively) [see Table 4 below].

Table 4
F-tests in Analysis of Covariance

	df	SS	ms	F
1. <u>SCHOOLS</u>				
schools	2	34.4432	17.2216	4.03 *
deviation	260	1110.8323	4.2724	
schools & error	262	1145.2755		
2. <u>METHODS</u>				
methods	2	1075.6404	537.8202	125.9***
deviation	260	1110.8323	4.2724	
methods & error	262	2185.4727		
3. <u>INTERACTION</u>				
interaction	4	41.0342	10.2585	2.40
deviation	260	1110.8323	4.2724	ns
interaction & error	264	1151.8665		

*** = .01
** = .001

ns = not significant
* = .05

The test 8 figures were adjusted to a test 1 figure of 18.65 and the adjusted means are shown in Table 5. (The adjusted means are regarded as better estimates of the treatment effects than the unadjusted means because one of the sources of experimental error has been removed by the adjustments - Snedecor and Cochran, Statistical Methods, Sixth Edition, page 429). From this it can be seen that the Nottingham school gave results significantly higher than the Ipswich school ($p < .05$).

Both the step-back and O'Brien methods gave a large significant ($P < .01$) increase over the Control. However, the most important observation is that the step-back method gave results significantly higher than the O'Brien method ($P < .01$).

Table 5

Adjusted Means at Test 8

<u>SCHOOLS/METHODS</u>	<u>SHOT DISTANCE IN FEET</u>
Loughborough school	23.94
Nottingham school	24.47
Ipswich school	23.77
LSD (0.05)	0.60
LSD (0.01)	0.79
Step-back method	25.97
O'Brien method	24.67
Control method	20.96
LSD (.05)	0.60
LSD (.01)	0.79
SD.260 df	2.067

Table 5 cont.....

SCHOOL(S)	<u>STEP BACK</u>	<u>O'BRIEN</u>	<u>CONTROL</u>
	(Shot putting distance in feet)		
Loughborough	25.91	25.24	20.65
Nottingham	26.75	24.67	22.00
Ipswich	25.50	24.08	21.23
LSD 0.05		1.05	
LSD 0.01		1.38	
Interaction		ns	

Using all the above statistical treatments, it shows statistically that during test 1 to 8, that the step-back method when compared with the accepted O'Brien method for shot putting it is the better of the two. It is therefore felt that during the introduction of the event to adolescent boys, the step-back should be encouraged, not only for its simplicity of movement, but in distance thrown.

3. Student's 't' test

Student's 't' test was applied to see whether any significant differences arose between the groups in the Nottingham school in the factors of Height, Weight, Shot distance, Bench press and Half-squat. Results show (Table 6) that a comparison of the initial means at test 1 by application of the t-test resulted in no significant differences between methods for any of the five variables.

Table 6

(Nottingham school only)

Student 't' test for testing of significanceTEST 1

	Height		Weight		Shot		Bench Press		Squat	
	Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd
Step-back	67.90	3.28	138.87	24.48	19.18	6.106	114.47	12.32	148.60	23.02
O'Brien	68.66	2.75	143.03	16.27	18.94	2.62	115.90	10.12	151.30	15.53
Control	68.47	2.52	140.10	17.65	19.05	5.112	121.21	9.624	156.60	18.78

(P=70.05)

	't'	Probability
1. HEIGHT		
(a) Step back/O'Brien	.20	ns
(b) O'Brien/Control	.50	ns
(c) Control/Step back	.75	ns
2. WEIGHT		
(a) Step back/O'Brien	.80	ns
(b) O'Brien/Control	.60	ns
(c) Control/Step back	.20	ns
3. SHOT DISTANCE		
(a) Step back/O'Brien	.124	ns
(b) O'Brien/Control	.01	ns
(c) Control/Step back	.10	ns
4. BENCH PRESS		
(a) Stepback/O'Brien	.20	ns
(b) O'Brien/Control	1.90	ns
(c) Control/Step back	1.95	ns
5. HALF SQUAT		
(a) Step back/O'Brien	.50	ns
(b) O'Brien/Control	1.20	ns
(c) Control/Step back	1.20	ns

Results at test 1 show that the samples are acceptable as the same population for all areas of height, weight, shot distance, bench press and half-squat are non-significant.

However, at test 8, both the step-back and the O'Brien groups are significant in shot putting distance, when compared

to the control group. (The step-back group in fact, is highly significant when compared to the control group = 4.747) [Table 7].

The test 1 results show that the three method groups were well matched at the start of the investigation.

Table 7

TEST 8

	Height		Weight		Shot		Bench Press		Squat	
	Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd
Step-back	67.97	3.13	139.50	24.42	27.20	5.24	125.80	11.29	164.60	17.65
O'Brien	68.10	2.75	144.00	16.14	24.91	3.45	127.00	9.28	167.00	14.80
Control	68.47	2.58	140.80	16.44	22.42	4.43	126.75	7.24	164.93	16.89

($P > 0.05$)

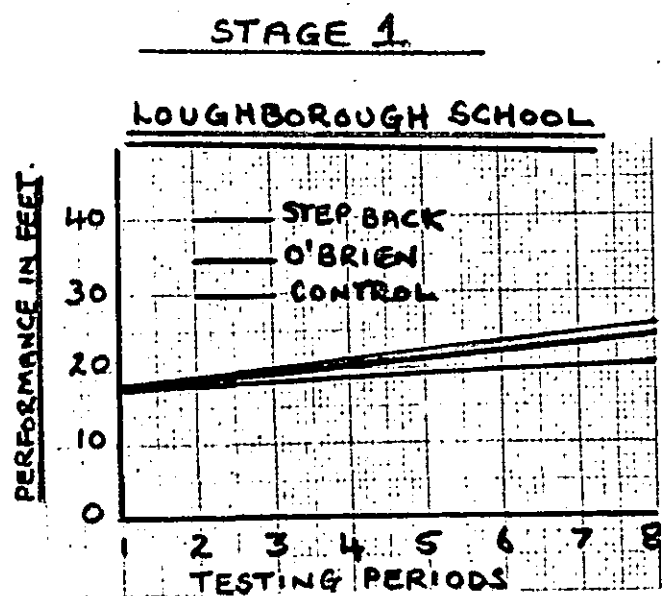
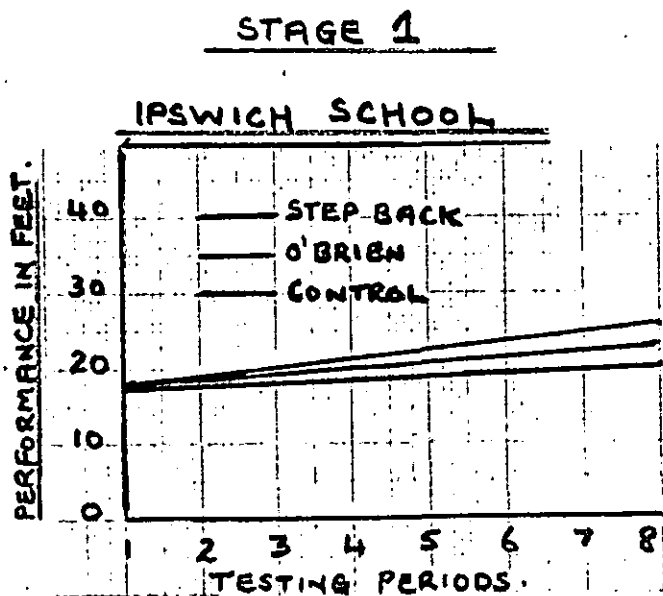
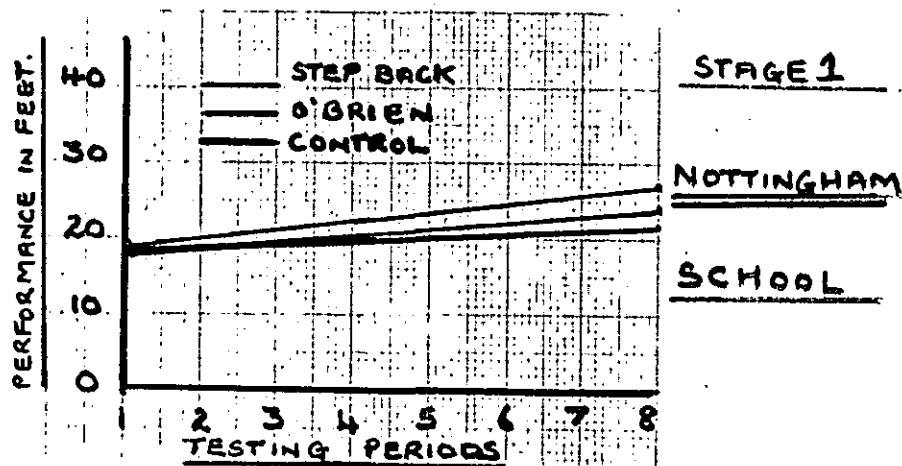
	't'	Probability
1. HEIGHT		
(a) Step-back/O'Brien	.21	ns
(b) O'Brien/Control	.532	ns
(c) Control/Step-back	.703	ns
2. WEIGHT		
(a) Step-back/O'Brien	.842	ns
(b) O'Brien/Control	.190	ns
(c) Control/Step-back	.242	ns
3. SHOT DISTANCE		
(a) Step back/O'Brien	1.936	ns
(b) O'Brien/Control	2.439	*
(c) Control/Step back	4.747	**
4. BENCH PRESS		
(a) Step back/O'Brien	.450	ns
(b) O'Brien/Control	.930	ns
(c) Control/Step back	.38	ns
5. HALF SQUAT		
(a) Step back/O'Brien	.569	ns
(b) O'Brien/Control	.470	ns
(c) Control/Step back	.075	ns

The most interesting observation shows that when the O'Brien and Step-back groups are compared to the control group in shot putting distance they are significantly different. (In fact, the step-back group is highly significant at 4.747). The step-back group when compared against the O'Brien, improve from test 1 (.124) to test 8 (1.936). However, the margins of improvement were not statistically significant in this school.

GRAPHS SHOWING IMPROVEMENT MADE
FROM TEST 1 TO TEST 8 IN ALL THREE GROUPS
OF THE NOTTINGHAM, IPSWICH AND LOUGHBOROUGH
SCHOOLS RESPECTIVELY

Fig 8

Motor learning curves showing rapid initial improvement in shot putting, particularly from step-back method, suggesting the greater applicability of this method for beginners



4. Mean Scores for Attitude Test (Nottingham)

The results of the attitude tests administered during Stage 1, and at the end of Stage 3, are included below (for comprehensive outlay of the answer sheet, see Appendix 2)

Table 8

Social Experience	Control			Step back			O'Brien		
	Before	After	t	Before	after	t	Before	after	t
Health & Fitness	45.4	45.7	-0.92 NS	47.5	47.4	0.24 NS	46.4	46.0	1.3 NS
Thrill & some Risk	48.2	48.7	-0.69 NS	49.3	49.6	-1.03 NS	48.3	49.0	-2.4 *
Beauty	41.9	42.9	-2.5 *	44.3	43.7	2.18 *	42.9	42.6	0.91 NS
Strenuous	43.7	44.1	-0.9 NS	45.4	44.4	3.65 ***	42.5	42.4	0.2 NS
Chance	43.4	43.4	0 NS	46.8	45.9	2.99 **	44.8	46.3	-4.7 ***
Tension	37.7	37.4	0.73 NS	40.2	39.0	3.41 ***	35.9	35.5	0.8 NS
	44.7	45.9	-6.5 ***	46.4	47.0	-2.0 NS	45.6	46.3	-2.7 *

t: paired t test for comparing before and after scores

ns: not significant

* : $P < .05$

** : $P < .01$

Results show several significant effects, the main ones being:

1. Decrease of beauty score using O'Brien method.
2. Decrease of strenuous score using O'Brien method, but increase using step-back method.
3. Increase of tension scores using all three methods, although significance was reached in only two cases.
4. All groups list on top, the value of Physical Activity for Health and Fitness - Control (48.2-48.7); Step-back (49.3-49.6); O'Brien (48.3-49.0).

5. All groups list on bottom, the value of Physical Activity as Games of Chance - Control (37.7-37.4); Step-back (40.2-39.0); O'Brien (35.9-35.5).

5(a) Somatotype

The results of the first part of the somatotype is shown below. It shows the somatotype distribution of the 90 subjects of Nottingham school, on whom data have been collected. Each subject is presented by a dot.

From the somatochart it is apparent that there is a fairly varied distribution of body types, but taking the population as a whole, the majority of students are Ectomorphic-Mesomorphs. The somatotype mean rounded to the nearest half point rating is $3 \ 4 \ 3^2$.

In order to produce an analysis of the distribution of somatotypes, the data have been categorised into thirteen main groups (Hertzberg and Dupertuis, 1963; Jones et al, 1965). The most obvious division is into groups in which one of the three basic components is seen to predominate, as well as into groups in which various other combinations of the components exist.

The groups are as follows:-

1. Endomorphs - individuals in whom the first component is at least 4^2 and is greater than either of the other two by at least one point. For example $5 \ 4 \ 2^2$, or $4^2 \ 3^2 \ 3^2$.
2. Mesomorphs - individuals in whom the second component is at least 4^2 and is greater than either of the other two by at least one point. For example $3 \ 5 \ 4$, or $2^2 \ 4^2 \ 3^2$.

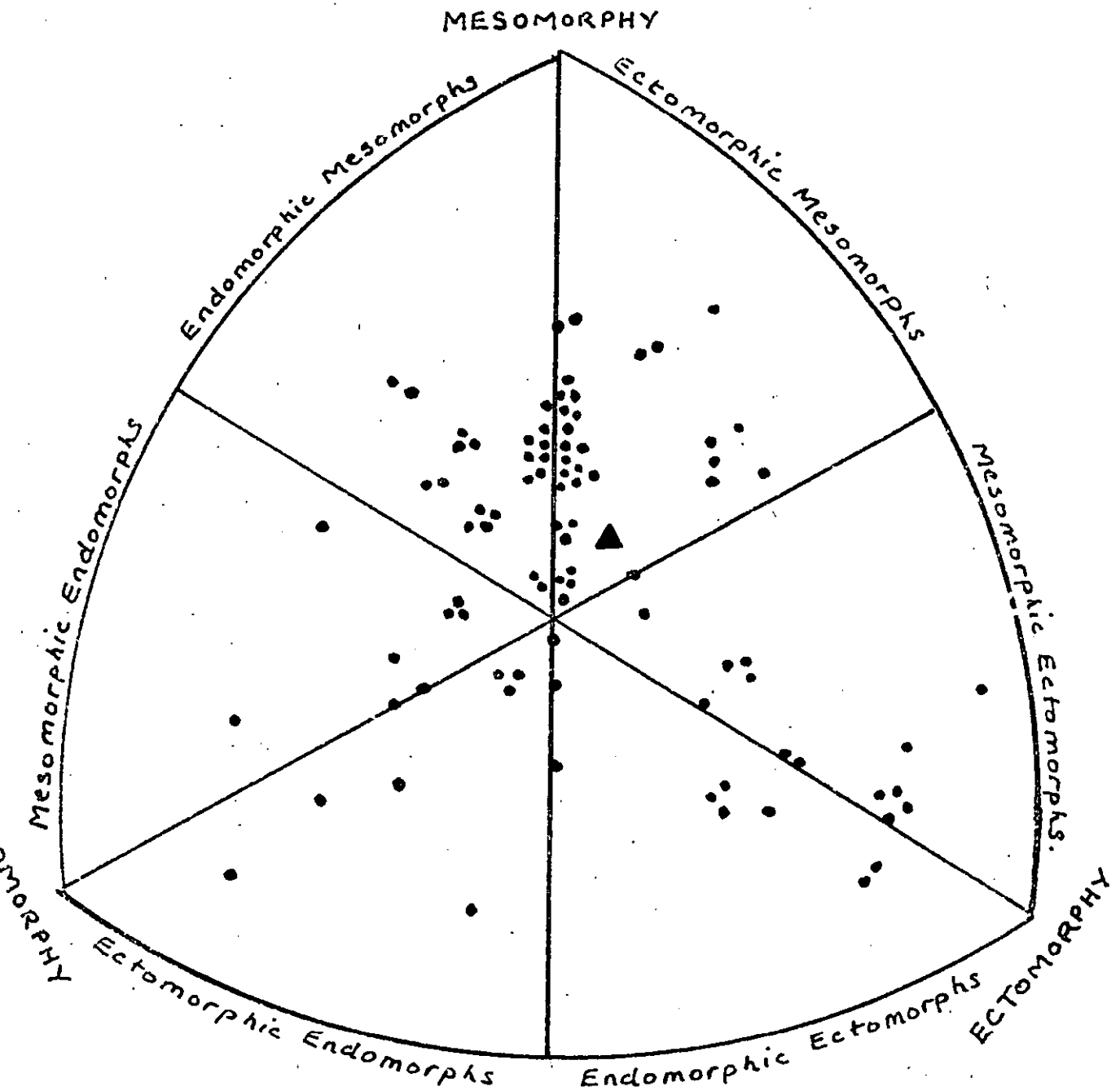
3. Ectomorphs - individuals in whom the third component is at least 4^2 and is greater than either of the other two by at least one point. For example $3\ 3^2\ 5$, or $2\ 3^2\ 4^2$.
4. Endomorph - Mesomorphs - individuals in whom the first and second components are balanced and in whom these components exceed the third component by more than one full point. Example: $4\ 4\ 2$, or $4^2\ 4^2\ 2^2$.
5. Endomorph - Ectomorphs - individuals in whom the first and third components are balanced and in whom these components exceed the second component by more than one full point. Example: $4\ 2\ 4$, or $4^2\ 2^2\ 4^2$.
6. Mesomorph-Ectomorphs - individuals in whom the second and third components are balanced and exceed the first component by more than one full point. Examples: $2^2\ 4\ 4$, or $3\ 4^2\ 4^2$.
7. Mesomorph-Endomorphs - individuals in whom the first component is dominant over the second by half a point and the third component is lower. Examples: $4^2\ 4\ 1^2$, or $4^2\ 4\ 2$.
8. Ectomorphic-Endomorphs - individuals in whom the first component is dominant over the third by half a point and the second component is lower. Example: $4^2\ 3\ 4$, or $4^2\ 2^2\ 4$.
9. Endomorphic-Mesomorphs - individuals in whom the second component is dominant over the first by half a point and the third is lower. Example: $4\ 4^2\ 2$, or $4\ 4^2\ 1^2$.
10. Ectomorphic-Mesomorphs - individuals in whom the second component is dominant over the third by half a point and the first component is lower. Example: $1^2\ 4^2\ 4$, or $2\ 4^2\ 4$.

TOTAL POPULATION

N = 90 (NOTTINGHAM SCHOOL)



MEAN SOMATOTYPE.



SOMATOCHART.

FIG. 9

11. Endomorphic-Ectomorphs - individuals in whom the third component is dominant over the first by half a point and the second component is lower. Example: $4\ 3\ 4^2$, or $4\ 2^2\ 4^2$.
12. Mesomorphic-Ectomorphs - individuals in whom the third component is dominant over the second by half a point and the first component is lower. Example: $1^2\ 4\ 4^2$, or $2\ 4\ 4^2$.
13. Balanced Somatotypes - individuals in whom all three components are approximately equal or do not differ from each other by more than one point. Example $3^2\ 3^2\ 4$, or $4\ 4\ 4$.

Table 9 gives the number of subjects in each of the above divisions. It can be seen that Group 2 (Mesomorphs) has the greatest representation with 38 subjects, followed by Group 3 (Ectomorphs) with 13 subjects and Group 1 (Endomorphs) with 9 subjects.

