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AUTHOR Staniford, David J.
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ABSTRACT

This paper presents several concepts that underlie the acquisition and performance of motor skills and relates them to the practical problems faced by the physical education teacher or coach. Information is included from motor learning research, discussions with international colleagues, and the author's research and work with teachers and coaches. Significant research on retention as it relates to motor skill learning is reviewed toward developing practical teaching strategies. Strategies for teaching for retention are described toward developing lifetime retention of motor skills. An information processing theory is described in simple terms, and specific principles related to better teaching of motor skills are developed for use in practical teaching situations. (Author/JCW)

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TEACHING FOR RETENTION

Interpreting Motor Learning Research in the Practical Teaching Situation

by

David J. Staniford
Rotary International Fellow
College of Health, Physical Education
and Recreation
University of Oregon

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TEACHING FOR RETENTION

Introduction

The objective of this paper is to present several concepts that are believed to underlie the acquisition and performance of motor skills and then to relate these concepts to the practical problems faced by the physical education teacher or coach. It is hoped by the author, to encourage amongst motor skill practitioners, the use and adoption of specific teaching strategies designed to improve retention. The author has drawn significantly on motor learning research, discussions with several international colleagues, as well as his own research and work with teachers and coaches. In this paper, significant research on retention as it relates to motor skill learning will be briefly reviewed towards developing practical teaching strategies. "Teaching for retention" strategies, will be described towards developing lifetime retention. Through this paper and through a slide presentation the author will present several principles and methods for improving retention in the learning of motor skills.

RETENTION

To speak on Retention I feel I must also speak about FORGETTING and define a few basic terms:- According to Oxendine (1):

(SLIDE 1) RETENTION refers to the persistence of knowledges or skills which have been learned.

FORGETTING is the failure to retain that which has been learned.

REMINISCENCE refers to improvement during the period in which there is no practice.

These three basic terms have some importance to the physical education teacher or to anyone involved in teaching motor skills.

Retention and Forgetting are essentially opposites of the same phenomenom. For example, 100 per cent retention of a motor skill is equal to zero forgetting - and 20 per cent retention equals 80 per cent forgetting.

Most evaluation carried out during or after the educative process involves finding out what a student knows - what he has learned or what knowledge or skills he has acquired as a result of a specified learning experience. We do this also in physical education activities - we try to assess what the student knows; or whether he has acquired the correct techniques required for a particular game or activity; or what concepts, knowledge or attitudes he has acquired.

Maybe this is not enough. Maybe we should be trying to find out what he or she has forgotten, and why? - or trying to answer such questions as:

How much of the particular skill pattern is retained and how long can a student be expected to retain this skill? (for a lifetime?).

At what point does a skill pattern become automatic?

How quickly is the neuromuscular pattern for a particular skill forgotten?

What is the optimum practice period length and its distribution for maximum retention of skill?

My aim today is to encourage, particularly amongst the motor skill practitioners, a greater awareness of what retention is, and how it may be related to the practical teaching situation. I will present some selected research evidence on retention and attempt to provide some practical guidelines for physical education teachers as to how this evidence may be used in the practical teaching situation.

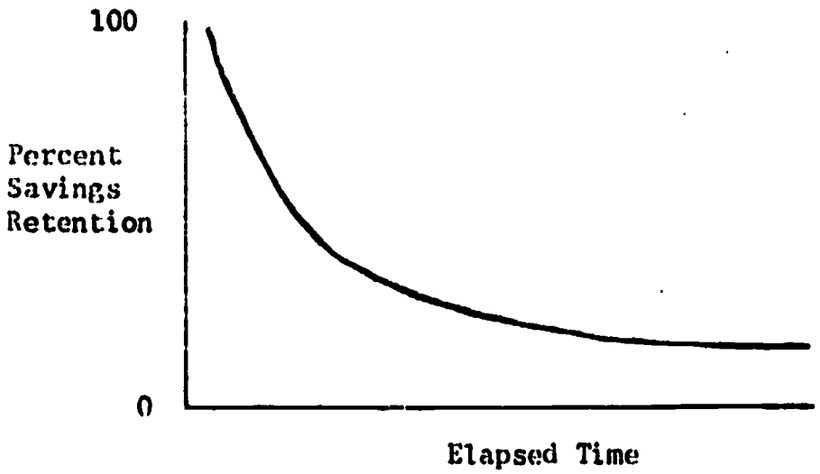
PRINCIPLES OF RETENTION AND FORGETTING

"All learning experiences will be more valuable if the individual is able to remember them for a reasonably long time. Retention is essential if the person is to put to use what he has learned. If the information cannot be recalled on the appropriate occasion, the time spent on learning it has been largely wasted". (2).

It is important then, that teachers become concerned not only with learning, but with retention of skills or materials which have been learned. Teachers in many subject fields have been traditionally concerned with immediate performance, often to the neglect of techniques which might improve long-term retention. With the increased emphasis on "lifetime sports skills" in contemporary school and college physical education programmes I believe it is essential for physical educators to examine methods of enhancing life - long retention.

THE RETENTION CURVE

A retention curve illustrates the amount of skill which is retained at various points in time following the cessation of practice. The retention of an unpracticed skill or unreviewed verbal learning follows a decelerating curve. The shape of this curve is almost as well known as that of the learning curve.



(SLIDE II)

The Typical Retention Curve

It appears that forgetting is never complete. Thus the true retention curve never reaches the baseline. Motor skills or verbal materials which are experienced only once are often recalled under certain conditions.

Unusual incidences of retention in everyday life seem to verify that forgetting is never complete. The descent of the retention curve is greatly affected by such factors as:

1. Type of material learned.
2. Its meaningfulness to the learner.
3. The type of practice schedule used by the learner.
4. Intensity and speed of learning.

SELECTED RESEARCH

There has been very little research in Australasia in the area of Retention and Motor Skill learning. However, the following selected examples of studies done in the U.S. may help us to answer some of the questions I have posed earlier:

Hill(3) reported in 1957 on retention of typing skills, which is believed to be representative of the longest interval between original learning and relearning. He tested himself at twenty five year intervals, after original learning in 1907. It was found that retention was quite marked, with about 50% retention of the first twenty five years (in 1932) and about 25% retention at the end of fifty years (in 1957).

Bell(4) in 1950, using a pursuit motor task, produced findings that large amounts of retention existed up to one year after the initial learning took place and relearning to the original criterion occurred far more rapidly than originally took place.

Purdy and Lockhart(5) conducted a study to determine retention among five gross motor skills.

College women learned novel skills including:

(a) a nickle toss requiring timing and accuracy,

(b) a ball toss involving hand-eye co-ordination,

(c) a foot volley involving foot-eye co-ordination,

(d) a Lacrosse throw and catch requiring total body co-ordination and adjustments,

(e) balancing on a bongo board

Subjects were divided into three groups according to their ability to learn each of the skills. After a period of nine to fifteen months, thirty six of the original seventy five women were given a retention -

learning test on each of the skills. At this retention - check, they practiced the skills for three days in the same manner as was followed from the original learning.

In analysing the data Purdy and Lockhart found that:-

1. A high degree of skill was retained after approximately one year of no practice. The total group retained 94% of its best performance on original learning. 89% of subjects displayed reminiscence on one or more skills.

2. Relearning of previously attained skill levels was rapid after approximately one year of no practice. After 3 days of practice the total group regained the level of proficiency acquired in the ten days of original learning.

3. The skill groups retained their relative positions in learning, retention and relearning of gross motor skills. The high skill group had significantly better scores than the average and low skill groups; the average skill group had significantly better scores than the low skill group.

4. When proportion of skill retained and relearned was considered, differences among the classified skill groups were small.

After observing the high degree of retention in these skills, the authors suggested that teachers probably spend too much time reviewing previously learned skills.

- Intermediate and advanced performers should be able to go very quickly into more advanced skills.
- Long periods of review on more fundamental skills are generally a waste of time.

BASIC PRINCIPLES FOR RETENTION AND FORGETTING

From the research literature(6), several general principles may be derived in regard to retention and forgetting with motor skills:

(SLIDE III, IV)

1. The higher the proficiency attained on a motor skill during initial learning, the more slowly the skill is forgotten.
2. Retention is better when the task is learned under a distributed practice schedule than under a massed schedule.
3. Tasks that are meaningful and highly motivating tend to be remembered better than meaningless, low-motivating tasks.
4. Relearning of motor tasks is rapid.