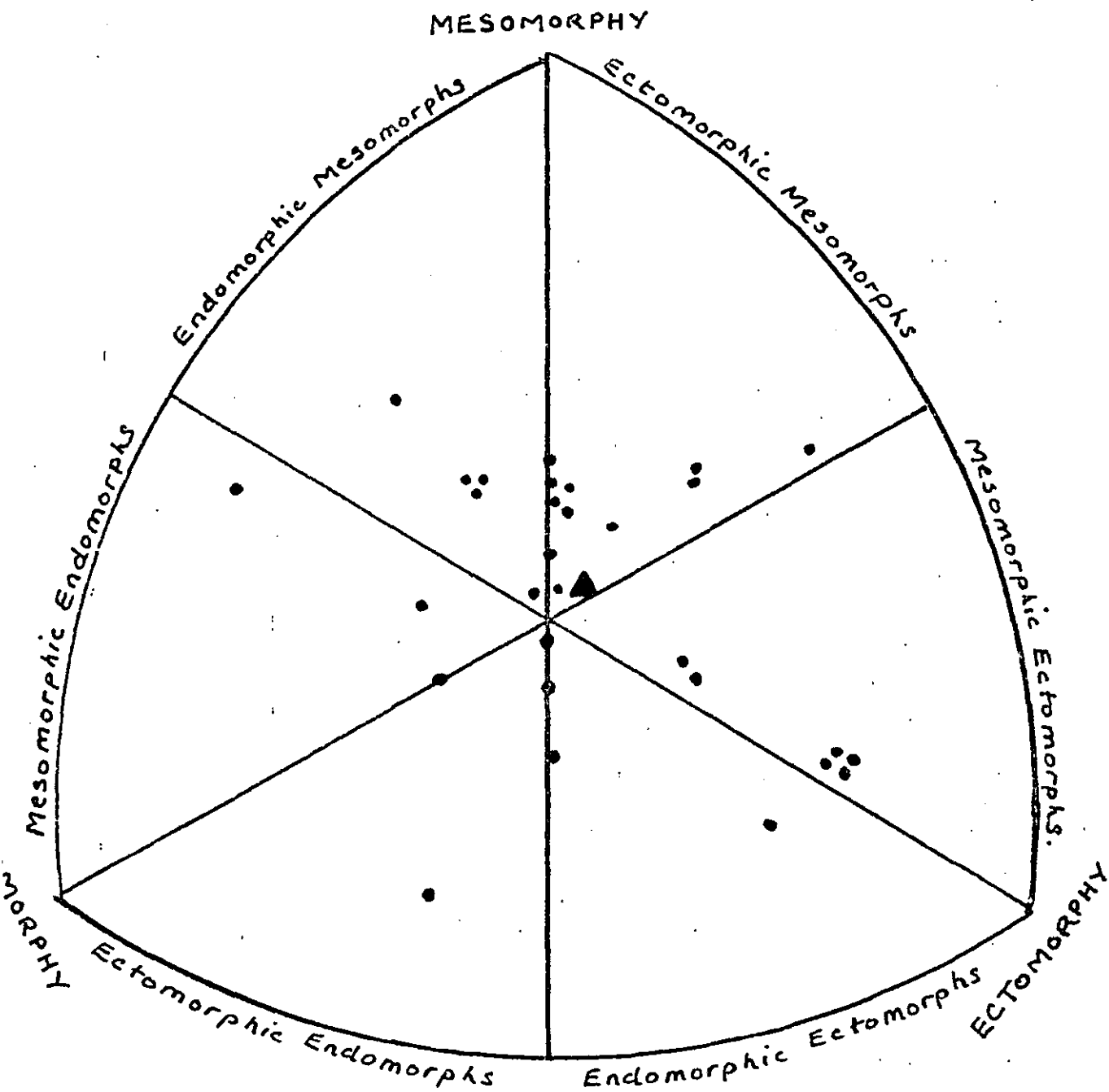
Figures 9, 10, 11, and 12 show how the somatotype distribution of the total population and respective groups, and fall within the classification of Ectomorphic-Mesomorphs. However, Figure 13 which shows the somatotype distribution of the best ten results in the three groups for shot putting (Step-back, O'Brien and Control) fall within the classification of Endomorphic-Mesomorphs.

Table 9Distribution of Somatotypes

Group	Somatotype	No.
1.	Endomorphs	9
2.	Mesomorphs	38
3.	Ectomorphs	13
4.	Endomorphs-Mesomorphs	3
5.	Endomorphs-Ectomorphs	2
6.	Mesomorphs-Ectomorphs	2
7.	Mesomorphic-Endomorphs	1
8.	Ectomorphic-Endomorphs	6
9.	Endomorphic-Mesomorphs	2
10.	Ectomorphic-Mesomorphs	3
11.	Endomorphic-Ectomorphs	2
12.	Mesomorphic-Ectomorphs	4
13.	Balanced Somatotypes	5
	Total =	90 subjects

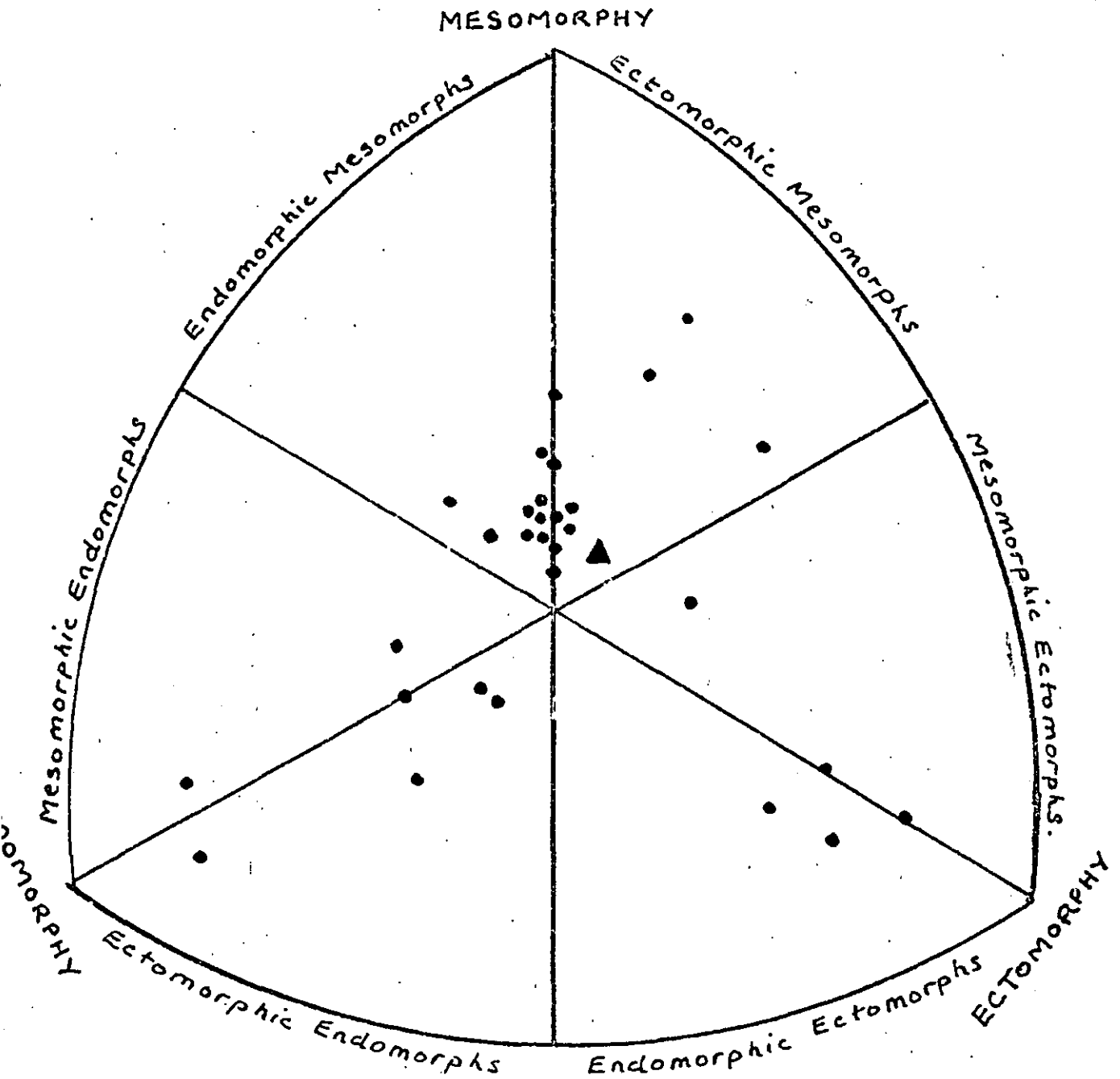
STEP BACK METHODN= 30 (NOTTINGHAM SCHOOL)

▲ MEAN SOMATOTYPE.

SOMATOCHART.FIG. 10

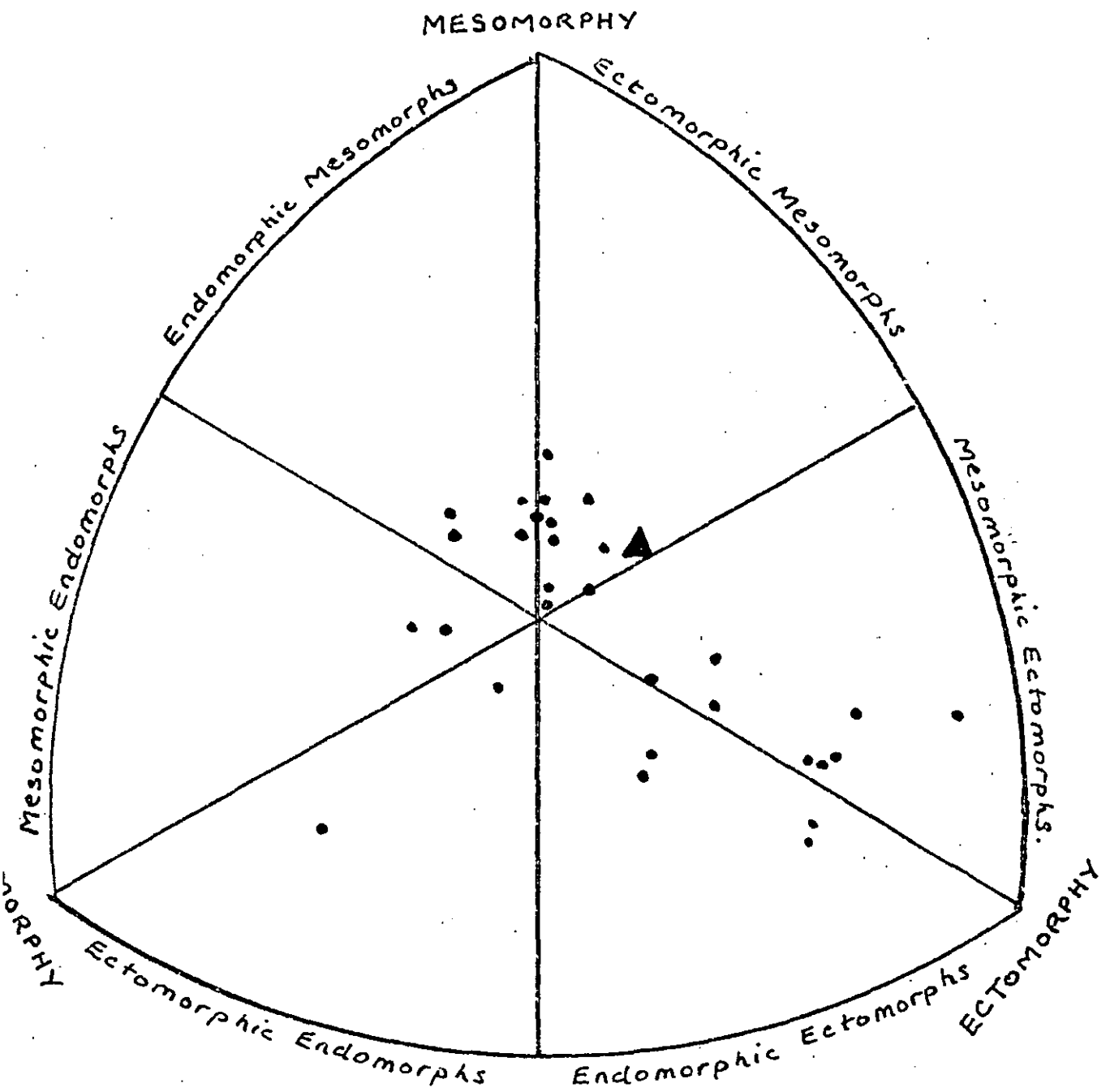
O'BRIEN METHODN=30 (NOTTINGHAM SCHOOL)

▲ MEAN SOMATOTYPE.

SOMATOCHART.FIG. II

CONTROL GROUPN=30 (NOTTINGHAM SCHOOL)

▲ MEAN SOMATOTYPE.

SOMATOCHART.FIG. 12

BEST 30 RESULTS OF THEWHOLE INVESTIGATION (NOTTINGHAM SCHOOL).TOP PERFORMERS.

▲ MEAN SOMATOTYPE.

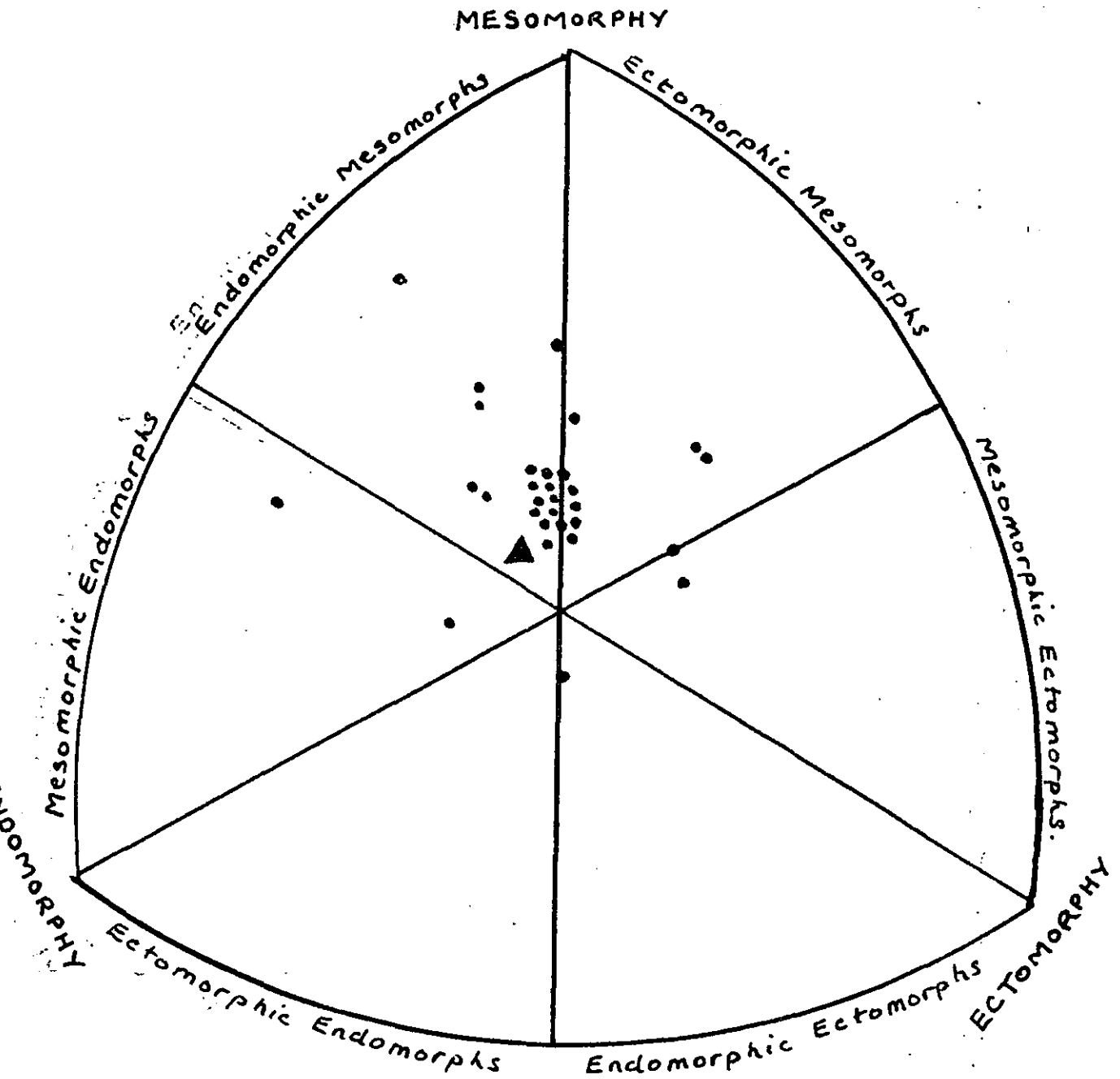
SOMATOCHART.FIG. 13

Table 105(b) Product Moment Correlation Coefficients

Method	Somatotype	Performance		
		1	2	3
Control	Endomorphy	0.412 *	0.367 *	0.429 *
	Mesomorphy	0.926 ***	0.915 ***	0.888 ***
	Ectomorphy	-0.328	-0.297	-0.316
O'Brien	Endomorphy	-0.238	-0.222	-0.159
	Mesomorphy	0.648 ***	0.603 ***	0.566 **
	Ectomorphy	-0.300	-0.212	-0.277
Step-Back	Endomorphy	0.188	0.191	0.215
	Mesomorphy	0.827 ***	0.812 ***	0.781 ***
	Ectomorphy	-0.538 **	-0.553 **	-0.562 **

Notes:

- Each coefficient calculated from 30 paired values
- Critical values of r for significance (df=28)

+	($P < 0.05$)	0.3610
**	($P < 0.01$)	0.4629
***	($P < 0.001$)	0.5703

Main Conclusions

- There is good agreement across performances.
- Mesomorphy is strongly positively correlated with shot putt distance thrown, for all three methods (Step-back, O'Brien and Control).

6. Stage 2 (Nottingham School only)

This experimental stage was performed on the Nottingham school (N = 90) only.

The results are below:- (Table 11)(Table 12) (student 't' test was applied to the results to see whether any significant differences arose between groups and activities).

Table 11

Test 9	Height		Weight		Shot dist.		Bench press $\frac{1}{2}$ squat	
	Mean	sd	Mean	sd	Mean	sd	Mean	sd
Step back	67.97	3.15	139.74	25.54	27.52	5.27	127.13	11.98
O'Brien	68.10	2.67	144.40	16.15	25.57	3.71	129.00	9.21
Control	68.47	2.58	141.07	16.67	22.62	4.30	127.07	7.50

	't'	probability ($P \geq 0.05$)
1. HEIGHT		
(a) Step-back against O'Brien	= .13	ns
(b) O'Brien against Control	= .58	ns
(c) Control against Step-back	= .66	ns
2. WEIGHT		
(a) Step-back against O'Brien	= .83	ns
(b) O'Brien against Control	= .75	ns
(c) Control against Step-back	= .247	ns
3. SHOT DISTANCE		
(a) Step back against O'Brien	= 1.42	ns
(b) O'Brien against Control	= 2.7	*
(c) Control against Step-back	= 3.87	**
4. BENCH PRESS		
(a) Step back against O'Brien	= 1.02	ns
(b) O'Brien against Control	= .84	ns
(c) Control against Step back	= .0	ns
5. HALF SQUAT		
(a) Step back against O'Brien	= 1.035	ns
(b) O'Brien against Control	= .49	ns
(c) Control against Step-back	= .417	ns

Table 12

Test 16

	Height		Weight		Shot		Bench press		squat	
	Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd
Step back	68.02	3.49	146.57	24.04	28.63	5.30	130.27	12.03	172.67	18.09
O'Brien	68.10	2.76	144.80	16.15	27.16	4.18	131.33	9.64	173.73	16.5
Control	68.47	2.58	141.53	16.79	23.91	4.13	129.80	7.25	171.53	17.03

	't'	probability
1. HEIGHT		
(a) Step back against O'Brien	= .14	ns
(b) O'Brien against Control	= .475	ns
(c) Control against Step-back	= .558	ns
2. WEIGHT		
(a) Step-back against O'Brien	= .781	ns
(b) O'Brien against Control	= .747	ns
(c) Control against step-back	= .177	ns
3. SHOT DISTANCE		
(a) Step-back against O'Brien	= .032	ns
(b) O'Brien against Control	= 3.047	**
(c) Control against Step-back	= 3.8	**
4. BENCH PRESS		
(a) Step back against O'Brien	= .373	ns
(b) O'Brien against Control	= .685	ns
(c) Control against Step-back	= .179	ns
5. HALF SQUAT		
(a) Step back against O'Brien	= .381	ns
(b) O'Brien against Control	= .515	ns
(c) Control against step-back	= .115	ns
	(P > .05)	

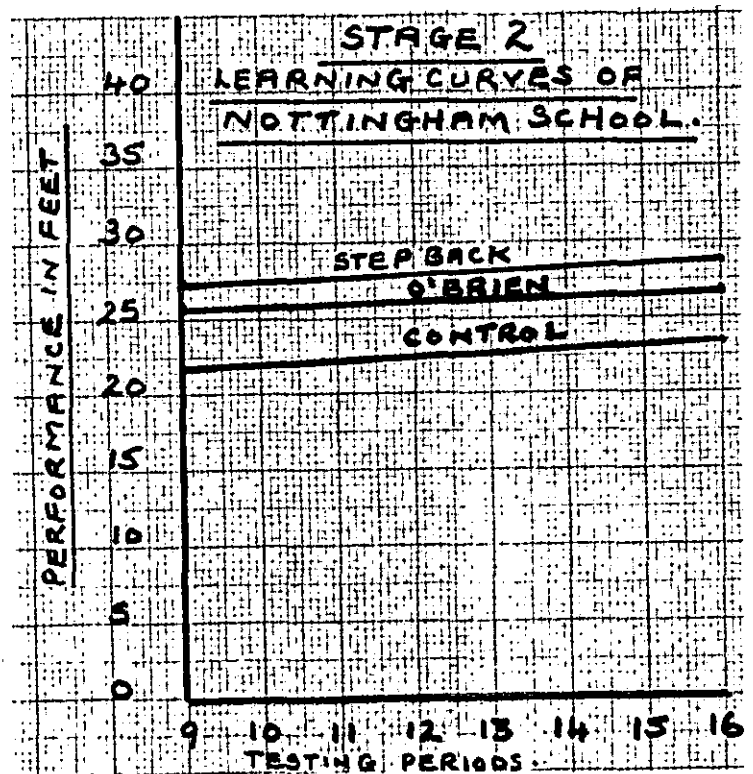
The most interesting observation from this Stage 2, is that there is not much of a gain in shot putting distance by either three groups, but it appears that the O'Brien group are closing the gap with the Step-back method, most probably

due to their added strength from weight training. The step-back group's improvement appears to be small, maybe there is after all, a broken sequence in this method, from a technical point of view.