Both the early and more recent research suggests that motor skills seem remarkably resistant to extinction(7). There is some evidence to indicate that verbal skills are more likely to be forgotten than motor skills.(8)

Gagne and Fleishman(9) suggest that human activities more resistant to forgetting are motor skills which are continuous such as walking, swimming, skating, skiing, juggling or bicycle riding, as opposed to those consisting of separated movements. Oxendine(10) puts forward several points relating to the retention of continuous versus discrete motor skills. He states that:

1. Continuous activities usually involve a great deal of overlearning. Participation usually requires numerous repetitions of the same movement e.g.

after a child first learns to walk, each step involves overlearning. (skiing, swimming also).

2. The fitness level and age of the performer may also have some effect on retention of a continuous or discrete motor skill.

3. A lower level of skill is often associated with continuous rather than discrete motor skills, (walking v's accuracy task or gymnastic stunt).

Other factors affecting Retention:

REMINISCENCE

It is not an unusual occurrence in sports for an individual who returns to activity after a few weeks or months to discover that he is a better performer than when he last participated. This discovery is contrary to what one would expect from the retention curves.

Some researchers(11) have indicated that this phenomenom may be possible because of unconscious or conscious use of mental practice and mental rehearsal. Such rehearsal may occur during periods of no physical practice and may help to improve performance.

Often when massed practice is used to teach a skill the student becomes fatigued and bored - poorer performance may show up at the end of a practice session than in the middle stages. Often an interval of rest from practice can be very beneficial, or the use of distributed practice periods may be advisable.

RETROACTIVE INHIBITION

1. The Perseveration Theory - According to this theory, there is a tendency for the learner to continue thinking

about the task, or to perservate, for a period after the cessation of practice. If a period of idleness follows practice, the individual often may engage in continuous rehearsal which reinforces the learning that took place. However, if the individual takes part in other activity immediately after the work period, perseveration is interrupted, and as a result the original activity is not learned as well - so retention would be poorer.

TRANSFER OR COMPETITION THEORY

This theory assumes that the loss of retention caused by intervening activity is the result of negative transfer from one activity to another or of interaction between two activities.

Many studies have shown that the degree of retention of one task is influenced by its similarity to the intervening task. This concept differs significantly from the perseveration theory in which any activity following the original learning would interrupt the lingering mental activity and cause forgetting.

The transfer theory is really one of negative transfer in which learning from one task intrudes upon another.

IMPLICATIONS FOR PHYSICAL EDUCATION TEACHERS

I have mentioned several important basic principles in relation to retention, forgetting and reminiscence. Maybe in our methods of teaching motor skills (continuous, discrete or complex) we could experiment a little towards using some of the research evidence available in this area. Maybe we could actually "teach to improve retention and reminiscence", so as to hinder the forgetting process. By this process we may indeed be

able to improve our teaching of skills, towards the attainment of "Lifetime skills".

SUMMARY OF IMPLICATIONS

(a) Retention of motor skills is quite similar to retention of verbal materials,

(b) Effective learning must take place before material will be remembered,

(c) For motor or verbal tasks, meaningful useful skills will be retained better than skills with no apparent purpose,

(d) Many physical skills are retained longer than verbal skills because such motor skills are often overlearned.

*(e) Distributed practices are advantageous for retention as well as for original learning.

*(f) Reviews should be most frequent soon after the learning has been accomplished,

* (SLIDES V, VI, VII)

*(g) Practice with the intention of remembering and with an awareness of possible distractions will aid retention,

*(h) Any activity following the learning period may hinder or interfere with material learned,

*(i) Interference is greater when the intervening activity is similar to the original learning,

*(j) The more unique the learned activity, the less likely will be the interference,

*(k) Maximum retention can be promoted by overlearning skills and by regularly using them.

"Good teaching involving appropriate motivating techniques, interesting learning tasks, and desirable practice conditions begets good learning. Good learning, in turn, begets good retention".(12)

INFORMATION - PROCESSING THEORY

The Information - Processing or Flow Theory has been used by Welford(16) and others to describe man as an information processor - placing definite limitations on the amount of information he can process.

We can process no more than about three 'bits' of information effectively in the usual skill learning situation. In simple terms, we process skill learning information very much like a computer processes information using what is often called our "channel capacity".

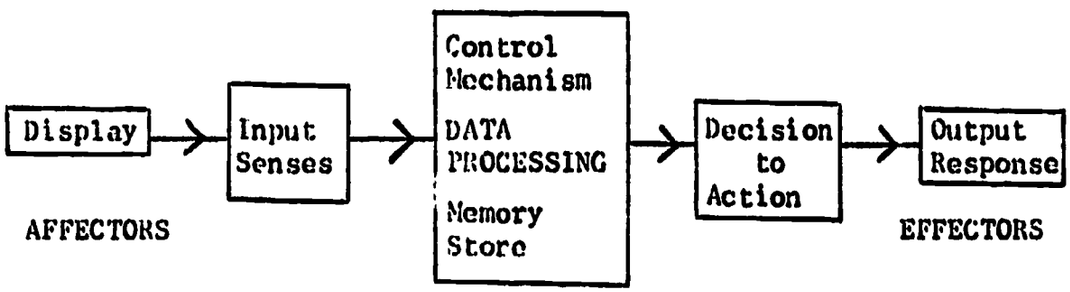


Fig. 1 The Channel

The 'channel' involves the central mechanisms of the brain through which the information is processed. The input information is processed and a command is sent to the muscular system which produces movement or an output. Past experiences, overlearning and feedback affect the processing of information greatly.

The 'display' is essentially the external environment, containing those stimuli that regulate performance of the skill(17).

For maximum retention past experiences, overlearning and appropriate feedback must be used to full advantage by the teacher. The following principles have been found helpful:

1. The performer's attention must be directed towards appropriate stimuli so that processing can be selectively carried out by the central mechanism. The coach or teacher must then assist this selection of

specific and appropriate stimuli - using specific teaching cue to aid in the selection process. e.g. Follow the ball with your head.

Bend the knee on the forehand.

2. The performer must be taught to select with certainty the appropriate responses to the display situation and eventually develop a capacity to do this without help from the coach.

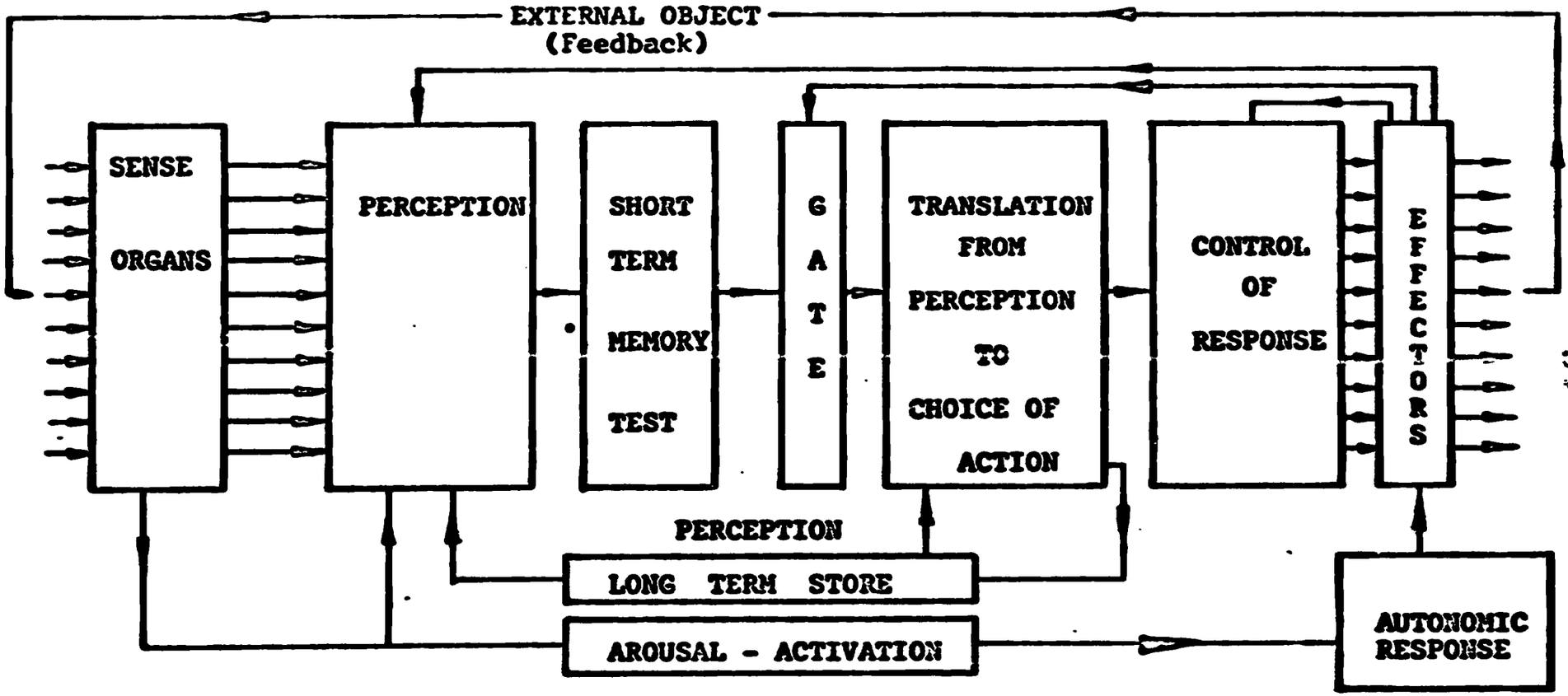
In providing information to the learner however, most coaches talk too much. When given too many 'bits' of information to process, the learner may become confused, thus interfering with the selective interpretation of the display. Often this is called "Paralysis of Analysis" where too much information (nine or ten bits) is given to the learner. Although it is often very hard for the over-enthusiastic coach to keep quiet, more emphasis should be placed on selecting priorities for the learner's selective attention and then reducing these to a minimum.