Graph Showing Improvements made From Test 9
to Test 16 in the Nottingham School

Fig 14

Learning curves generally assumed to be one indicating a gradual decrease in the amount of learning after initial quick improvement in Stage 1. (Cratty 1973)



7. Stage 3 (Nottingham School only)

The same experimental procedure for Stages 1 and 2 was applied to this Stage 3. The results are listed below: Tables 13 and 14.

Table 13

Test 17

	Height		Weight		Shot		Bench press		Squat	
	Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd
Step back	68.02	3.49	140.87	23.54	28.86	5.39	131.73	11.67	177.53	16.18
O'Brien	68.10	2.63	145.03	16.14	27.92	4.60	132.27	9.59	178.33	15.18
Control	68.47	2.58	141.70	16.77	23.98	4.14	130.60	7.52	175.40	15.64

		't'	Probability
1. HEIGHT			
(a)	Step back against O'Brien	= .0103	ns
(b)	O'Brien against Control	= .784	ns
(c)	Control against Step back	= .558	ns
2. WEIGHT			
(a)	Step back against O'Brien	= .786	ns
(b)	O'Brien against Control	= .764	ns
(c)	Control against Step back	= .161	ns
3. SHOT DISTANCE			
(a)	Step back against O'Brien	= .695	ns
(b)	O'Brien against Control	= 3.020	**
(c)	Control against Step back	= 2.512	**
4. BENCH PRESS			
(a)	Step back against O'Brien	= .546	ns
(b)	O'Brien against Control	= .533	ns
(c)	Control against Step back	= .465	ns
5. HALF SQUAT			
(a)	Step back against O'Brien	= .194	ns
(b)	O'Brien against Control	= .776	ns
(c)	Control against Step back	= .550	ns
		(P = 7.05)	

Table 14

Test 24

	Height		Weight		Shot		Bench press		Squat	
	Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd
Step back	68.10	3.22	141.83	23.69	29.90	5.27	135.60	11.49	185.93	14.75
O'Brien	68.17	2.78	145.50	16.27	30.52	5.20	137.87	10.40	186.13	14.80
Control	68.47	2.58	142.07	16.65	25.53	4.21	132.47	6.64	180.87	12.29

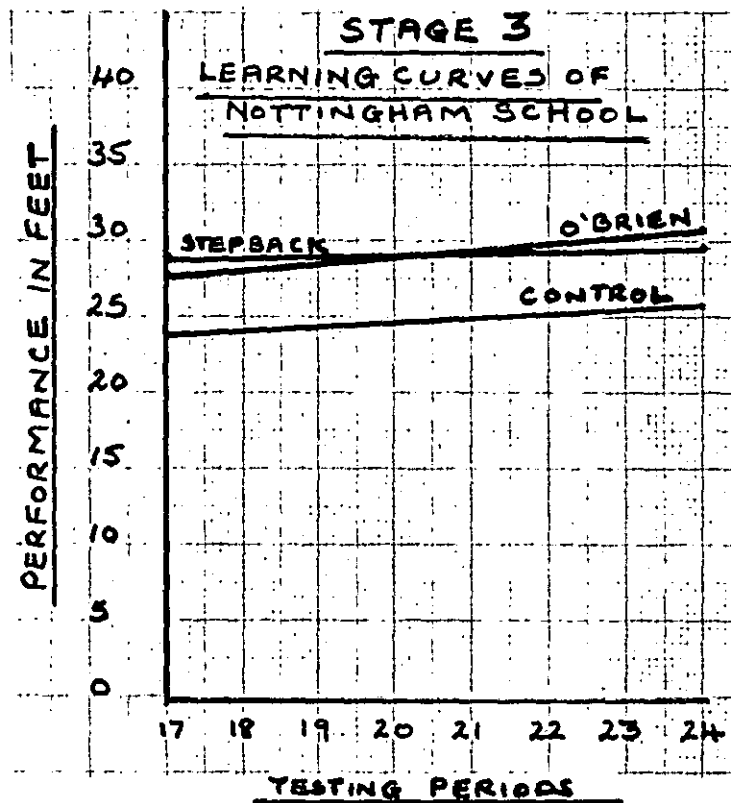
	't'	Probability
1. HEIGHT		
(a) Step back against O'Brien	= .084	ns
(b) O'Brien against Control	= .128	ns
(c) Control against Step back	= .478	ns
2. WEIGHT		
(a) Step back against O'Brien	= .687	ns
(b) O'Brien against Control	= .794	ns
(c) Control against Step back	= .044	ns
3. SHOT DISTANCE		
(a) Step back against O'Brien	= .448	ns
(b) O'Brien against Control	= 4.10	★ ★
(c) Control against Step back	= 3.54	★ ★
4. BENCH PRESS		
(a) Step back against O'Brien	= .787	ns
(b) O'Brien against Control	= 2.269	★
(c) Control against Step back	= 1.19	ns
5. HALF SQUAT		
(a) Step back against O'Brien	= .515	ns
(b) O'Brien against Control	= 1.47	ns
(c) Control against Step back	= 1.42	ns
(P > .05)		

At the completion of the investigation on the Nottingham school, both the O'Brien and Step back groups are highly significant when compared against the Control group in shot putting distance. It appears that the O'Brien group is the better of the two when boys gain strength from weight-training, although not statistically proved. Initially, in the introduction of shot putting in schools, the Step-back method should be used by all teachers of physical education, because the method seems easy and quick results are achieved.

Fig 15

Graph Showing Improvements Made From
Test 17 to Test 24 in the Nottingham
School

Learning curves showing that the O'Brien method having a 'better' curve of performance improvement at the completion of the investigation, when compared to the Step-back method. The control group throughout the investigation, the least improved.



CHAPTER 7

DISCUSSION

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DISCUSSION

This investigation has been concerned with the relative effectiveness of two standard methods of learning and performing the shot putt among adolescent boys.

The study of learning is of increasing concern to educators in general and to physical educators in particular. This concern is based on the realisation that the effectiveness of teaching programmes is dependent upon knowledge of the phenomenon of learning. With a more crowded curriculum, the need for efficiency in teaching skills is apparent for a number of reasons. First, efficiency will save time and allow the teaching of more activities in the school programme. Then, too, efficient methods will enable each individual to attain a higher degree of skill. In addition, with the best teaching techniques being employed, it is likely that the individual will develop a more positive attitude toward the particular activity for example, the shot putt. Therefore, to promote enjoyment, fitness and the other benefits of greater participation, efficiency in teaching skills is essential. Such efficiency will be attained only after the teacher has gained a thorough knowledge of the learning process as it relates to motor activities.

The plasticity of the human system and the versatility of body movements did not permit the early techniques of shot putting to remain the same. The yearning which is expressed

in the Olympic Emblem, "Citius, Altius, Fortius" (Quicker Higher, More Strongly), sent the technique of shot putting on the way to very impressive development.

The improvement of the shot putt technique went through a developmental process which is typical of human growth, that being differentiation and integration. From a side on method, this was improved to a 'back to the direction of throw' technique, which enabled throwers to keep in contact with the missile for a longer period of time, which was conducive for good putting distances. To use this method which was originated by Parry O'Brien, to its best advantage, the athlete had to be strong enough in order to 'shift' across the circle to arrive in a very powerful putting position.

This lead the investigator to believe that although the O'Brien method of putting the shot was the best technique yet discovered for this event, what was questioned was whether this necessarily was the best technique for children in the class situation, and the same doubt could easily be expressed about almost all adult techniques. This is simply because these techniques were devised for, and used by, dedicated trained athletes, athletes with the time, facilities and ability to perform them and profit by them.

It was for this very reason that this investigation took place and with the previous information set up in our minds, the problem to be solved in this thesis was whether the methods of the Step-Back or that of O'Brien can be more easily learned by adolescent boys in a physical education class. There are however, a number of considerations which should be taken into account before each stage of learning and performing is discussed.

The Teaching Programme

In planning an experiment of this nature, the investigator experienced many problems not normally encountered in the ordinary laboratory design. The control of administration and instructional material all contributed to making the research techniques difficult.

Despite careful preparation, during the morning period, it was self evident that the planning of the third or fourth consecutive session would be better than the first session. To combat this, attempts were made to control this problem by changing groups to different group times in the course of work. Any bias towards the effectiveness of organisation, or guidance may have been excluded because of this fact. The fundamental difficulty was trying to differentiate between random and systematic biases: "When this happens the validity of the experimental results is lost. Measures of proficiency based upon subjective ratings and evaluations are particularly suspect from the point of bias. Changes from time to time and place to place are the rule rather than the exception. Furthermore, in an experiment being carried on at a given time and place it is entirely possible that the raters must be biased in favour of one rather than the other, of the methods under study, and they may, prejudice their ratings accordingly". (Thorndike 1947).

A number of instructional aids utilised in this investigation may have tended to prevent any bias in the results from the skill programme. It may have contributed in maintaining a consistent level of motivation: Wolffe (1935), Seashore et al (1944), and Luborsky (1945), stressed the importance of using

a variety of material, and it was felt therefore, that the balance between teaching to learn and desire would be maintained without damage to the presentation.

Retention and Forgetting

Once something is learned, there is every reason to believe, not only that it will be remembered, but that it will never be truly forgotten. However, everyone is familiar with the personal panic involved, in not remembering a once known fact or forgetting the rules of the game. It would appear that forgetting is not due to the fading away of neural connections, nor to the deterioration of neural pathways. Rather, forgetting seems to be related to interference; that is skills are changed or erased by new experiences which are more satisfying and efficient.

Subjects were involved throughout the period of training, in other parts of the school curriculum. This therefore, lead to the learning of other skills during the experimental programme. This may well have had an effect on the final production of the results. As Jenkins and Dallenbach (1924) concluded: "The results of our study as a whole indicate that forgetting is not so much a matter of decay of old impressions and association as it is a matter of interference, inhibition or obliteration of the old by the new". The experimental groups did follow congeneric patterns of work; it may therefore be proposed that uniformity of integration validated the investigation.

Earlier studies of Muller and Pilzecker (1900), De Camp (1915), and Webb (1917) paid particular attention to the degree

retention as affected by interpolated learning. The serious problem that arises is: what type of interpolated learning is to be examined in terms of positive and negative similarity? For according to Mc Geogh (1931), and Irion (1946) retention of physical and recreational activities are typically less interfering than other learning activities. It may be, in this sense, that this lessens inhibitory influences to a minimum.

It would of course be a mistake to assume that the results of this investigation would be applicable to wider scenes: the peculiar aspects of distribution of practice and interpolated material must weaken the results within those limitations described earlier.

Knowledge of Results

If a subject practices without knowing the results of his actions, improvement in his performance is unlikely. Knowledge of results serves as a guide to the learner in his subsequent practices, and functions as a basis of selection of what is good in that performance. The knowledge should be as exact as possible. Trowbridge and Cason (1932) studied line-drawing and it was shown that blindfolded subjects who, as soon as possible after each trial were told the amount and direction of error improved much more than did those who were told simply whether the line was right or wrong. Other researchers in practical skills agree that the learner should be given as specific and as immediate information as possible.

All groups in this investigation were informed immediately of their shot putting distances, and were given in feet and inches, as opposed to metric, to facilitate an easier understanding of performances achieved.

Aspiration Levels

Worrell (1959) points out that for each person there may be different levels of aspiration, depending on interpretation of the term. It may mean a certain level hoped for, expected, or minimally satisfied with. In other words a level of aspiration can indicate the discrepancy between previous performance and expected performance; between wished for and previous performance; or, personally acceptable and previous performance.

It is unrealistic for a person to have a large discrepancy between his estimated performance and his actual performance. When the performance level is far below the aspiration level, the result is consistent personal failure. When the situation is reversed, there is a better chance of success. Therefore, it can be seen that success and failure may be determined in relation to the level of aspiration. An unhealthy situation occurs when too many successes or failures are experienced by an individual; hence it is desirable to have an approximate relationship between hoped for, and actual performance.

The aspiration levels in this investigation were high for both the O'Brien and Step Back groups, the latter in particular, in the initial stages (Stage 1) of learning and performing, because the greater the success, in distance putt,

the greater was the probability of raising their level. The control groups who were not motivated for achievement levels, soon lost their desired levels of aspiration, when compared to the motivated and coached groups, because repeated failure in distance putt encouraged this low level.

Environment

An adverse environment, over stimulation, inadequate nutrition, tension, synthetic excitement, and other controllable environmental factors have a bearing upon learning. It is not to be assumed that all conditions must be perfect in order for learning to take place, but in general, the better the environment, the greater the possibility for learning.

Dirty gymnasiums and playfields; extreme temperatures, poor lighting, and inadequate or improper clothing, detract from the learning situation. Over stimulation of emotions is also undesirable.. Mistakenly, some teachers seek to boost their charges by urgent exhortations to win the game. Or they will scold and abuse, shout and threaten. Such methods are sometimes useful, but can be easily carried to excess, at which point the learner rebels and rejects further exhortations. Then learning can stop. The learner who can tackle the problem in an atmosphere of enlightenment and understanding has a desirable environment in which to learn.

Subjects in this investigation took part in an atmosphere of athletic participation, in which proper facilities existed with well equipped gymnasias. Intrinsic interest, with reporting results and encouraging improvement, were given to the Step-back and O'Brien groups respectively. However, the

control groups after a brief motivated period, declined in their interest to further improvement.

The Distribution of Material

In subsequent investigations, the sequential nature of the material may be of interest. However, the programme itself might have been improved by placing more lectures, particularly during the testing sessions, before the practical sessions commenced. In this manner, the meaningfulness and objectivity of material may have been more beneficial. As a result the difficulties of administration alluded to earlier in this investigation, may have reduced the effectiveness of guidance.

The strength factor involved within the skills

An assessment was made of the strength factors involved in the investigation. Presented below are the reasoning of the methodology involved.

- (a) The very nature of the shot putt skill required a high degree of power performance and it was seen that over a period of 40 one hour sessions, subjects would indulge in an increased volume of explosive skill work. An unspecified amount of progress was accepted and could be attributed to increase in strength, but this would only be uniform throughout the sample groups.
- (b) Further acceptance was the utilisation of increased strength and power, which needed to go hand in hand with the development of the skill.

Time Interval between Learning and Re-test in Skill Acquisition

A lapse occurred during the practical sessions between the last of the practical sessions and the re-test. The time lapse between those two phases were of some importance - both retention and degree of initial learning would play an increasing importance - yet support on this matter is not conclusive. Although Bunch (1936) and Bunch and Mc Craven (1938), did not find any significant effect in the length of time interval, Ray (1945) found that interference increased with moderate time intervals but decreased with longer intervals (time intervals of 14, 27, and 91 days). A point to be noted however, is whether or not the results would have been different with variable re-tests dates. Studies in the future might examine transfer over a series of re-tests.

Time Intervals between the Skill Sessions

The programme of skill acquisition consisted for the Nottingham school of three stages of eight testing periods for each stage, including eight skill sessions. The Ipswich and Loughborough schools participated in one stage of learning (eight testing periods and two skill sessions - a procedure that allowed 48 hours approximately between consecutive sessions.

Most investigators in terms of optimum learning support some type of distributed practice. Since the pioneer work of Ebbinghaus (1885), distributed practice has been given favour over massed practice - despite the fact that significant evidence favouring massed practice, shows the latter has values in certain fine motor skills.

In the present investigation, the distribution of practice was controlled more by the practicalities of administration than anticipating programming. The programme in definitive terms however, balanced close to a practical teaching situation both in the length of the individual session (60 mins) and the number of sessions per week. Nevertheless, it is significant that the interpolated curricula work, outside the region of the experiment, might have played a part in the results of this investigation.

Curves of Learning

As all Physical Educators know, physical skills cannot be learned without participating, and a few cannot be acquired at a single trial. Most skills involved are usually complex and require many repetitions and considerable time. There may be considerable variation from period to period but the trend which is shown by the general shape of a curve is called a curve of learning.

During Stage 1 (Tests 1 - 8), all groups in this investigation achieved a curve of increasing gains (often called a

curve of positive acceleration - page 122). In Stage 2 (Tests 9-17) for the Nottingham School only, the complex skill of shot putting, there was a period in which gains between trials were less than the gains between earlier ones, thus producing a curve of decreasing gains (often called a curve of negative acceleration). This is the curve which will be found most frequently at the secondary level of education, or when dealing with an average performer, who wishes to become an expert (Krueger 1947).

The final Stage 3 (tests 18-26) for the Nottingham school only, both the O'Brien and Step-back groups appear to show possibilities of a trace of positive acceleration, whilst the Step-back in the latter tests change towards negative acceleration. The control group throughout, show a curve of decreasing gains (often called a curve of negative acceleration) (page 139.).

Evidence is clear therefore that subjects show continuous improvement in performance over the three stages of learning and performing, with the Step-back method in Stage 1 (tests 1-8), Nottingham school, making a better curve of positive acceleration, than the other groups concerned in this investigation, (see page 113 for graph details).

Stage 1 (tests 1-8)

It must be noted that during this stage of learning and performing the shot putt, three schools, namely Loughborough, Ipswich and Nottingham took part in this phase of investigation.

This investigation shows quite clearly that the step-back method is superior to the O'Brien method when teaching beginners. Launder (1967) used the step-back method in an attempt to eliminate the back glide in its hopping form. It appeared to have an advantage over the current O'Brien method especially at schoolboy level, but not at international standard. Unfortunately he published no quantitative assessments. This work for this investigation supports Launder (1967) by showing an advantage at schoolboy level to start with the step-back method, but as soon as the athlete is strong enough, he should practice the O'Brien method. All groups who performed the step-back method for shot putting, favoured this method since it is easier to learn and relatively simple to perform. Far more progress was gained in performing this method than the accepted O'Brien method and this was proved statistically.

Schoolboys found the O'Brien method difficult to perform for the following reasons:-

1. During the initial stance the weight of the body over the right foot was difficult to maintain.
2. It was hard to dip the trunk forward and to fall off balance (compare fig3g page 88).
3. During the drive-off the right leg was not bent, therefore showing that at schoolboy level, strength was lacking. (Compare Fig3h page 88).
4. At the completion of the shift, the subject could not arrive into a good powerful throwing position. (Compare Fig3i page 88).

5. The delivery was poor, with no speed of movement.
6. Most often, failure to remain in the circle is the result of two faults: (a) failing to co-ordinate the release action. Novice shot putters will sometimes tend to delay the release until their body is well beyond the left foot. In this case, rather than providing lift, the left foot is pushing them out of the circle. (b) failing to drag the right foot and leg towards the front of the circle. Beginners of this method tend to throw the right knee forcefully forward and up. This indicates a failure to shift onto the left leg and produces an over-balance forward, out of the circle, resulting in a foul putt.

The step-back method is much better suited to athletes who are lighter and faster than the heavier types. It also helped to gain and maintain balance which is so important to good throwing results. The step-back method seems to aid those individuals with a relatively small body mass, this category includes decathletes, certain multi-purpose club athletes and above all, schoolboys or novices. The accent on speed and relative simplicity of movement, with more accommodation for the lead-up stages and maintenance of balance commends this method to the novice. A point to take into consideration here is that the step back method seems to be learnt more quickly than the O'Brien method. Young boys find the step back method easier to perform with added stability in a simple sequence of movements, which make less demand on leg strength.

The step-back has of course been tried out experimentally with international class athletes (Elvin 1967; Bedford 1971), but they have reached shorter distances than obtained from the O'Brien method. The O'Brien method is superior for the top athletes in many ways. First, the putter can make more use of a forward lean outside the circle (which requires great strength) thereby gaining more range of movement. He can also twist (if a right-handed shot putter) more to his right, therefore gaining more range of rotation to his putt. But, the most important factor is that he can land in the centre of the circle much lower than in the step-back method, therefore more power can be generated from the legs. It is for this reason that international class shot putters, all of whom have excessive strength and body weight, favour the O'Brien method.

At the end of Stage 1, the step-back method is significantly better in performance, when compared to the O'Brien method. It also seems easier to learn and makes less demand on leg strength.

Stage 2 (tests 9-17)

This stage of learning and performing was conducted simply on the adolescent boys of the Nottingham school. It would perhaps bear significant relevance to mention at this stage that at Stage 1, the 't' score for the step back method against the O'Brien method was 1.936. Although not significantly proved it appeared to be the better method of the two in distance putt.

However, at Stage 2, (tests 9-17) the 't' score for the step-back method against the O'Brien method was .032. There appears to be no difference in either method for shot putting distance. The O'Brien group have started to close the gap, most probably due to their added strength from weight training. Explosive power is the most obvious characteristic of a highly successful athlete (Morehouse, 1962). Since power is equal to the product of force times velocity, it is in reality equally dependant on both characteristics of a good athlete, force (or strength) and velocity (or speed). Power can be changed by altering either. A small and relatively weak athlete may, if he possesses great speed, have greater power than a larger athlete who is stronger, but slower. He is able to achieve good power by overcoming a shortage of strength with an excess of speed. Conversely, a slow athlete may have great power by overcoming a shortage of speed with superior strength. The most powerful athlete, of course, is one who has exceptional speed and strength. They are usually very strong and have the ability to exert explosive bursts of muscular speed.

There are many theories of training to improve power. To be successful, all of them must improve either or both of the factors involved: strength and speed. Weight training, sensibly programmed, will develop both factors simultaneously. The most popular amongst athletes, where strength and power are the main aim, for example, the shot event is the Pyramid System, which Lange (1917) established: the principle that increase in muscular strength came only when the muscle was

required to work against a greater load than had previously been attempted. This theme was considerably developed by De Lorme and Watkins (1951). In this method, progression is maintained by adding extra poundage as the repetitions decrease.

The results show that by lifting weights to gain strength, the O'Brien method seems to benefit. There is absolutely no better way to improve strength and ~~power~~ for application to all sports by training with weights (Tuppery 1959).

Stage 3 (tests 18-24)

This final stage of learning and performing the shot putt event in the Nottingham school, show that the 't' score for the O'Brien method against the step-back method was .448. The O'Brien method appears now to be a better method for distance in the shot event when compared to the step-back method. The step back group improvement appears to be small, may be there is after all, a broken sequence in this method, from a technical point of view.

The control group as expected tended to succumb to feelings of frustration and a loss of interest, because the desire for power and efficiency seems to be engraved in human nature.

The investigator stresses that very few boys of secondary school age will develop an efficient shot technique, and those who do are usually physically precocious boys who have been encouraged to specialise in the event. Unfortunately, these boys tend to fall by the wayside as they are overtaken by late developers, usually long-boned

individuals who are not strong enough or sufficiently well co-ordinated at fourteen but who 'fill out' from sixteen to nineteen.

It is for this very reason that with limited time in a physical education class, adolescent boys should be introduced to the shot event by performing the step back method. Only when time is available with the opportunity to gain strength from weight training exercises, should boys then specialise and be introduced to the O'Brien method. The results of this investigation support this statement.

Related Issues (A) - Attitudes

The initial introduction to any activity may influence a subject's attitude toward it. For instance, an individual who has met success in an event may approach it in a different manner, than to one who has failed. Success, however, does not have to be assessed merely in terms of winning. Winning at all costs is a totally unsatisfactory aim. It is better to aim at the development of skill, so that individuals become interested in the skill - this is one of the reasons why this investigation took place with the introduction of the step-back method. It was felt, that in the introductory phase, this would be an easier method to execute than the O'Brien method, because it is naturally easier to walk or run backwards under control, than it is to execute the low backward driving hop/glide of the O'Brien.

With regard to its use in teaching beginners, the investigator regards it as one of the several possible methods

by which school children can get themselves across the circle and in essence, not too concerned how they do it in the early stages. This may seem heretical but this approach to the teaching of athletics proved its worth in this investigation in terms of developing great interest, high standards and attitudes towards physical education and recreation. Most of the performers who participated in this investigation favoured a positive attitude towards physical education and the three groups in the Nottingham school, all considered that physical activity for health and fitness was the important criteria for involvement in physical education.

Related Issues (B) - Somatotype

Some people have physical characteristics especially well adapted for successful performance in certain sports, can be readily verified by observation. As a result of this, considerable study of the exact significance of physical characteristics relative to performance potential, exercise needs, and exercise effects has been pursued.

Tanner (1964) studied the physiques of 137 Olympic track and field athletes. Of the runners, sprinters tended to be endomorphic or ectomorphic-mesomorphics; 400 metre runners ectomorphic-mesomorphs; while runners of distances of 800 metres and above tended to be either mesomorphic-ectomorphs or ectomorphic-mesomorphs. Weight men tended to be high in mesomorphy and fell into the general classification of endomorphic-mesomorphs.

Body type is also apparently related to the endowment of certain motor performance characteristics essential for sports participation. Clarke and Broms (1968) studied strength in 722 boys at the ages of 10, 13 and 16 years. They divided their groups into high, average and low strength groups on the basis of strength index scores, and found that high strength groups had the highest mesomorphy means. The low strength group at 16 years and the average strength groups at 10 and 13 years were high in ectomorphy. Similar results were found for cable tension strength tests. Those low in the physical fitness index tended to be high in the endomorphic component. Laubach and McConville, (1966) found that mesomorphy was the only body type component that correlated significantly with muscle strength. The findings of this investigation tend to support the generalisation that in 'shot putting' and in strength factors arising from weight lifting come from a body type high in mesomorphy.

Teaching Implications

Perhaps the most important implication, is the tragedy of much athletic teaching has been that the selection process, rather than being a natural one with boys making selections freely over a period of four to six years according to their tastes and abilities, has been in the form of an early 'specialisation' often begun in the first and second years of secondary schools. This process has often produced good short-term results at representative level, but has been disastrous to athletics as a physical education activity.

No boy wants to feel a failure and the early specialisation process often produces feelings of despair and resentment which harden into antagonism in later years.

Athletics must therefore be treated for what it is, a series of simple objective tests, and every opportunity must be taken to allow children to test themselves. In any competition, there can only be one winner. If, however the stress is laid on person performance, rather than on winning, then athletics becomes a personal sport in a way which team sports can never be. A growing boy is bound to improve and if his performance is constantly recorded, his improvements will act as a persistent spur to further effort. Knowledge of results is an accepted part of all skill learning and in athletics, a knowledge of results can be quickly and accurately obtained.

Finally, it is hoped that this investigation has helped in such a way, in establishing a method of introducing shot putting, which appear simple to the novice and give essential earlier results, which are conducive to sound teaching and to the goodness of the sport.

Recommendations

The results of this investigation give rise to the following recommendations:

1. A similar investigation should be conducted for three schools over the three stages of learning and performing the shot event.

2. A similar investigation should be conducted using a wider range of apparatus. This should be extended to include a 6 lb, and 10lb implements.
3. A similar investigation should concern itself with
 - (a) Samples from a non-physical education adult background, (men and women).
 - (b) Samples from pre-adolescent background (girls and boys).

CHAPTER 8

SUMMARY AND CONCLUSIONS

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The Problem

The study of motor skills and learning is the concern of many academic disciplines. The physical educator has the study of factors accompanying the gross motor performance and learning of healthy human beings as his unique area.

Every boy and girl in track and field athletics must be given athletic tasks which they can perform and from which they can derive satisfaction. The sad truth is that very many boys and girls have rejected or abandoned athletics because they have not enjoyed it, and have not had a sense of achievement in it.

The purpose of this investigation was to determine the relative effectiveness of two standard methods of learning and performing the shot putt among adolescent boys. Optimum teaching methods were used to balance the situation in an educational environment. It was postulated by the investigator that the step-back method would result in improvement significantly different than those using the O'Brien method. Only when strength is gained, does the O'Brien method become more 'efficient' in shot putting distance.

Procedures

The subjects for this investigation were two hundred and seventy schoolboys enrolled at Ipswich, Loughborough

and Nottingham comprehensive schools. (Stage 1).

For the remaining stage(s) 2 and 3, just ninety schoolboys from Nottingham took part in the study.

The subjects were randomly assigned into three groups namely, the O'Brien, the Step-back and the Control.

All groups apart from the Control(s) received similar lecture/demonstration instruction. General encouragement and motivation was supplied not only on a group basis, but at individuals as well. The programme of instruction was spread over 40 hour period, during which theory-lectures, practical and testing sessions were used.

Results

1. At test 1, there was no significant difference between schools or between methods of training and no significant interaction between the two factors. (Stage 1).
2. Using the adjusted figures for test 8, following the analysis of covariance, significant differences between schools and between methods were detected. In particular, the Ipswich school gave results significantly ($P < .05$) lower than the Nottingham school. In addition both the step-back and O'Brien gave a significantly higher figure than the control and turn, those subjects using the step-back method, were significantly higher than those using the O'Brien method. ($P < .01$) Stage 1.

3. In stage 2, for the Nottingham school only, the obtained values for 't' were not significant for the O'Brien and step-back methods but both methods were significant when compared with the control group.
4. In stage 3, for the Nottingham school only, the obtained values for 't' were not significant for the O'Brien and Step-back methods but both methods were highly significant when compared with the control group.
5. There is a correlation between mesomorphy and actual shot putting distance in all three groups of the Nottingham school.
6. Attitude test(s) of the Nottingham school towards physical education resulted in the following:
(t= paired test for comparing before and after scores).
 - (a) Decrease of physical activity as the Beauty in Human movement score using the step-back method (3.65).
 - (b) Decrease of physical activity as prolonged and strenuous training score using step-back method (2.99) but increase in the O'Brien method (-4.78).
 - (c) Increase of physical activity for the release of tension score using all three methods although significance was reached in only two cases - Control group -6.69, O'Brien -2.70 .

Conclusions

Based on the interpretations of the results of this investigation (raw data in the Appendices), the following conclusion seems justified:

1. There was a significant difference in distance putt between the step-back and O'Brien methods of shot putting at the end of Stage 1. During stages 2 and 3, as a result of weight training, there was no significant difference in performance for the step-back and O'Brien methods of shot putting.

With lighter boys in particular, it has been noticeable that continuity of action is possible throughout each putt in the step-back method. (Overall distance/weight averages for Stage 1 performances were as follows: Step-back 26.18' - 140.27lbs; O'Brien 24.70' - 144.02lbs; Control 21.13' - 140.37lbs). Lighter boys therefore, can also put the shot reasonable distances with the step-back method.

The investigator does not claim this is the panacea for all shot putt ills, but he does stress that it is a method of introducing shot putting in an uncomplicated manner and one in which basic mechanical principles are applied efficiently.

The step-back method appears to be 'natural' to balance the body by using its opposite side. We walk and run in this balanced way so it is natural to dispose the weight of a shot, not over an already burdened limb but more equally by moving some of the weight over towards the other leg. Thus, the weight falls within the body.

A major problem with young school children and novices when attempting to use a type of "O'Brien technique" is the precarious balance position at the start of the putt, occasioned by their physical immaturity.

Lack of strength in the lateral abdominals, under — development of the quadriceps, and the absence of an overall power are reflected in the ability of the young athlete to allow the shot, (preparatory to the putt) to be maintained, as it must be, at the neck and yet at the same time, over or even outside the rim of the circle, while still being capable of exerting maximum drive across the circle.

Therefore, to achieve better balance the young athlete must adjust to a compromise position by almost standing upright and bringing the shot nearer to a position above the toes of the supporting foot. This nullifies the first premise of the normally accepted technique (O'Brien) i.e. applying force over a great range of speed.

Strong young performers, with much practice, adopt to their inadequacies and develop individual styles. But many potential putters cannot adjust easily, and are discouraged and may even give up the event.

Every teacher is encouraged therefore to consider teaching shot putting by the step-back method, rather than leaving the event to tall strong athletes, who represent so few of a school population.

This simply taught and easily executed method encourages mass participation, and is based on continuity of action rather than force application and above all, it appears to be satisfying for the performer. Only when schoolboys become stronger through activities like weight training/lifting etc., they should then transfer to the O'Brien method, where by from their added strength, they can apply better force and power to this more mechanically efficient technique. As

expected, the Control group made least progress, through lack of motivation and coaching in the testing sessions.

2. The attitudes of the boys in the Nottingham school favoured physical education and recreation in a positive manner. The three groups all considered that physical activity for health and fitness was the most important activity, whilst the least favoured activity was considered to be that of physical activity as games of chance.

3. The body type (somatotype) of the better performers in the shot putt event, tended to be high in mesomorphy and fell into the general classification of the endomorphic-mesomorphic range ($3\ 4^2\ 2^2$).

4. Although not statistically proved, it would appear that there is some correlation between strength and distance putt. (Most of the better performers tended to be the better weight-lifters/trainers in the bench press and half-squat respectively - see Appendix 1.

5. The four hypotheses were not rejected and seem justified.

Finally, the scarcity of teaching time and relatively minute position of shot putting in the whole array of athletic disciplines in the school situation would constitute another argument for the teaching of simpler techniques. Therefore, the step-back method would appear to fulfill these criteria. It is suggested that continued developments in research will

be of value to the physical educator, coach or anyone else interested in and dedicated to improving human learning and performance in Motor Skills, especially the technical events in athletics.

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APPENDICES

APPENDIX 1.

APPENDIX 1SHOT PUTTING RESULTSSTAGE 1(a) Nottingham SchoolO'Brien Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>	<u>Bench Press</u>	<u>Squat</u>
1	69"	173 lbs	20.50'	130 lbs	168 lbs
2	66"	143 lbs	18.75'	110 lbs	150 lbs
3	66"	147 lbs	18.00'	112 lbs	158 lbs
4	72"	169 lbs	25.00'	130 lbs	180 lbs
5	71"	150 lbs	18.00'	112 lbs	166 lbs
6	64"	134 lbs	15.33'	120 lbs	140 lbs
7	65"	136 lbs	16.50'	96 lbs	120 lbs
8	69"	140 lbs	15.00'	100 lbs	130 lbs
9	71"	163 lbs	19.75'	110 lbs	150 lbs
10	70"	166 lbs	21.75'	106 lbs	140 lbs
11	69"	108 lbs	12.25'	100 lbs	130 lbs
12	72"	147 lbs	18.50'	114 lbs	154 lbs
13	69"	150 lbs	18.33'	112 lbs	150 lbs
14	70"	154 lbs	19.08'	116 lbs	152 lbs
15	71"	146 lbs	21.25'	120 lbs	146 lbs
16	70"	155 lbs	21.75'	120 lbs	150 lbs
17	72"	136 lbs	19.75'	118 lbs	148 lbs
18	67"	150 lbs	17.90'	124 lbs	150 lbs
19	66"	148 lbs	18.25'	120 lbs	154 lbs
20	68"	147 lbs	20.00'	120 lbs	160 lbs
21	67"	140 lbs	21.25'	128 lbs	160 lbs
22	66"	134 lbs	19.75'	116 lbs	162 lbs
23	71"	149 lbs	22.50'	120 lbs	170 lbs
24	69"	140 lbs	24.25'	124 lbs	166 lbs
25	64"	135 lbs	19.17'	118 lbs	158 lbs
26	63"	96 lbs	11.50'	94 lbs	120 lbs
27	69"	150 lbs	27.25'	132 lbs	182 lbs
28	68"	140 lbs	21.33'	122 lbs	150 lbs
29	66"	133 lbs	20.67'	128 lbs	154 lbs
30	62"	112 lbs	11.00'	100 lbs	122 lbs

Test 1.

STAGE 1(a) Nottingham SchoolStep-back Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>	<u>Bench Press</u>	<u>Squat</u>
1	71"	146 lbs	27.25'	124 lbs	164 lbs
2	71"	157 lbs	29.33'	134 lbs	186 lbs
3	72"	158 lbs	30.50'	136 lbs	184 lbs
4	69"	147 lbs	21.58'	120 lbs	168 lbs
5	65"	131 lbs	19.25'	116 lbs	154 lbs
6	68"	122 lbs	10.50'	100 lbs	120 lbs
7	68"	115 lbs	11.25'	100 lbs	124 lbs
8	70"	145 lbs	20.25'	126 lbs	168 lbs
9	69"	142 lbs	18.50'	116 lbs	150 lbs
10	69"	146 lbs	21.58'	110 lbs	150 lbs
11	70"	170 lbs	27.00'	130 lbs	180 lbs
12	71"	165 lbs	23.08'	124 lbs	166 lbs
13	67"	152 lbs	23.25'	120 lbs	174 lbs
14	71"	172 lbs	28.25'	126 lbs	180 lbs
15	66"	122 lbs	17.67'	118 lbs	144 lbs
16	65"	124 lbs	20.00'	124 lbs	154 lbs
17	63"	106 lbs	9.67'	96 lbs	120 lbs
18	64"	108 lbs	9.33'	98 lbs	120 lbs
19	70"	175 lbs	29.00'	134 lbs	180 lbs
20	71"	170 lbs	23.42'	114 lbs	166 lbs
21	63"	101 lbs	11.08'	98 lbs	120 lbs
22	64"	108 lbs	16.58'	96 lbs	120 lbs
23	61"	104 lbs	15.67'	102 lbs	124 lbs
24	63"	96 lbs	15.33'	100 lbs	120 lbs
25	71"	158 lbs	15.75'	110 lbs	120 lbs
26	70"	157 lbs	16.25'	110 lbs	150 lbs
27	64"	108 lbs	11.33'	100 lbs	120 lbs
28	71"	149 lbs	18.80'	118 lbs	140 lbs
29	69"	174 lbs	16.58'	114 lbs	138 lbs
30	71"	138 lbs	17.50'	120 lbs	154 lbs

Test 1.

STAGE 1.(a) Nottingham SchoolControl Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>	<u>Bench Press</u>	<u>Squat</u>
1	68"	140 lbs	17.25'	124 lbs	150 lbs
2	71"	160 lbs	22.50'	130 lbs	176 lbs
3	67"	145 lbs	18.33'	124 lbs	150 lbs
4	68"	137 lbs	28.33'	132 lbs	186 lbs
5	70"	151 lbs	16.90'	124 lbs	160 lbs
6	65"	122 lbs	14.00'	120 lbs	150 lbs
7	71"	158 lbs	26.08'	120 lbs	170 lbs
8	70"	162 lbs	20.08'	130 lbs	168 lbs
9	70"	149 lbs	17.00'	126 lbs	150 lbs
10	69"	155 lbs	16.58'	128 lbs	150 lbs
11	67"	119 lbs	13.42'	100 lbs	122 lbs
12	68"	145 lbs	21.25'	130 lbs	176 lbs
13	71"	150 lbs	24.50'	130 lbs	170 lbs
14	72"	162 lbs	22.75'	130 lbs	170 lbs
15	73"	170 lbs	26.08'	126 lbs	178 lbs
16	68"	129 lbs	14.00'	102 lbs	120 lbs
17	66"	133 lbs	15.08'	122 lbs	160 lbs
18	67"	140 lbs	13.75'	110 lbs	144 lbs
19	66"	122 lbs	14.90'	110 lbs	144 lbs
20	68"	137 lbs	17.80'	122 lbs	158 lbs
21	63"	100 lbs	12.90'	100 lbs	118 lbs
22	62"	107 lbs	13.50'	108 lbs	120 lbs
23	69"	119 lbs	17.50'	122 lbs	140 lbs
24	72"	133 lbs	16.90'	120 lbs	154 lbs
25	71"	130 lbs	17.08'	120 lbs	150 lbs
26	71"	165 lbs	25.42'	130 lbs	180 lbs
27	70"	155 lbs	22.08'	124 lbs	170 lbs
28	68"	142 lbs	25.50'	130 lbs	182 lbs
29	67"	128 lbs	19.08'	120 lbs	162 lbs
30	66"	140 lbs	21.00'	124 lbs	170 lbs

Test 1.