To improve retention then, we must endeavor to aid the information processing system to operate at its optimum - performance may be limited when the amount of input information exceeds the capacity of the channel to transmit it.

Welford in a recent presentation of his information processing model(18) pointed to the importance of both intrinsic and external feedback in improving skill performance. (See Fig. 2)

Intrinsic feedback refers to the 'feel' of the activity or skill within the performer while external feedback is that gained by way of a teacher or coach through teaching cue, gesture or through watching another performer. Using 'selective teaching cues' the coach or teacher can indeed assist the performer improve feedback which according to Welford

INFORMATION FLOW IN MOTOR SKILL ACQUISITION



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METHUEN, 1968.

Fig 2.

may relay back into the channel at several points as in the model.

In the early stages of learning motor skills, information is lost very quickly from the short term memory store. As skill is practiced, feedback is gained and overlearning takes place more use is made of what Welford describes in his model as the long term memory store. Our aim in teaching and coaching them must be to develop the selective attention process towards the learner himself making the appropriate interpretation and decisions to action from the display - so as many of his/her responses become automatic.

In the practical teaching situation there are several situations where knowledge of the above facts would be of benefit to a teacher or coach of motor skills.

The following questions may be useful:

a. How can the instructor insure that each piece or bit of information is selectively attended to by the learner?

b. How many bits of information can a particular group or individual effectively use? This of course may vary with the type of activity and the individual.

Another issue which is of importance in improving retention involves the effector processes (output responses). The effector processes must be executed in an environment that is as close as possible to the game situation since the movements must be exactly matched to the demands of the display.

The teacher or coach can aid the learner in this matching process by discussing with students simply how the mind processes motor skills. A simple understanding of Information Processing Theory and channel capacity can indeed aid the learning process particularly where complex skills are

being learned.

While practice in 'game like' situations with appropriate selective feedback is one way of insuring the development of stimulus - response mechanisms other methods might include:

a. Mental practice and mental rehearsal.

b. Watching others perform the skill with assisted selective feedback from a coach.

c. Using the interval period between practice sessions.

d. Use of a student notebook to record specific cues and intrinsic feedback, including personal feelings about the activity and progress so far.

Through practice towards better retention, parts of the skill or activity may become redundant where concentration may then be given to more complex skills and strategies. In terms of an open skill it is important that the performer learns to predict what will occur in a particular situation. He may even predict what type of feedback he can expect to receive from a particular movement. The net result of this phenomenon is that the input variability to the processing mechanism is reduced and in effect the execution of the movement becomes easier.

The teacher or coach at this stage can proceed with introducing strategy techniques and so on, to improve the performers' ability to manipulate the display - or predict the revelent percentages in the display (anticipate), e.g. percentage tennis.

In summing up the following points appear appropriate:

1. All learning experiences will be more valuable if the individual is able to remember them longer.

2. Retention is essential if the learner is to use what is learned.

3. If the information cannot be recalled on the appropriate occasion, the time spent on learning is largely wasted.

4. Research evidence suggests that most skills are learned early in life. This does not mean that "old dogs cannot learn new tricks", but it does suggest a need to teach skills to children early in life - towards better retention and lifetime participation.

It is important for teachers and coaches to be concerned with not only learning - but also with retention. If we are concerned with helping people learn skills better, we must "teach for retention - lifetime retention".

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