STAGE 1(a) Nottingham SchoolO'Brien Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>	<u>Bench Press</u>	<u>Squat</u>
1	69"	174 lbs	27.25'	142 lbs	186 lbs
2	66"	145 lbs	24.58'	122 lbs	172 lbs
3	66.5"	148 lbs	25.08'	120 lbs	170 lbs
4	72"	170 lbs	32.42'	146 lbs	196 lbs
5	71"	151 lbs	23.90'	120 lbs	170 lbs
6	64"	135 lbs	22.58'	124 lbs	158 lbs
7	65"	138 lbs	18.33'	110 lbs	136 lbs
8	69"	140 lbs	22.50'	118 lbs	142 lbs
9	71"	164 lbs	27.25'	130 lbs	174 lbs
10	70"	167 lbs	29.33'	126 lbs	172 lbs
11	69"	109 lbs	18.17'	110 lbs	140 lbs
12	72"	148 lbs	23.90'	120 lbs	162 lbs
13	69"	150 lbs	25.90'	128 lbs	170 lbs
14	70"	154 lbs	24.25'	126 lbs	166 lbs
15	71"	147 lbs	23.42'	128 lbs	158 lbs
16	70"	156 lbs	28.33'	138 lbs	176 lbs
17	72"	136 lbs	22.90'	122 lbs	166 lbs
18	67"	150 lbs	24.80'	128 lbs	168 lbs
19	66"	147 lbs	25.50'	132 lbs	168 lbs
20	68"	149 lbs	23.90'	130 lbs	164 lbs
21	67"	141 lbs	26.25'	134 lbs	172 lbs
22	66"	136 lbs	24.90'	122 lbs	174 lbs
23	71.5"	149 lbs	28.33'	136 lbs	184 lbs
24	69"	141 lbs	27.08'	134 lbs	180 lbs
25	64"	135 lbs	23.80'	128 lbs	170 lbs
26	63"	98 lbs	19.25'	114 lbs	158 lbs
27	69"	153 lbs	31.90'	144 lbs	194 lbs
28	68"	142 lbs	28.08'	134 lbs	166 lbs
29	66"	134 lbs	24.75'	132 lbs	160 lbs
30	62"	113 lbs	18.80'	112 lbs	138 lbs

Test 8.

STAGE 1(a) Nottingham SchoolStep-back Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>	<u>Bench Press</u>	<u>Squat</u>
1	71"	148 lbs	33.33'	140 lbs	180 lbs
2	71.5"	158 lbs	35.50'	142 lbs	196 lbs
3	72"	158 lbs	35.08'	148 lbs	196 lbs
4	69"	147 lbs	27.42'	128 lbs	180 lbs
5	65"	131 lbs	24.00'	122 lbs	170 lbs
6	68"	122 lbs	21.00'	110 lbs	150 lbs
7	68"	116 lbs	25.33'	116 lbs	150 lbs
8	70"	145 lbs	31.17'	136 lbs	180 lbs
9	69.5"	142 lbs	28.58'	124 lbs	166 lbs
10	69"	146 lbs	27.25'	120 lbs	170 lbs
11	70"	171 lbs	33.90'	142 lbs	186 lbs
12	71"	166 lbs	31.75'	132 lbs	170 lbs
13	67"	154 lbs	29.67'	128 lbs	174 lbs
14	71"	171 lbs	32.90'	132 lbs	190 lbs
15	66"	125 lbs	22.42'	122 lbs	150 lbs
16	65"	126 lbs	25.08'	128 lbs	160 lbs
17	63"	106 lbs	20.58'	110 lbs	134 lbs
18	64"	109 lbs	21.25'	110 lbs	140 lbs
19	70"	175 lbs	36.58'	148 lbs	196 lbs
20	71"	171 lbs	35.08'	130 lbs	180 lbs
21	63"	101 lbs	20.08'	106 lbs	150 lbs
22	64.5"	108 lbs	21.25'	110 lbs	150 lbs
23	61.5"	104 lbs	21.42'	114 lbs	150 lbs
24	63"	96 lbs	20.75'	116 lbs	150 lbs
25	71"	158 lbs	27.17'	126 lbs	150 lbs
26	70"	158 lbs	26.75'	126 lbs	150 lbs
27	64"	109 lbs	19.75'	118 lbs	140 lbs
28	71"	150 lbs	26.80'	130 lbs	160 lbs
29	69"	175 lbs	30.08'	130 lbs	160 lbs
30	71"	139 lbs	24.17'	130 lbs	160 lbs

Test 8.

STAGE 1(a) Nottingham SchoolControl Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>	<u>Bench Press</u>	<u>Squat</u>
1	68"	141 lbs	20.67'	128 lbs	154 lbs
2	71"	160 lbs	26.00'	132 lbs	180 lbs
3	67"	145 lbs	22.25'	128 lbs	160 lbs
4	68"	137 lbs	28.42'	134 lbs	190 lbs
5	70"	151 lbs	19.50'	128 lbs	166 lbs
6	65"	123 lbs	17.90'	120 lbs	160 lbs
7	71"	160 lbs	30.17'	130 lbs	190 lbs
8	70"	161 lbs	24.42'	132 lbs	170 lbs
9	70"	151 lbs	19.08'	128 lbs	154 lbs
10	69"	156 lbs	20.67'	128 lbs	154 lbs
11	67"	121 lbs	16.90'	108 lbs	140 lbs
12	68"	145 lbs	26.90'	134 lbs	180 lbs
13	71"	151 lbs	27.80'	136 lbs	176 lbs
14	72"	162 lbs	24.80'	134 lbs	176 lbs
15	73"	170 lbs	30.90'	134 lbs	190 lbs
16	68"	130 lbs	16.80'	110 lbs	140 lbs
17	66"	133 lbs	16.80'	124 lbs	160 lbs
18	67"	140 lbs	20.25'	124 lbs	160 lbs
19	66"	122 lbs	18.67'	118 lbs	160 lbs
20	68"	138 lbs	22.75'	128 lbs	166 lbs
21	63"	102 lbs	18.00'	116 lbs	130 lbs
22	62"	109 lbs	17.90'	116 lbs	130 lbs
23	69"	121 lbs	18.08'	128 lbs	150 lbs
24	72"	134 lbs	18.90'	128 lbs	156 lbs
25	71"	130 lbs	19.50'	130 lbs	156 lbs
26	71"	165 lbs	30.25'	136 lbs	190 lbs
27	70"	155 lbs	25.90'	130 lbs	180 lbs
28	68"	142 lbs	25.80'	130 lbs	186 lbs
29	67"	128 lbs	22.50'	126 lbs	172 lbs
30	66"	141 lbs	21.75'	126 lbs	172 lbs

Test 8.

Complete Stage 1 (Nottingham School)

Results (Means)

	Shot(ft)	Height (ins.)	Weight (lbs)	Bench Press (lbs)	Squat (lbs)	
Step back	19.18	67.90	138.87	114.47	148.06	Test 1
	27.20	67.97	139.50	125.80	164.60	Test 8
O'Brien	18.94	68.07	143.03	115.90	151.30	Test 2
	24.91	68.10	144.00	127.00	167.00	Test 8
Control	19.05	68.47	140.10	121.21	156.60	Test 1
	22.42	68.47	140.80	126.73	164.93	Test 8

STAGE 2(a) Nottingham SchoolO'Brien Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>	<u>Bench Press</u>	<u>Squat</u>
1	69"	174 lbs	27.50'	144 lbs	190 lbs
2	66"	146 lbs	22.42'	126 lbs	172 lbs
3	66.5"	148 lbs	26.08'	120 lbs	172 lbs
4	72"	171 lbs	33.80'	150 lbs	200 lbs
5	71"	151 lbs	24.17'	122 lbs	172 lbs
6	64"	135 lbs	23.00'	124 lbs	160 lbs
7	65"	138 lbs	18.50'	112 lbs	140 lbs
8	69"	141 lbs	22.90'	118 lbs	142 lbs
9	71"	165 lbs	28.67'	126 lbs	172 lbs
10	70"	168 lbs	30.50'	130 lbs	172 lbs
11	69"	110 lbs	17.00'	110 lbs	142 lbs
12	72"	148 lbs	24.42'	120 lbs	172 lbs
13	69"	151 lbs	27.00'	130 lbs	172 lbs
14	70"	154 lbs	24.17'	130 lbs	172 lbs
15	71"	147 lbs	24.00'	130 lbs	160 lbs
16	70"	156 lbs	30.50'	140 lbs	184 lbs
17	72"	136 lbs	24.42'	130 lbs	166 lbs
18	67"	150 lbs	24.17'	130 lbs	168 lbs
19	66"	147 lbs	26.80'	132 lbs	168 lbs
20	68"	149 lbs	25.00'	130 lbs	168 lbs
21	67"	141 lbs	28.17'	136 lbs	180 lbs
22	66"	136 lbs	25.25'	128 lbs	180 lbs
23	71.5"	150 lbs	30.00'	136 lbs	190 lbs
24	69"	142 lbs	29.50'	136 lbs	190 lbs
25	64"	135 lbs	22.90'	128 lbs	170 lbs
26	63"	99 lbs	21.00'	118 lbs	158 lbs
27	69"	154 lbs	33.75'	144 lbs	200 lbs
28	68"	143 lbs	29.80'	136 lbs	168 lbs
29	66"	134 lbs	24.90'	136 lbs	160 lbs
30	62"	113 lbs	18.90'	118 lbs	142 lbs

Test 9.

STAGE 2(a) Nottingham SchoolStep-back Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>	<u>Bench Press</u>	<u>Squat</u>
1	71"	148 lbs	32.00'	140 lbs	180 lbs
2	71.5"	158 lbs	36.17'	148 lbs	200 lbs
3	72"	159 lbs	35.90'	150 lbs	200 lbs
4	69"	141 lbs	27.00'	130 lbs	180 lbs
5	65"	131 lbs	24.75'	120 lbs	170 lbs
6	68"	123 lbs	21.90'	110 lbs	154 lbs
7	68"	116 lbs	25.90'	118 lbs	160 lbs
8	70"	145 lbs	32.08'	140 lbs	176 lbs
9	69.5"	142 lbs	29.67'	124 lbs	170 lbs
10	69"	145 lbs	27.00'	124 lbs	170 lbs
11	70"	172 lbs	34.50'	146 lbs	190 lbs
12	71"	166 lbs	31.58'	130 lbs	170 lbs
13	67"	154 lbs	30.08'	130 lbs	174 lbs
14	71"	171 lbs	31.00'	130 lbs	180 lbs
15	66"	125 lbs	22.90'	120 lbs	150 lbs
16	65"	126 lbs	25.80'	130 lbs	160 lbs
17	63"	106 lbs	22.00'	110 lbs	130 lbs
18	64"	110 lbs	21.08'	110 lbs	136 lbs
19	70"	176 lbs	37.08'	150 lbs	200 lbs
20	71"	171 lbs	36.42'	132 lbs	186 lbs
21	63"	102 lbs	19.90'	110 lbs	142 lbs
22	64.5"	107 lbs	21.08'	110 lbs	150 lbs
23	61.5"	104 lbs	21.75'	114 lbs	150 lbs
24	63"	97 lbs	20.00'	116 lbs	142 lbs
25	71"	158 lbs	28.42'	130 lbs	160 lbs
26	70"	158 lbs	27.50'	130 lbs	160 lbs
27	64"	110 lbs	20.00'	120 lbs	142 lbs
28	71"	149 lbs	27.08'	130 lbs	160 lbs
29	69"	176 lbs	30.17'	132 lbs	170 lbs
30	71"	140 lbs	25.00'	130 lbs	160 lbs

Test 9.

STAGE 2(a) Nottingham SchoolControl Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>	<u>Bench Press</u>	<u>Squat</u>
1	68"	141 lbs	20.00'	130 lbs	160 lbs
2	71"	160 lbs	26.58'	134 lbs	180 lbs
3	67"	146 lbs	23.00'	130 lbs	160 lbs
4	68"	138 lbs	29.00'	140 lbs	200 lbs
5	70"	152 lbs	19.08'	130 lbs	170 lbs
6	65"	123 lbs	18.00'	120 lbs	160 lbs
7	71"	161 lbs	30.00'	134 lbs	200 lbs
8	70"	162 lbs	25.42'	128 lbs	170 lbs
9	70"	151 lbs	20.17'	124 lbs	150 lbs
10	69"	155 lbs	20.90'	124 lbs	154 lbs
11	67"	121 lbs	17.50'	110 lbs	140 lbs
12	68"	145 lbs	27.50'	134 lbs	180 lbs
13	71"	151 lbs	28.08'	132 lbs	180 lbs
14	72"	162 lbs	23.90'	130 lbs	180 lbs
15	73"	170 lbs	30.00'	134 lbs	200 lbs
16	68"	131 lbs	17.42'	110 lbs	150 lbs
17	66"	133 lbs	16.67'	126 lbs	160 lbs
18	67"	141 lbs	21.00'	126 lbs	170 lbs
19	66"	123 lbs	19.42'	118 lbs	160 lbs
20	68"	139 lbs	22.50'	126 lbs	170 lbs
21	63"	102 lbs	18.50'	116 lbs	130 lbs
22	62"	110 lbs	18.08'	114 lbs	130 lbs
23	69"	121 lbs	18.00'	126 lbs	150 lbs
24	72"	133 lbs	19.50'	128 lbs	160 lbs
25	71"	130 lbs	20.00'	130 lbs	156 lbs
26	71"	166 lbs	31.42'	140 lbs	200 lbs
27	70"	155 lbs	25.67'	134 lbs	184 lbs
28	68"	142 lbs	26.00'	130 lbs	190 lbs
29	67"	128 lbs	23.75'	128 lbs	170 lbs
30	66"	140 lbs	21.58'	128 lbs	170 lbs

Test 9.

STAGE 2(a) Nottingham SchoolO'Brien Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>	<u>Bench Press</u>	<u>Squat</u>
1	69"	175 lbs	29.17'	148 lbs	190 lbs
2	66"	148 lbs	24.80'	130 lbs	174 lbs
3	66.5"	149 lbs	30.33'	126 lbs	176 lbs
4	72"	172 lbs	35.50'	156 lbs	206 lbs
5	71"	151 lbs	24.90'	122 lbs	172 lbs
6	64"	135 lbs	23.42'	124 lbs	160 lbs
7	65"	138 lbs	19.90'	114 lbs	140 lbs
8	69"	141 lbs	23.90'	120 lbs	146 lbs
9	71"	165 lbs	30.33'	130 lbs	176 lbs
10	70"	167 lbs	31.75'	130 lbs	176 lbs
11	69"	110 lbs	19.50'	116 lbs	150 lbs
12	72"	148 lbs	27.08'	126 lbs	176 lbs
13	69"	151 lbs	29.00'	132 lbs	176 lbs
14	70"	154 lbs	25.42'	130 lbs	176 lbs
15	71"	148 lbs	25.17'	130 lbs	160 lbs
16	70"	156 lbs	33.08'	146 lbs	190 lbs
17	72"	136 lbs	24.80'	130 lbs	170 lbs
18	67"	150 lbs	25.80'	130 lbs	170 lbs
19	66"	148 lbs	27.90'	132 lbs	176 lbs
20	68"	150 lbs	25.50'	130 lbs	168 lbs
21	67"	142 lbs	30.17'	138 lbs	186 lbs
22	66"	136 lbs	26.42'	130 lbs	180 lbs
23	71.5"	149 lbs	31.75'	140 lbs	200 lbs
24	69"	143 lbs	31.00'	140 lbs	200 lbs
25	64"	135 lbs	23.42'	128 lbs	176 lbs
26	63"	100 lbs	22.42'	120 lbs	160 lbs
27	69"	156 lbs	34.75'	148 lbs	206 lbs
28	68"	143 lbs	31.90'	138 lbs	170 lbs
29	66"	134 lbs	25.17'	136 lbs	160 lbs
30	62"	114 lbs	20.67'	120 lbs	148 lbs

Test 16.

STAGE 2(a) Nottingham SchoolStep-back Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>	<u>Bench Press</u>	<u>Squat</u>
1	71"	149 lbs	33.17'	144 lbs	186 lbs
2	72"	160 lbs	37.33'	150 lbs	206 lbs
3	72"	160 lbs	37.00'	156 lbs	210 lbs
4	69"	150 lbs	27.80'	130 lbs	190 lbs
5	65"	131 lbs	25.50'	120 lbs	170 lbs
6	68"	123 lbs	23.17'	116 lbs	160 lbs
7	68"	118 lbs	25.00'	120 lbs	160 lbs
8	70"	146 lbs	33.42'	144 lbs	176 lbs
9	70"	143 lbs	30.90'	126 lbs	180 lbs
10	69"	146 lbs	28.67'	124 lbs	180 lbs
11	70.5"	173 lbs	35.67'	150 lbs	194 lbs
12	71"	166 lbs	32.17'	134 lbs	176 lbs
13	67"	155 lbs	30.90'	130 lbs	174 lbs
14	71"	172 lbs	32.17'	134 lbs	180 lbs
15	66"	126 lbs	23.90'	120 lbs	160 lbs
16	65"	127 lbs	27.50'	134 lbs	166 lbs
17	63"	108 lbs	23.42'	116 lbs	142 lbs
18	64"	111 lbs	21.75'	116 lbs	142 lbs
19	70"	175 lbs	37.90'	156 lbs	210 lbs
20	71"	171 lbs	37.50'	140 lbs	190 lbs
21	63"	103 lbs	21.08'	116 lbs	152 lbs
22	64.5"	109 lbs	22.00'	116 lbs	152 lbs
23	61.5"	106 lbs	22.90'	120 lbs	160 lbs
24	63"	98 lbs	21.75'	116 lbs	152 lbs
25	71"	158 lbs	30.42'	130 lbs	176 lbs
26	70"	158 lbs	29.08'	130 lbs	170 lbs
27	64"	111 lbs	21.00'	126 lbs	152 lbs
28	71"	150 lbs	28.75'	130 lbs	160 lbs
29	69"	174 lbs	30.90'	132 lbs	170 lbs
30	71"	140 lbs	26.17'	132 lbs	166 lbs

Test 16.

STAGE 2(a) Nottingham SchoolControl Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>	<u>Bench Press</u>	<u>Squat</u>
1	68"	141 lbs	22.08'	132 lbs	166 lbs
2	71"	161 lbs	27.17'	136 lbs	180 lbs
3	67"	146 lbs	23.90'	132 lbs	166 lbs
4	68"	139 lbs	30.80'	144 lbs	200 lbs
5	70"	152 lbs	20.33'	132 lbs	170 lbs
6	71"	162 lbs	30.90'	138 lbs	200 lbs
7	70"	162 lbs	26.42'	130 lbs	174 lbs
8	70"	151 lbs	21.58'	126 lbs	154 lbs
9	69"	155 lbs	21.75'	126 lbs	154 lbs
10	65"	123 lbs	19.17'	124 lbs	166 lbs
11	67"	121 lbs	19.00'	116 lbs	150 lbs
12	68"	146 lbs	28.50'	138 lbs	180 lbs
13	71"	151 lbs	29.00'	138 lbs	180 lbs
14	72"	162 lbs	25.80'	130 lbs	186 lbs
15	73"	171 lbs	31.00'	140 lbs	206 lbs
16	68"	131 lbs	19.17'	116 lbs	154 lbs
17	66"	133 lbs	18.33'	126 lbs	160 lbs
18	67"	141 lbs	21.42'	126 lbs	170 lbs
19	66"	123 lbs	20.50'	120 lbs	166 lbs
20	68"	140 lbs	24.08'	128 lbs	170 lbs
21	63"	103 lbs	20.17'	120 lbs	150 lbs
22	62"	110 lbs	19.50'	120 lbs	140 lbs
23	69"	122 lbs	19.42'	126 lbs	150 lbs
24	72"	133 lbs	21.08'	130 lbs	166 lbs
25	71"	131 lbs	20.90'	130 lbs	166 lbs
26	71"	169 lbs	31.50'	144 lbs	200 lbs
27	70"	155 lbs	25.90'	134 lbs	186 lbs
28	68"	143 lbs	27.90'	134 lbs	190 lbs
29	67"	129 lbs	25.67'	130 lbs	170 lbs
30	66"	140 lbs	22.42'	128 lbs	170 lbs

Test 16.

Complete Stage 2 (Nottingham School)

Results (Means)

	Shot (ft)	Height(ins)	Weight(lbs)	Bench Press (lbs)	Squat(lbs)	
Step Back	27.52	67.97	139.74	127.13	165.73	Test 9
	28.63	68.02	140.57	130.27	172.07	Test 16
O'Brien	25.57	68.10	144.40	129.00	170.06	Test 9
	27.16	68.10	144.80	131.33	173.73	Test 16
Control	22.62	68.47	141.07	127.07	167.80	Test 9
	23.91	68.47	141.53	129.80	171.53	Test 16

STAGE 3(a) Nottingham SchoolO'Brien Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>	<u>Bench Press</u>	<u>Squat</u>
1	69"	175 lbs	30.75'	146 lbs	190 lbs
2	66"	148 lbs	25.90'	130 lbs	174 lbs
3	66.5"	149 lbs	32.50'	130 lbs	180 lbs
4	72"	173 lbs	37.00'	160 lbs	210 lbs
5	71"	151 lbs	25.17'	130 lbs	180 lbs
6	64"	136 lbs	24.33'	130 lbs	170 lbs
7	65"	137 lbs	20.08'	116 lbs	150 lbs
8	69"	141 lbs	24.75'	126 lbs	150 lbs
9	71"	166 lbs	31.90'	130 lbs	174 lbs
10	70"	167 lbs	32.50'	134 lbs	180 lbs
11	69"	111 lbs	18.75'	116 lbs	150 lbs
12	72"	148 lbs	28.58'	124 lbs	170 lbs
13	69"	151 lbs	30.67'	136 lbs	180 lbs
14	70"	154 lbs	25.90'	130 lbs	176 lbs
15	71"	148 lbs	25.80'	130 lbs	180 lbs
16	70"	156 lbs	34.80'	150 lbs	200 lbs
17	72"	137 lbs	24.00'	130 lbs	170 lbs
18	67"	150 lbs	25.08'	126 lbs	170 lbs
19	66"	148 lbs	27.50'	130 lbs	176 lbs
20	68"	150 lbs	26.00'	130 lbs	176 lbs
21	67"	142 lbs	31.17'	138 lbs	190 lbs
22	66"	137 lbs	27.42'	132 lbs	180 lbs
23	71.5"	149 lbs	31.08'	140 lbs	196 lbs
24	69"	144 lbs	31.42'	140 lbs	200 lbs
25	64"	135 lbs	24.90'	130 lbs	180 lbs
26	63"	100 lbs	22.90'	126 lbs	170 lbs
27	69"	157 lbs	36.75'	152 lbs	210 lbs
28	68"	143 lbs	32.42'	144 lbs	186 lbs
29	66"	134 lbs	25.75'	136 lbs	176 lbs
30	62"	114 lbs	21.90'	126 lbs	156 lbs

Test 17.

STAGE 3(a) Nottingham SchoolStep back Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>	<u>Bench Press</u>	<u>Squat</u>
1	71"	150 lbs	33.42'	140 lbs	190 lbs
2	72"	160 lbs	37.90'	154 lbs	210 lbs
3	72"	160 lbs	37.42'	156 lbs	210 lbs
4	69"	150 lbs	27.42'	134 lbs	196 lbs
5	65"	132 lbs	24.90'	120 lbs	180 lbs
6	68"	123 lbs	23.00'	120 lbs	170 lbs
7	68"	118 lbs	25.90'	120 lbs	170 lbs
8	70"	146 lbs	33.00'	144 lbs	176 lbs
9	70"	143 lbs	30.33'	130 lbs	180 lbs
10	69"	146 lbs	27.90'	128 lbs	180 lbs
11	70.5"	174 lbs	36.80'	154 lbs	200 lbs
12	71"	166 lbs	31.90'	134 lbs	176 lbs
13	67"	155 lbs	31.00'	130 lbs	176 lbs
14	71"	172 lbs	32.17'	130 lbs	176 lbs
15	66"	127 lbs	23.33'	120 lbs	160 lbs
16	65"	127 lbs	26.90'	130 lbs	176 lbs
17	63"	109 lbs	24.42'	126 lbs	160 lbs
18	64"	111 lbs	22.33'	120 lbs	160 lbs
19	70"	175 lbs	37.50'	156 lbs	210 lbs
20	71"	171 lbs	37.90'	146 lbs	200 lbs
21	63"	103 lbs	21.80'	120 lbs	160 lbs
22	64.5"	110 lbs	22.67'	120 lbs	160 lbs
23	61.5"	107 lbs	22.80'	120 lbs	160 lbs
24	63"	99 lbs	22.42'	120 lbs	160 lbs
25	71"	158 lbs	31.67'	130 lbs	180 lbs
26	70"	158 lbs	30.08'	130 lbs	180 lbs
27	64"	112 lbs	21.42'	126 lbs	150 lbs
28	71"	150 lbs	28.00'	130 lbs	170 lbs
29	69"	174 lbs	32.00'	138 lbs	180 lbs
30	71"	140 lbs	27.58'	132 lbs	170 lbs

Test 17.

STAGE 3(a) Nottingham SchoolControl Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>	<u>Bench Press</u>	<u>Squat</u>
1	68"	141 lbs	23.50'	132 lbs	170 lbs
2	71"	162 lbs	27.42'	136 lbs	180 lbs
3	67"	146 lbs	23.25'	130 lbs	170 lbs
4	68"	140 lbs	31.08'	148 lbs	210 lbs
5	70"	152 lbs	20.17'	130 lbs	170 lbs
6	65"	123 lbs	18.90'	124 lbs	170 lbs
7	71"	162 lbs	31.33'	140 lbs	200 lbs
8	70"	162 lbs	26.00'	130 lbs	180 lbs
9	70"	151 lbs	21.00'	126 lbs	160 lbs
10	69"	155 lbs	22.33'	126 lbs	160 lbs
11	67"	121 lbs	18.90'	120 lbs	160 lbs
12	68"	146 lbs	29.17'	140 lbs	186 lbs
13	71"	151 lbs	28.58'	136 lbs	180 lbs
14	72"	162 lbs	25.00'	130 lbs	186 lbs
15	73"	171 lbs	32.42'	140 lbs	200 lbs
16	68"	131 lbs	20.58'	116 lbs	160 lbs
17	66"	133 lbs	18.75'	126 lbs	160 lbs
18	67"	141 lbs	21.58'	126 lbs	170 lbs
19	66"	123 lbs	20.75'	126 lbs	170 lbs
20	68"	140 lbs	23.80'	130 lbs	170 lbs
21	63"	104 lbs	20.58'	120 lbs	160 lbs
22	62"	110 lbs	20.75'	120 lbs	150 lbs
23	69"	122 lbs	19.42'	126 lbs	150 lbs
24	72"	133 lbs	21.08'	130 lbs	170 lbs
25	71"	131 lbs	20.33'	130 lbs	170 lbs
26	71"	170 lbs	32.00'	148 lbs	210 lbs
27	70"	155 lbs	25.17'	136 lbs	190 lbs
28	68"	143 lbs	27.17'	136 lbs	190 lbs
29	67"	130 lbs	25.50'	130 lbs	180 lbs
30	66"	140 lbs	22.90'	130 lbs	180 lbs

Test 17.

STAGE 3(a) Nottingham SchoolO'Brien Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>	<u>Bench Press</u>	<u>Squat</u>
1	69.5"	176 lbs	36.42'	150 lbs	206 lbs
2	66"	148 lbs	26.90'	134 lbs	180 lbs
3	66.5"	150 lbs	37.00'	146 lbs	200 lbs
4	72"	175 lbs	40.33'	168 lbs	216 lbs
5	71"	151 lbs	26.90'	134 lbs	186 lbs
6	64"	136 lbs	25.08'	132 lbs	180 lbs
7	65"	137 lbs	23.75'	120 lbs	160 lbs
8	69"	141 lbs	27.42'	130 lbs	166 lbs
9	71.5"	166 lbs	35.80'	140 lbs	180 lbs
10	70"	168 lbs	35.42'	140 lbs	184 lbs
11	69"	111 lbs	21.80'	120 lbs	160 lbs
12	72"	149 lbs	32.33'	132 lbs	180 lbs
13	69"	152 lbs	33.75'	136 lbs	186 lbs
14	70"	154 lbs	25.90'	130 lbs	180 lbs
15	71"	148 lbs	27.42'	132 lbs	186 lbs
16	70"	157 lbs	38.50'	154 lbs	210 lbs
17	72"	137 lbs	27.27'	136 lbs	186 lbs
18	67"	150 lbs	27.42'	130 lbs	180 lbs
19	66"	149 lbs	33.08'	136 lbs	186 lbs
20	68"	150 lbs	26.90'	130 lbs	180 lbs
21	67.5"	143 lbs	31.00'	140 lbs	200 lbs
22	66"	137 lbs	29.17'	136 lbs	186 lbs
23	71.5"	150 lbs	34.42'	146 lbs	200 lbs
24	69"	145 lbs	33.90'	146 lbs	200 lbs
25	64"	135 lbs	28.67'	136 lbs	190 lbs
26	63"	101 lbs	23.58'	130 lbs	170 lbs
27	69.5"	157 lbs	39.42'	160 lbs	216 lbs
28	68"	143 lbs	33.80'	146 lbs	190 lbs
29	66"	134 lbs	26.00'	136 lbs	180 lbs
30	62"	115 lbs	23.42'	130 lbs	160 lbs

Test 24.

STAGE 3(a) Nottingham SchoolStep back Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>	<u>Bench Press</u>	<u>Squat</u>
1	71.5"	151 lbs	34.42'	146 lbs	200 lbs
2	72"	162 lbs	38.58'	158 lbs	216 lbs
3	72"	161 lbs	38.08'	158 lbs	216 lbs
4	69"	150 lbs	28.17'	136 lbs	200 lbs
5	65"	133 lbs	26.17'	128 lbs	190 lbs
6	68"	124 lbs	24.00'	126 lbs	180 lbs
7	68"	119 lbs	26.08'	126 lbs	180 lbs
8	70.5"	148 lbs	34.33'	146 lbs	186 lbs
9	70"	147 lbs	31.50'	134 lbs	190 lbs
10	69"	147 lbs	28.42'	132 lbs	186 lbs
11	70.5"	174 lbs	37.90'	158 lbs	200 lbs
12	71"	166 lbs	32.80'	134 lbs	180 lbs
13	67"	156 lbs	33.00'	130 lbs	180 lbs
14	71.5"	172 lbs	33.17'	134 lbs	180 lbs
15	66"	127 lbs	25.00'	126 lbs	180 lbs
16	65"	129 lbs	27.17'	130 lbs	180 lbs
17	63.5"	110 lbs	25.08'	126 lbs	170 lbs
18	64"	112 lbs	23.42'	126 lbs	170 lbs
19	70"	176 lbs	38.42'	158 lbs	216 lbs
20	71"	172 lbs	39.50'	158 lbs	216 lbs
21	63"	104 lbs	21.90'	126 lbs	170 lbs
22	64.5"	111 lbs	23.33'	126 lbs	170 lbs
23	61.5"	108 lbs	23.90'	120 lbs	170 lbs
24	63"	101 lbs	24.00'	126 lbs	170 lbs
25	71"	159 lbs	33.17'	134 lbs	186 lbs
26	70"	158 lbs	31.08'	130 lbs	180 lbs
27	64"	112 lbs	23.17'	130 lbs	166 lbs
28	71"	150 lbs	29.80'	130 lbs	180 lbs
29	69"	175 lbs	34.50'	140 lbs	190 lbs
30	71.5"	141 lbs	29.08'	136 lbs	186 lbs

Test 24.

STAGE 3(a) Nottingham SchoolControl Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>	<u>Bench Press</u>	<u>Squat</u>
1	68"	142 lbs	25.50'	136 lbs	180 lbs
2	71"	162 lbs	28.00'	136 lbs	180 lbs
3	67"	147 lbs	25.08'	130 lbs	170 lbs
4	68"	140 lbs	31.90'	148 lbs	200 lbs
5	70"	152 lbs	21.42'	130 lbs	170 lbs
6	65"	124 lbs	21.17'	128 lbs	180 lbs
7	71"	162 lbs	33.00'	142 lbs	206 lbs
8	70"	162 lbs	28.17'	130 lbs	180 lbs
9	70"	152 lbs	22.67'	130 lbs	170 lbs
10	69"	155 lbs	24.00'	130 lbs	170 lbs
11	67"	121 lbs	20.42'	126 lbs	170 lbs
12	68"	147 lbs	31.08'	142 lbs	190 lbs
13	71"	152 lbs	29.75'	138 lbs	186 lbs
14	72"	162 lbs	27.00'	130 lbs	186 lbs
15	73"	171 lbs	33.75'	142 lbs	206 lbs
16	68"	131 lbs	21.67'	120 lbs	170 lbs
17	66"	133 lbs	20.00'	130 lbs	180 lbs
18	67"	141 lbs	21.75'	136 lbs	180 lbs
19	66"	124 lbs	21.90'	130 lbs	180 lbs
20	68"	140 lbs	25.50'	132 lbs	186 lbs
21	63"	104 lbs	21.80'	126 lbs	170 lbs
22	62"	111 lbs	23.00'	126 lbs	166 lbs
23	69"	122 lbs	20.58'	126 lbs	160 lbs
24	72"	133 lbs	22.90'	130 lbs	170 lbs
25	71"	131 lbs	22.33'	130 lbs	170 lbs
26	71"	169 lbs	33.90'	150 lbs	210 lbs
27	70"	156 lbs	26.90'	136 lbs	190 lbs
28	68"	144 lbs	29.42'	136 lbs	190 lbs
29	67"	131 lbs	27.17'	130 lbs	186 lbs
30	66"	141 lbs	24.17'	130 lbs	180 lbs

Test 24.

Complete Stage 3 (Nottingham School)

Results (Means?)

	Shot(ft)	Height(ins)	Weight(lbs)	Bench Press	Squat(lbs)	
O'Brien	27.92	68.10	145.03	133.27	178.33	Test 17
	30.52	68.17	145.50	137.87	186.13	Test 24
Step Back	28.86	68.02	140.87	131.73	177.53	Test 17
	29.90	68.10	141.83	135.60	185.93	Test 24
Control	23.98	68.47	141.70	130.60	175.40	Test 17
	25.53	68.47	142.07	132.67	180.87	Test 24

SHOT PUTTING RESULTSSTAGE 1(b) Ipswich SchoolO'Brien Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>
1	67"	141 lbs	21.25'
2	66"	134 lbs	19.75'
3	71"	149 lbs	22.50'
4	69"	140 lbs	24.25'
5	64"	135 lbs	19.17'
6	63"	94 lbs	11.50'
7	69"	150 lbs	27.25'
8	68"	140 lbs	21.33'
9	66"	133 lbs	20.67'
10	62"	112 lbs	11.00'
11	68"	150 lbs	24.42'
12	66"	126 lbs	17.08'
13	65"	148 lbs	16.67'
14	67"	136 lbs	15.25'
15	63.5"	152 lbs	18.42'
16	62.5"	138 lbs	15.00'
17	71"	146 lbs	19.80'
18	68"	151 lbs	17.42'
19	70"	128 lbs	16.80'
20	69"	148 lbs	19.00'
21	66"	138 lbs	19.75'
22	70"	149 lbs	21.00'
23	71"	156 lbs	20.90'
24	63.5"	146 lbs	19.50'
25	67"	148 lbs	17.00'
26	69"	142 lbs	20.08'
27	68"	134 lbs	15.90'
28	67"	146 lbs	15.00'
29	65"	139 lbs	16.58'
30	66"	145 lbs	17.08'

Test 1.

STAGE 1(b) Ipswich SchoolStep Back Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>
1	71"	146 lbs	27.57'
2	71"	157 lbs	29.33'
3	72"	158 lbs	30.50'
4	69"	147 lbs	21.58'
5	65"	131 lbs	19.25'
6	68"	122 lbs	10.50'
7	68"	115 lbs	11.25'
8	70"	145 lbs	20.25'
9	69"	142 lbs	18.50'
10	69"	146 lbs	21.58'
11	66"	150 lbs	20.17'
12	67"	154 lbs	18.25'
13	69"	142 lbs	15.80'
14	70"	146 lbs	17.42'
15	71"	140 lbs	16.80'
16	68"	130 lbs	17.67'
17	62"	122 lbs	16.90'
18	70"	136 lbs	20.75'
19	67"	131 lbs	16.90'
20	63"	133 lbs	16.08'
21	62.5"	140 lbs	16.17'
22	62"	155 lbs	18.53'
23	66"	128 lbs	16.42'
24	71"	151 lbs	19.80'
25	67.5"	124 lbs	16.08'
26	66"	121 lbs	16.33'
27	65"	128 lbs	17.90'
28	68"	142 lbs	18.00'
29	70"	165 lbs	20.80'
30	72"	172 lbs	25.75'

Test 1.

STAGE 1(b) Ipswich SchoolControl Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>
1	71"	149 lbs	19.80'
2	66"	130 lbs	16.00'
3	65"	122 lbs	15.25'
4	67"	120 lbs	14.00'
5	65"	136 lbs	17.80'
6	70"	159 lbs	20.75'
7	68"	129 lbs	18.17'
8	68.5"	133 lbs	17.90'
9	67"	136 lbs	16.25'
10	65"	112 lbs	13.08'
11	64"	135 lbs	19.80'
12	68"	158 lbs	21.75'
13	70"	163 lbs	22.17'
14	68"	146 lbs	17.75'
15	68"	140 lbs	16.42'
16	67.5"	130 lbs	17.00'
17	69"	132 lbs	15.25'
18	68"	166 lbs	22.08'
19	67"	141 lbs	21.00'
20	68"	147 lbs	20.75'
21	67.5"	131 lbs	18.00'
22	66"	126 lbs	17.25'
23	63"	129 lbs	15.17'
24	62.5"	131 lbs	15.33'
25	68"	140 lbs	17.80'
26	70"	150 lbs	21.00'
27	72"	159 lbs	24.00'
28	68"	141 lbs	18.80'
29	66"	146 lbs	17.33'
30	64"	145 lbs	15.58'

Test 1.

STAGE 1(b) Ipswich SchoolO'Brien Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>
1	67"	143 lbs	32.25'
2	66"	136 lbs	24.90'
3	71"	150 lbs	32.33'
4	69"	142 lbs	27.08'
5	64.5"	136 lbs	23.80'
6	63"	101 lbs	19.25'
7	69"	154 lbs	33.90'
8	68"	145 lbs	28.08'
9	66"	136 lbs	24.75'
10	62.5"	114 lbs	19.80'
11	68"	152 lbs	27.90'
12	66"	128 lbs	20.25'
13	65"	150 lbs	19.80'
14	67"	137 lbs	18.75'
15	64"	153 lbs	22.58'
16	62.5"	139 lbs	20.67'
17	71"	148 lbs	23.33'
18	68"	153 lbs	21.75'
19	70"	130 lbs	19.90'
20	69"	150 lbs	24.08'
21	66"	140 lbs	24.75'
22	70"	151 lbs	25.80'
23	71"	157 lbs	24.50'
24	63.5"	147 lbs	26.75'
25	67"	149 lbs	23.80'
26	69"	143 lbs	26.75'
27	68"	136 lbs	23.00'
28	67"	147 lbs	18.58'
29	65"	142 lbs	20.33'
30	66"	146 lbs	24.90'

Test 8.

STAGE 1(b) Ipswich SchoolStep back Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>
1	71"	148 lbs	33.33'
2	71"	160 lbs	35.50'
3	72"	160 lbs	35.08'
4	69"	147 lbs	27.42'
5	65"	134 lbs	24.00'
6	68"	124 lbs	21.00'
7	68"	119 lbs	25.33'
8	70"	147 lbs	31.17'
9	69"	143 lbs	28.58'
10	69"	147 lbs	27.25'
11	66.5"	151 lbs	25.42'
12	67"	155 lbs	28.17'
13	69"	142 lbs	21.00'
14	70"	148 lbs	21.08'
15	71"	141 lbs	19.42'
16	68"	132 lbs	23.08'
17	62.5"	123 lbs	24.90'
18	70"	137 lbs	29.80'
19	67"	130 lbs	22.75'
20	63"	133 lbs	24.42'
21	62.5"	141 lbs	25.27'
22	62.5"	155 lbs	24.25'
23	66"	130 lbs	23.67'
24	71"	152 lbs	27.42'
25	67.5"	125 lbs	23.58'
26	66"	122 lbs	21.17'
27	65"	129 lbs	24.08'
28	68"	143 lbs	23.58'
29	70"	164 lbs	26.17'
30	72"	171 lbs	28.00'

Test 8.

STAGE 1(b) Inswich SchoolControl Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>
1	71"	150 lbs	22.42'
2	66"	130 lbs	18.00'
3	65"	121 lbs	18.25'
4	67"	121 lbs	17.17'
5	65.5"	137 lbs	19.33'
6	70"	160 lbs	23.90'
7	68"	131 lbs	20.75'
8	68.5"	134 lbs	19.75'
9	67"	137 lbs	18.58'
10	65"	114 lbs	16.17'
11	64"	135 lbs	21.00'
12	68"	159 lbs	23.00'
13	70"	164 lbs	26.50'
14	68.5"	147 lbs	18.90'
15	68"	140 lbs	17.17'
16	67.5"	130 lbs	19.25'
17	69"	133 lbs	18.67'
18	68"	167 lbs	26.58'
19	67"	142 lbs	24.58'
20	68"	148 lbs	23.80'
21	67.5"	132 lbs	21.17'
22	66"	127 lbs	19.90'
23	63.5"	131 lbs	19.75'
24	62.5"	132 lbs	17.25'
25	68"	141 lbs	19.33'
26	70"	152 lbs	25.00'
27	72"	160 lbs	28.08'
28	68"	140 lbs	21.08'
29	66"	147 lbs	19.75'
30	64"	145 lbs	18.33'

Test 8.

Complete Stage 1 (Ipswich School)

Results (Means)

	<u>Shot</u> (ft)	<u>Weight</u> (lbs)	
Step back	18.74	141.20	Test 1
	25.87	141.77	Test 8
O'Brien	18.72	139.87	Test 1
	24.15	141.83	Test 8
Control	18.41	139.40	Test 1
	20.78	140.23	Test 8

SHOT PUTTING RESULTSSTAGE 1(c) Loughborough SchoolO'Brien Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>
1	69"	170 lbs	20.50'
2	66"	143 lbs	18.75'
3	66"	147 lbs	18.00'
4	72"	169 lbs	25.00'
5	71"	150 lbs	18.00'
6	64"	134 lbs	15.33'
7	65"	136 lbs	10.50'
8	69"	140 lbs	15.00'
9	71"	163 lbs	19.75'
10	70"	166 lbs	21.75'
11	69"	108 lbs	12.25'
12	72"	147 lbs	18.50'
13	69"	150 lbs	18.33'
14	70"	154 lbs	19.08'
15	71"	148 lbs	21.25'
16	70"	155 lbs	21.75'
17	72"	136 lbs	19.75'
18	67"	150 lbs	17.90'
19	66"	148 lbs	18.25'
20	68"	147 lbs	20.00'
21	66"	134 lbs	20.75'
22	68"	139 lbs	20.33'
23	62"	128 lbs	16.90'
24	64"	137 lbs	17.33'
25	66"	110 lbs	15.25'
26	62"	109 lbs	14.75'
27	64"	140 lbs	17.90'
28	67"	151 lbs	19.42'
29	66"	147 lbs	20.17'
30	66"	145 lbs	19.75'

Test 1.

STAGE 1(c) Loughborough SchoolStep Back Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>
1	70"	170 lbs	27.00'
2	71"	165 lbs	23.08'
3	67"	150 lbs	23.25'
4	71"	172 lbs	28.25'
5	66"	122 lbs	17.67'
6	65"	124 lbs	20.00'
7	63"	105 lbs	9.67'
8	64"	108 lbs	9.33'
9	70"	174 lbs	29.00'
10	71"	168 lbs	23.42'
11	72"	184 lbs	26.08'
12	67.5"	122 lbs	17.00'
13	67"	140 lbs	13.90'
14	68"	164 lbs	16.42'
15	61"	103 lbs	13.25'
16	67"	120 lbs	17.33'
17	63"	115 lbs	14.90'
18	66"	120 lbs	23.42'
19	66.5"	130 lbs	18.75'
20	62.5"	120 lbs	17.75'
21	63"	109 lbs	11.08'
22	64"	118 lbs	16.58'
23	61"	106 lbs	15.67'
24	63"	100 lbs	15.33'
25	71"	156 lbs	15.75'
26	70"	158 lbs	16.25'
27	64"	120 lbs	11.33'
28	71"	149 lbs	18.80'
29	69"	174 lbs	16.58'
30	71"	140 lbs	17.50'

Test 1.

STAGE 1(c) Loughborough SchoolControl Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>
1	64"	114 lbs	15.42'
2	68"	149 lbs	24.08'
3	67"	138 lbs	20.00'
4	64"	128 lbs	17.17'
5	71"	150 lbs	26.50'
6	63.5"	120 lbs	15.08'
7	70"	149 lbs	20.50'
8	62.5"	132 lbs	16.25'
9	65"	131 lbs	14.25'
10	69"	151 lbs	20.50'
11	65"	122 lbs	14.75'
12	69"	157 lbs	20.67'
13	65.5"	135 lbs	14.33'
14	66"	140 lbs	17.90'
15	68"	127 lbs	16.42'
16	68"	136 lbs	18.37'
17	66"	142 lbs	19.67'
18	67.5"	150 lbs	19.08'
19	72"	132 lbs	20.42'
20	70"	137 lbs	20.00'
21	68"	152 lbs	17.17'
22	68"	157 lbs	18.50'
23	67"	150 lbs	16.90'
24	66"	146 lbs	17.33'
25	64"	127 lbs	14.00'
26	65"	129 lbs	16.33'
27	67"	136 lbs	18.80'
28	68"	140 lbs	18.42'
29	69"	160 lbs	20.80'
30	67"	141 lbs	16.33'

Test 1.

STAGE 1.(c) Loughborough SchoolO'Brien Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>
1	69"	179 lbs	33.25'
2	66"	146 lbs	26.58'
3	66.5"	150 lbs	25.08'
4	72"	172 lbs	32.42'
5	71"	152 lbs	25.90'
6	64"	139 lbs	22.58'
7	65"	140 lbs	22.33'
8	69"	140 lbs	22.50'
9	71"	165 lbs	27.25'
10	70"	173 lbs	29.33'
11	69"	112 lbs	22.17'
12	72"	151 lbs	23.90'
13	69"	153 lbs	25.90'
14	70"	158 lbs	27.25'
15	71"	150 lbs	23.42'
16	70.5"	159 lbs	28.33'
17	72"	136 lbs	22.90'
18	67"	150 lbs	24.80'
19	66"	149 lbs	25.50'
20	68"	152 lbs	23.90'
21	66"	136 lbs	28.00'
22	68"	142 lbs	27.90'
23	62.5"	130 lbs	21.42'
24	64.5"	139 lbs	20.50'
25	66"	112 lbs	18.75'
26	62.5"	110 lbs	17.17'
27	64"	144 lbs	25.08'
28	67"	153 lbs	23.33'
29	66"	150 lbs	27.42'
30	66"	145 lbs	26.33'

Test 8.

STAGE 1.(c) Loughborough SchoolStep back Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>
1	70"	174 lbs	33.90'
2	71"	168 lbs	31.75'
3	67"	156 lbs	29.67"
4	71"	171 lbs	32.90'
5	66"	125 lbs	22.42'
6	65"	126 lbs	22.08'
7	63"	110 lbs	20.58'
8	64"	112 lbs	21.25'
9	70"	178 lbs	36.58'
10	71"	175 lbs	35.08'
11	72"	185 lbs	33.33'
12	67.5"	126 lbs	22.90'
13	67"	142 lbs	24.90'
14	68"	166 lbs	27.75'
15	61.5"	106 lbs	18.25'
16	67"	123 lbs	25.80'
17	63.5"	118 lbs	22.80'
18	66.5"	122 lbs	25.90'
19	63"	132 lbs	25.50'
20	66"	122 lbs	22.80'
21	63.5"	112 lbs	19.08'
22	64.5"	120 lbs	19.25'
23	61.5"	109 lbs	19.42'
24	63"	103 lbs	18.75'
25	71"	157 lbs	27.17'
26	70"	159 lbs	26.75'
27	64"	122 lbs	19.75'
28	71"	151 lbs	24.80'
29	69"	175 lbs	29.08'
30	71"	141 lbs	24.17'

Test 8.

STAGE 1(c) Loughborough SchoolControl Group

<u>Subject</u>	<u>Height</u>	<u>Weight</u>	<u>Shot</u>
1	64"	115 lbs	17.80'
2	68.5"	150 lbs	25.33'
3	67"	139 lbs	22.42'
4	64"	130 lbs	19.33'
5	71" "	150 lbs	27.25'
6	64"	121 lbs	17.75'
7	70"	150 lbs	22.75'
8	62.5"	133 lbs	17.80'
9	65"	133 lbs	18.67'
10	69"	150 lbs	22.33'
11	65"	121 lbs	16.08'
12	69"	158 lbs	21.00'
13	65.5"	136 lbs	15.80'
14	66"	142 lbs	19.42'
15	68"	127 lbs	19.25'
16	68"	136 lbs	21.33'
17	66"	143 lbs	21.90'
18	67.5"	151 lbs	20.42'
19	72"	133 lbs	21.75'
20	70"	138 lbs	23.75'
21	68"	153 lbs	19.25'
22	68"	159 lbs	20.50'
23	67"	151 lbs	19.33'
24	66"	147 lbs	18.08'
25	64.5"	127 lbs	16.25'
26	65"	128 lbs	20.75'
27	67"	136 lbs	19.75'
28	68"	141 lbs	20.90'
29	69"	159 lbs	22.25'
30	67"	145 lbs	19.00'

Test 8.

Complete Stage 1 (Loughborough School)

Results (Means)

	Shot (ft)	Weight(lbs)	
Step back	18.75	136.80	Test 1
	25.48	139.60	Test 8
O'Brien	18.31	143.37	Test 1
	24.94	146.23	Test 8
Control	18.25	139.70	Test 1
	20.48	140.90	Test 8

APPENDIX 2

APPENDIX 2ATTITUDES (Sheets and Results)Please Read Carefully

1. I am conducting an experiment and would like you to join in and help.
2. This booklet contains three Attitude Tests towards PHYSICAL EDUCATION.
3. You are asked to show how you feel about certain aspects of Physical Education. All you have to do is read each statement carefully before writing down your answer.
4. Read the instructions for each of the three tests carefully before you decide your answers.
5. The following terms are explained to help you with your answers.
 - (a) 'PHYSICAL EDUCATION' includes physical education lessons in the gymnasium, all types of games such as rugby, tennis, golf etc. It also includes fitness training, (weight training and circuit training), athletics, swimming and all those other physical activities organised by the school during and after school hours.
 - (b) 'SKILLS' are the ways used to do any particular physical activity, e.g. the way you pass or kick a ball in football.
 - (c) 'PHYSIQUE' refers to the **shape** and size of the body (especially the shape).

- (d) 'COMPETITIVE SPORTS' include those physical activities in which a person competes, either as a member of a team, or as an individual.
- (e) 'LEISURE TIME' is your own free time - especially during holidays, and after ~~school~~ hours.

-1-

Using the scales below, express on the
Answer Sheet what the concept in the box means
to you.

PHYSICAL ACTIVITY AS A SOCIAL
EXPERIENCE

Sports, games and other forms of
physical recreation whose primary
purpose is to provide opportunities
for social participation; that is,
to meet new people and continue
personal friendships.

As you proceed always be thinking about the idea or concept
in the box.

- | | | | |
|----|-----------|-------------------|------------|
| 1. | good | __:__:__:__:__:__ | bad |
| 2. | worthless | __:__:__:__:__:__ | worthwhile |
| 3. | pleasant | __:__:__:__:__:__ | unpleasant |
| 4. | sour | __:__:__:__:__:__ | sweet |
| 5. | nice | __:__:__:__:__:__ | awful |
| 6. | sad | __:__:__:__:__:__ | happy |
| 7. | clean | __:__:__:__:__:__ | dirty |
| 8. | relaxed | __:__:__:__:__:__ | tense |

Using the scales below, express on the Answer Sheet what the concept in the box means to you.

PHYSICAL ACTIVITY FOR HEALTH
AND FITNESS

Participating in physical activity primarily to improve one's health and physical fitness.

As you proceed always be thinking about the idea or concept in the box.

- | | | | |
|----|-----------|-------------------|------------|
| 1. | good | __:__:__:__:__:__ | bad |
| 2. | worthless | __:__:__:__:__:__ | worthwhile |
| 3. | pleasant | __:__:__:__:__:__ | unpleasant |
| 4. | sour | __:__:__:__:__:__ | sweet |
| 5. | nice | __:__:__:__:__:__ | awful |
| 6. | sad | __:__:__:__:__:__ | happy |
| 7. | clean | __:__:__:__:__:__ | dirty |
| 8. | relaxed | __:__:__:__:__:__ | tense |

-3-

Using the scales below, express on the Answer Sheet what the concept in the box means to you.

PHYSICAL ACTIVITY AS A THRILL BUT
INVOLVING SOME RISK

Physical activities providing, at some risk to the participant, thrills and excitement through speed, acceleration sudden change of direction, and exposure to dangerous situations, such as cycling or horse riding.

As you proceed, always be thinking about the idea or concept in the box.

- | | | | |
|----|-----------|-------------------|------------|
| 1. | good | __:__:__:__:__:__ | bad |
| 2. | worthless | __:__:__:__:__:__ | worthwhile |
| 3. | pleasant | __:__:__:__:__:__ | unpleasant |
| 4. | sour | __:__:__:__:__:__ | sweet |
| 5. | nice | __:__:__:__:__:__ | awful |
| 6. | sad | __:__:__:__:__:__ | happy |
| 7. | clean | __:__:__:__:__:__ | dirty |
| 8. | relaxed | __:__:__:__:__:__ | tense |

-4-

Using the scales below, express on the
Answer Sheet what the concept in the box
means to you.

PHYSICAL ACTIVITY AS THE BEAUTY IN
HUMAN MOVEMENT

Physical activities which are thought
of as possessing beauty or certain
artistic qualities such as ballet,
gymnastics or figure skating

As you proceed, always be thinking about the idea or concept
in the box.

- | | | | |
|----|-----------|-----------------------|------------|
| 1. | good | __:__:__:__:__:__:__: | bad |
| 2. | worthless | __:__:__:__:__:__:__: | worthwhile |
| 3. | pleasant | __:__:__:__:__:__:__: | unpleasant |
| 4. | sour | __:__:__:__:__:__:__: | sweet |
| 5. | nice | __:__:__:__:__:__:__: | awful |
| 6. | sad | __:__:__:__:__:__:__: | happy |
| 7. | clean | __:__:__:__:__:__:__: | dirty |
| 8. | relaxed | __:__:__:__:__:__:__: | tense |

-5-

Using the scales below, express on the Answer Sheet what the concept in the box means to you.

PHYSICAL ACTIVITY AS PROLONGED AND
STRENUOUS TRAINING

Physical activities which require long periods of strenuous and often painful training; which involve stiff competition and demands that the individual give up a number of pleasures for a period of time.

As you proceed, always be thinking about the idea or concept in the box.

- | | | | |
|----|-----------|-------------------|------------|
| 1. | good | __:__:__:__:__:__ | bad |
| 2. | worthless | __:__:__:__:__:__ | worthwhile |
| 3. | pleasant | __:__:__:__:__:__ | unpleasant |
| 4. | sour | __:__:__:__:__:__ | sweet |
| 5. | nice | __:__:__:__:__:__ | awful |
| 6. | sad | __:__:__:__:__:__ | happy |
| 7. | clean | __:__:__:__:__:__ | dirty |
| 8. | relaxed | __:__:__:__:__:__ | tense |

-6-

Using the scales below, express on the
Answer Sheet what the concept in the box
means to you.

PHYSICAL ACTIVITY FOR THE RELEASE
OF TENSION.

The participation (or watching others
participate) in physical activities
to get away from the problems of
modern living; to provide a release
from pent up emotions.

As you proceed, always be thinking about the idea or concept
in the box.

- | | | | |
|----|-----------|-------------------|------------|
| 1. | good | __:__:__:__:__:__ | bad |
| 2. | worthless | __:__:__:__:__:__ | worthwhile |
| 3. | pleasant | __:__:__:__:__:__ | unpleasant |
| 4. | sour | __:__:__:__:__:__ | sweet |
| 5. | nice | __:__:__:__:__:__ | awful |
| 6. | sad | __:__:__:__:__:__ | happy |
| 7. | clean | __:__:__:__:__:__ | dirty |
| 8. | relaxed | __:__:__:__:__:__ | tense |

-7-

Using the scales below, express on the Answer Sheet what the concept in the box means to you.

PHYSICAL ACTIVITY AS GAMES OF CHANCE

Games and sports where chance and luck are more important than skill in determining the winner, such as dice or horse racing.

As you proceed, always be thinking about the idea or concept in the box.

1. good __:__:__:__:__:__bad
2. worthless __:__:__:__:__:__worthwhile
3. pleasant __:__:__:__:__:__unpleasant
4. sour __:__:__:__:__:__sweet
5. nice __:__:__:__:__:__awful
6. sad __:__:__:__:__:__happy
7. clean __:__:__:__:__:__dirty
8. relaxed __:__:__:__:__:__tense

Classification of Sports and Physical
Activity.

Instructions: This is the last one. You will remember from other inventories the different types of physical activity such as SOCIAL EXPERIENCE, HEALTH and FITNESS, etc. Keep the definitions of each of these in mind as you answer the following questions.

1. What two sports or physical activities are best for providing enjoyable social experiences?
 - 1.
 - 2.
2. What two physical activities do you think are the best for developing HEALTH and FITNESS?
 - 1.
 - 2.
3. What two physical activities are best for providing THRILLS at some RISK?
 - 1.
 - 2.
4. What two physical activities do you think are best for showing the BEAUTY of HUMAN MOVEMENT?
 - 1.
 - 2.
5. What two physical activities do you think are best for releasing TENSION?
 - 1.
 - 2.

6. What two physical activities do you think require the most PROLONGED and STRENUOUS TRAINING?

1.

2.

7. What two sports or physical activities do you think are based mostly on CHANCE or LUCK?

1.

2.

- Q.1. How often do you read about sports and physical activity in the newspapers.
- | at least per week. | once or twice per month. | less often or never. |
|----------------------|--------------------------|----------------------|
| <input type="text"/> | <input type="text"/> | <input type="text"/> |
- Q.2. How often do you read about sports and physical activity in magazines and books
- | | | |
|----------------------|----------------------|----------------------|
| <input type="text"/> | <input type="text"/> | <input type="text"/> |
|----------------------|----------------------|----------------------|
- Q.3. On the average, how many hours do you watch sports on television each week.
- (a) in Summer no. of hrs.....
- (b) in Winter no. of hrs.....
- Q.4. In what sport or physical activity do you like to participate the most? Consider all types of sports from swimming to football
- Q.5. In what sport or physical activity does your father (or guardian) like to participate the most.
- Q.6. If you had the chance, name the sport in which you would like to participate most of all (even though you may never have played it before)
- Q.7. What is your favourite sport to attend as a spectator
- Q.8. What is your father's (or guardian's) favourite sport to attend as a spectator

Q.9. What is your favourite sport on
Television

.....

Q.10. What is your father's favourite
sport on Television

.....

Q.11. How old are you

.....

Q.12. How many brothers and sisters
do you have

.....

|

Q.13. How many of you brothers and
sisters are older than you

.....

RESULTS OF ATTITUDE TESTS TOWARDSPHYSICAL EDUCATION (Nottingham School)Test 1. Completion of Stage 1O'BRIEN GROUP

1st	Physical Activity for Health and Fitness	-	46.00
2nd	Physical Activity for the Release of Tension	-	45.57
3rd	Physical Activity as prolonged and strenuous training	-	45.43
4th	Physical Activity as a Social Experience	-	45.20
5th	Physical Activity as a Thrill but involving Risk	-	44.53
6th	Physical Activity as the beauty in human movement	-	44.20
7th	Physical Activity as Games of Chance	-	35.93

.....

STEP BACK GROUP

1st	Physical Activity for Health and Fitness	-	49.00
2nd	Physical Activity as a Social Experience	-	47.38
3rd	Physical Activity as prolonged and strenuous training	-	46.77
4th	Physical Activity as the Beauty of human movement	-	45.33
5th	Physical Activity as a thrill but involving Risk	-	44.30
6th	Physical Activity for the Release of tension	-	43.73
7th	Physical Activity as Games of Chance	-	43.53

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CONTROL GROUP

1st	Physical Activity for Health and Fitness	-	48.37
2nd	Physical Activity as a Social Experience	-	45.43
3rd	Physical Activity as Tension Release	-	44.70
4th	Physical Activity as the beauty of movement	-	43.73
5th	Physical Activity as prolonged and strenuous training	-	43.43
6th	Physical Activity as a Thrill but involving Risk	-	41.60
7th	Physical Activity as Games of Chance	-	37.73

RESULTS OF ATTITUDE TESTS TOWARDSPHYSICAL EDUCATION

(Nottingham School)

Test 2. (After the end of Stage 3)O'BRIEN GROUP

1st	Physical Activity for Health and Fitness	-	48.09
2nd	Physical Activity for the Release of Tension	-	46.30
3rd	Physical Activity as prolong and strenuous training	-	46.03
4th	Physical Activity as a social experience	-	45.97
5th	Physical Activity as a thrill but involving Risk	-	42.57
6th	Physical Activity as the beauty in human Movement	-	42.43
7th	Physical Activity as Games of Chance	-	35.20

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STEP BACK GROUP

1st	Physical Activity for Health and Fitness	-	49.63
2nd	Physical Activity as a Social Experience	-	47.38
3rd	Physical Activity for the Release of Tension	-	47.03
4th	Physical Activity as prolong and strenuous training	-	46.20
5th	Physical Activity as the beauty of human movement	-	44.40
6th	Physical Activity as a thrill but involving Risk	-	43.67
7th	Physical Activity as a Game of Chance	-	39.00

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CONTROL GROUP

1st	Physical Activity for Health and Fitness	-	48.70
2nd	Physical Activity for Release of Tension	-	45.90
3rd	Physical Activity as a Social Experience	-	45.67
4th	Physical Activity as the beauty of human movement	-	44.06
5th	Physical Activity as prolonged and strenuous training	-	43.10
6th	Physical Activity as a thrill but involving Risk	-	42.87
7th	Physical Activity as Games of Chance	-	37.40

ATTITUDE TESTSO'BRIEN GROUP

SUBJECT	Social Exp.		Health & Fitness		Thrill & some risk		Beauty		Strenuous		Chance		Tension	
	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.
1	46	47	49	51	39	40	49	42	50	52	35	32	54	55
2	47	45	45	47	42	41	44	41	44	46	40	35	45	47
3	48	47	52	54	41	42	48	47	51	54	32	30	52	52
4	46	47	54	53	46	47	46	43	54	52	35	31	52	50
5	48	47	46	47	47	46	45	41	42	47	41	47	46	47
6	45	46	45	48	43	44	40	42	40	42	30	31	38	40
7	40	42	46	48	42	41	44	45	41	43	35	30	38	41
8	45	46	47	46	43	40	40	41	40	44	29	31	45	46
9	46	47	48	47	40	41	42	43	50	51	36	32	50	51
10	44	45	50	51	41	39	45	42	52	51	36	37	51	52
11	48	45	40	41	47	45	44	41	35	37	44	43	40	41
12	46	44	48	47	44	41	40	42	46	48	35	37	41	42
13	45	46	50	51	46	47	38	40	44	49	38	36	48	49
14	40	42	42	43	40	40	41	43	40	42	38	38	42	41
15	44	44	48	46	45	45	40	41	42	43	30	31	40	44
16	48	46	52	54	44	45	48	45	52	54	38	37	54	55
17	50	47	55	55	36	39	40	41	38	40	19	21	43	42
18	46	44	50	50	32	33	38	41	39	41	27	25	40	41
19	50	51	52	51	48	47	44	46	48	47	35	32	46	47
20	50	50	46	48	41	42	38	40	39	41	39	37	40	42
21	50	47	50	52	42	41	44	41	48	49	40	41	49	46
22	46	48	52	51	45	45	40	42	48	47	36	37	50	51
23	48	47	50	48	48	48	42	43	49	52	40	42	48	50
24	50	49	50	49	44	43	44	46	46	48	41	41	47	48
25	44	42	51	52	46	48	45	41	47	49	40	42	42	43
26	48	46	40	41	41	40	38	39	36	38	40	37	38	40
27	48	47	52	53	42	39	42	43	51	53	32	35	54	52
28	46	45	53	54	46	41	45	46	50	51	38	38	50	50
29	44	47	47	50	44	45	40	42	41	40	40	42	42	43
30	46	43	40	41	41	42	42	43	40	38	39	38	42	41

ATTITUDE TESTSSTEP BACK GROUP

subject	Social Exp		Health & Fitness		Thrill & some risk		Beauty		Strenuous		Chance		Tension	
	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.
1	50	49	50	52	49	47	47	44	50	48	42	40	51	49
2	50	47	54	53	48	46	48	45	52	51	38	37	50	51
3	52	50	50	52	46	44	47	44	50	48	39	36	46	47
4	50	49	50	51	46	43	46	42	46	46	40	38	46	48
5	48	50	47	48	43	41	45	45	45	42	40	41	47	45
6	47	46	46	47	40	42	45	44	44	41	33	35	42	45
7	49	48	46	48	39	40	38	39	40	41	31	30	39	42
8	49	47	54	51	46	46	49	48	51	48	42	40	47	49
9	52	50	50	52	42	40	44	43	48	46	43	40	46	48
10	47	47	51	52	46	43	46	44	47	44	42	38	45	47
11	49	50	50	51	45	44	44	42	49	48	39	38	50	50
12	52	51	51	51	45	43	50	50	52	50	46	42	47	48
13	50	52	50	50	48	47	46	47	50	48	44	41	48	47
14	49	47	52	53	47	48	49	48	50	47	42	40	51	52
15	44	43	48	49	41	40	43	42	46	48	30	33	48	48
16	40	42	49	48	46	44	46	46	40	42	36	37	42	41
17	45	46	47	48	40	42	42	41	41	40	39	38	40	40
18	43	44	46	47	46	43	49	48	45	46	43	41	46	45
19	51	50	55	49	50	51	51	50	52	50	42	40	50	48
20	48	47	53	54	42	43	49	51	50	51	41	42	50	47
21	45	44	46	48	40	42	43	42	40	42	42	40	44	45
22	43	44	43	45	39	40	42	43	39	40	43	40	45	47
23	42	43	45	45	42	41	43	44	41	40	43	40	42	44
24	47	49	46	47	43	44	41	40	42	41	43	41	40	42
25	50	51	54	52	42	42	45	44	50	47	40	38	50	50
26	48	47	50	51	46	45	47	48	51	50	43	44	49	47
27	42	43	45	43	42	43	44	42	46	46	44	43	47	49
28	45	46	48	47	47	46	43	40	47	46	46	48	45	47
29	50	52	53	54	46	44	43	41	51	50	33	35	51	52
30	47	48	50	51	47	46	46	45	48	49	37	33	48	51

ATTITUDE TESTSCONTROL GROUP

SUBJECT	Social Exp.		Health & Fitness		Thrill & some risk		Beauty		Strenuous		Chance		Tension	
	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.	Bef.	Aft.
1	44	42	48	50	43	41	45	41	47	49	36	35	42	44
2	46	47	52	50	46	47	47	46	49	50	36	31	48	50
3	47	48	50	49	40	43	43	40	45	47	39	32	46	47
4	46	47	55	52	36	40	40	38	38	35	19	19	43	44
5	48	48	49	47	35	39	39	38	38	39	36	35	39	38
6	47	46	46	46	45	41	38	40	37	39	35	32	40	41
7	51	52	54	54	47	45	51	50	52	50	42	41	52	53
8	45	45	52	53	40	41	43	45	49	51	40	37	50	52
9	43	40	45	47	40	43	47	48	43	47	45	44	48	50
10	47	48	48	46	41	43	44	46	40	43	37	40	48	49
11	43	41	46	46	40	42	42	40	45	44	40	38	39	40
12	46	47	50	52	43	47	45	47	46	45	39	37	50	52
13	48	49	51	50	46	45	47	47	48	47	41	39	51	53
14	48	49	50	52	45	46	43	45	42	41	40	39	45	47
15	52	50	56	47	45	45	48	46	51	50	38	37	53	52
16	45	47	49	49	41	42	40	42	46	43	40	38	51	52
17	44	41	45	47	45	46	41	43	40	41	41	39	43	46
18	47	48	46	45	43	44	42	42	42	40	40	38	40	41
19	42	43	45	47	40	41	39	41	38	39	43	45	44	45
20	40	41	40	42	41	42	38	41	37	41	28	32	36	38
21	43	43	45	46	40	41	41	42	40	42	30	31	41	42
22	45	46	47	49	41	43	46	47	41	43	42	44	39	41
23	39	40	41	43	40	40	47	49	35	38	39	40	33	35
24	40	41	43	45	38	41	40	41	37	35	35	37	39	40
25	42	43	45	46	40	42	42	44	40	40	37	39	42	41
26	50	51	55	54	50	50	50	48	52	50	32	33	51	50
27	48	47	50	52	40	43	46	48	47	45	38	40	48	49
28	46	48	50	52	44	45	45	47	47	41	39	42	48	50
29	47	47	49	51	43	40	47	46	45	41	40	41	45	47
30	44	45	49	51	40	38	46	44	46	47	45	47	46	48

APPENDIX 3

APPENDIX 3Somatotype ResultsSomatotype (Nottingham School)

SUBJECT	<u>O'Brien</u>			<u>Step Back</u>			<u>Control</u>		
	End.	Mes.	Ect.	End.	Mes.	Ect.	End.	Mes.	Ect.
1	3	6	1 ²	4	3 ²	4	5	2	3
2	4	5	2	3 ²	5	3 ²	3	4	3
3	5	3 ²	1 ²	3	5	3 ²	2	3	2 ²
4	3	5	2 ²	4	5	3	3	5	3 ²
5	4	2	3 ²	4	3	2 ²	4	3	3 ²
6	5	2 ²	1 ²	2	2	4 ²	2	2	3
7	5	2	2	1 ²	3	5 ²	3 ²	5	2 ²
8	4	3	3 ²	2	5	4	2	5	2 ²
9	3	5 ²	3	4	3 ²	3 ²	2 ²	2 ²	3 ²
10	2 ²	6	2	3	4	3	4	3	2 ²
11	1 ²	2	6 ²	3	5	2	2	1 ²	4 ²
12	3	3 ²	5	3	5	3	2 ²	5	3
13	1 ²	6	3	2	5	2 ²	3	4	4
14	1	6	3	3	5	2 ²	3	5	3 ²
15	2	5	4	2	4	3 ²	3 ²	5 ²	3 ²
16	3	5	3	3	3 ²	3	2 ²	2	4
17	1 ²	6	2	2 ²	2	4	2 ²	3	2 ²
18	2 ²	6	1 ²	3	5	1 ²	2	2 ²	3 ²
19	3	2	5 ²	5	1 ²	3 ²	2	2	3
20	2	6	2 ²	3	5	2 ²	2	3	3 ²
21	3	4	2 ²	2 ²	2 ²	4 ²	2 ²	2 ²	4
22	2	5	2 ²	1 ²	2	4	3	2	3
23	2	5	4	1	2 ²	3	1 ²	2	5 ²
24	3	5 ²	3 ²	3	2	5	2	2 ²	6
25	3	4	1 ²	2	3	3	2	2 ²	5 ²
26	3	2	5	3	3 ²	3	4	5	3
27	3	5	3	4	3	4	3	5	3
28	3	5 ²	3	2 ²	5	4	3 ²	5	3
29	6	2	3	5	4	1 ²	2 ²	3	3 ²
30	5 ²	3	2 ²	3	4	4 ²	4	3	2

SOMATOTYPE AND PERFORMANCE FOR 3 STAGES OF
LEARNING

STEP BACKPERFORMANCES (last test in each stage
of learning)

Subject No.	Somato- type Score	1	2	3
1. Endomorphy Mesomorphy Ectomorphy	4 3.5 4	33.33	33.17	34.42
2. Endo. Meso. Ecto.	3.5 5 3.5	35.50	37.33	38.58
3. Endo. Meso. Ecto.	3 5 3.5	35.08	37.00	38.08
4. Endo. Meso. Ecto.	4 5 3	27.42	27.80	28.17
5. Endo. Meso, Ect.	4 3 2.5	24.00	25.50	26.17
6. Endo. Meso. Ecto.	2 2 4.5	21.00	23.17	24.00
7. Endo. Meso. Ecto.	1.5 3 5.5	25.33	25.00	26.08
8. Endo Meso. Ecto.	2 5 4	31.17	33.42	34.33
9. Endo. Meso Ecto.	4 3.5 3.5	28.50	30.90	31.50
10. Endo. Meso. Ecto.	3 4 3	27.25	28.67	28.42

STEP BACKPERFORMANCES

Subject No.	Somato- type Score	1	2	3
11. End. Mes. Ect.	3 5 2	33.90	35.67	37.90
12. End. Mes. Ect.	3 5 3	31.75	32.17	32.80
13. End. Mes. Ect.	2 5 2	29.67	30.90	33.00
14. End. Mes. Ect.	3 5 2.5	32.90	32.17	33.17
15. End. Mes. Ect.	2 4 3.5	22.42	23.90	25.00
16. End. Mes. Ect.	3 3.5 3	25.08	27.50	27.17
17. End. Mes. Ect.	5 1.5 3.5	20.80	23.42	25.08
18. End. Mes. Ect.	2.5 2 4	21.25	21.75	23.42
19. End. Mes. Ect.	3 5 1.5	36.58	37.90	38.42
20. End. Mes. Ect.	3 5 2.5	35.08	37.08	39.50

STEP BACKPERFORMANCES

Subject No.	Somato- type Score			
		1	2	3
21. End. Mes. Ect.	2.5 2.5 4.5	20.08	21.08	21.90
22. End. Mes. Ect.	1.5 2 4	21.25	22.00	23.33
23. End. Mes. Ect.	1 2.5 3	21.42	22.90	23.90
24. End. Mes. Ect.	3 2 5	20.75	21.75	24.00
25. End. Mes. Ect.	2 3 3	27.17	30.42	33.17
26. End. Mes. Ect.	3 3.5 3	26.75	29.08	31.08
27. End. Mes. Ect.	4 3 4	19.75	21.00	23.17
28. End. Mes. Ect.	25. 5 4	26.80	28.75	29.08
29. End. Mes. Ect.	5 4 1.5	30.08	30.90	34.50
30. End. Mes. Ect.	3 4 4.5	24.17	26.17	29.08

O'BRIENPERFORMANCES (Last test in each stage
of Learning)

Subject No.	Somato- type Score	1	2	3
1. Endomorphy Mesomorphy Ectomorphy	3 6 1.5	27.25	29.17	36.42
2. End. Mes. Ect.	4 5 2	24.58	24.58	26.90
3. End. Mes. Ect.	5 3.5 1.5	25.08	30.33	37.00
4. End. Mes. Ect.	3 5 2.5	32.42	35.50	40.33
5. End. Mes. Ect.	4 2 3.5	23.90	24.90	26.90
6. End. Mes. Ect.	5 2.5 1.5	22.58	23.42	25.08
7. End. Mes. Ect.	5 2 2	18.33	19.90	23.75
8. End. Mes. Ect.	4 3 3½	22.50	23.90	27.42
9. End. Mes. Ect.	3 5.5 3	27.25	30.33	35.80

O'BRIENPERFORMANCES

Subject No.	Somato- type Score	1	2	3
10. End. Mes. Ect.	2.5 6 2	29.33	31.75	35.42
11. End. Mes. Ect.	1.5 2 6.5	18.17	19.50	21.80
12. End. Mes. Ect.	3 3.5 5	23.90	27.08	32.33
13. End. Mes. Ect.	1.5 6 3	25.90	29.00	33.75
14. End. Mes. Ect.	1 6 3	24.25	25.42	25.90
15. End. Mes. Ect.	2 5 4	23.42	25.17	27.42
16. End. Mes. Ect.	3 5 3	28.33	33.17	38.50
17. End. Mes. Ect.	3 2 5.5	22.90	24.80	27.17
18. End. Mes. Ect.	1.5 6 2	24.80	25.80	27.42

O'BRIENPERFORMANCES

Subject No.	Somato-type Score	1	2	3
19. End. Mes. Ect.	2.5 6 1.5	25.50	27.80	33.08
20. End. Mes. Ect.	2 6 2.5	23.90	25.50	26.90
21. End. Mes. Ect.	3 4 2.5	26.25	30.17	34.00
22. End. Mes. Ect.	2 5 2.5	24.90	26.42	29.17
23. End. Mes. Ect.	2 5 4	28.33	31.75	34.42
24. End. Mes. Ect.	3 5.5 3.5	27.08	31.00	33.90
25. End. Mes. Ect.	3 4 1.5	23.80	23.42	28.67
26. End. Mes. Ect.	3 2 5	19.25	22.42	23.58
27. End. Mes. Ect.	3 5 3	31.90	34.75	39.42

O'BRIENPERFORMANCES

Subject No.	Somato- type Score	1	2	3
28. End. Mes. Ect.	3 5.5 3	28.08	31.90	33.80
29. End. Mes. Ect.	6 2 3	24.75	25.17	26.00
30. End. Mes. Ect.	5.5 3 2.5	18.80	20.67	23.42

CONTROLPERFORMANCES (last test in each Stage of learning)

Subject No.	Somato-type Score	1	2	3
1. Endomorphy. Mesomorphy Ectomorphy	5 2 3	20.67	22.08	25.50
2. End. Mes. Ect.	3 4 3	26.00	27.17	28.00
3. End. Mes. Ect.	2 3 2.5	22.25	23.90	25.08
4. End. Mes. Ect.	3 5 3.5	28.42	30.80	31.90
5. End. Mes. Ect.	4 3 3.5	19.50	20.33	21.42
6. End. Mes. Ect.	2 2 3	17.90	19.17	21.17
7. End. Mes. Ect.	3.5 5 2.5	30.17	30.90	33.00
8. End. Mes. Ect.	2 5 2.5	24.42	26.42	28.17
9. End. Mes. Ect.	2.5 2.5 3.5	19.08	21.58	22.67
10. End. Mes. Ect.	4 3 2.5	20.67	21.75	24.00
11. End. Mes. Ect.	2 1.5 4.5	16.90	19.00	20.42

CONTROLPERFORMANCES

Subject No.	Somato-type Score	1	2	3
12. End. Mes. Ect.	2.5 5 3	26.90	28.50	31.08
13. End. Mes. Ect.	3 4 4	27.80	29.00	29.75
14. End. Mes. Ect.	3 5 3.5	24.80	25.80	27.00
15. End. Mes. Ect.	3.5 5.5 3.5	30.90	31.00	33.75
16. End. Mes. Ect.	2.5 2 4	16.80	19.17	21.67
17. End. Mes. Ect.	2 2 3	16.80	18.33	20.00
18. End. Mes. Ect.	2.5 3 2.5	20.25	21.42	21.75
19. End. Mes. Ect.	2 2.5 3.5	18.67	20.50	21.90
20. End. Mes. Ect.	2 3 3.5	22.75	24.08	25.50
21. End. Mes. Ect.	2.5 2.5 4	18.00	20.17	21.80

CONTROLPERFORMANCES

Subject No.	Somato- type Score	1	2	3
22. End. Mes. Ect.	3 2 3	17.90	19.50	23.00
23. End. Mes. Ect.	1.5 2 5.5	18.08	19.42	20.58
24. End. Mes. Ect.	2 2.5 6	18.90	21.08	22.90
25. End. Mes. Ect.	2 2.5 5.5	19.50	20.90	22.33
26. End. Mes. Ect.	4 5 3	30.25	31.50	33.90
27. End. Mes. Ect.	3 5 3	25.90	25.90	26.90
28. End. Mes. Ect.	3.5 5 3	25.80	27.90	29.42
29. End. Mes. Ect.	2.5 3	22.50	25.67	27.17
30. End. Mes. Ect.	4 3 2	21.75	22.42	24.17

