Development of Motor Patterns in Young Children

By LOLAS E. HALVERSON

Seldom in history has more attention been given to the importance of motor experience in the total development of the preschool and elementary school child. People from fields as diverse as politics and special education are agreeing on the basic importance of early motor activities in the life of the child. Physical educators too, at all levels, are emphasizing the need for improving programs for children, especially in the elementary schools.

With all this interest and attention, it is startling to realize that much of the material quoted in the most popular child development and physical education references today—upon which we base our assumptions about the development of children's motor skill—stems from preliminary research completed in the 1930's.² It is equally startling and not a little disturbing to realize that very little of this research was contributed by physical educators.

This seeming lack of interest in detailed study of motor development in children is reflected by the fact that physical education programs have been game or activity-centered from about 1930 to 1960. In general, during this period, physical education references placed little importance on basic skill development or knowledge about the body-in-movement as an essential objective in the overall development of the child. It was assumed that skills were important to success in games and dances, but most of the discussion in these references centered on the basic needs of children and on descriptions of games. Comparatively little concern was directed to methods of skill development. Even when this was stressed as an important objective, descriptions, analyses, illustrations, and suggestions for teaching were often inaccurate or misleading.

Now in the 1960's an emerging emphasis on movement as a basic focus in physical education has served to turn attention again to a look at the young child. From observation, it would appear that this child can do far more than we know. Only through study will we discover what he can do, and only through imaginative application of the results of this study, can we improve the movement experiences designed for him.

About the Author

Professor and Chairman of the Department of Physical Education for Women at the University of Wisconsin, Lolas E. Halverson, Ph.D., is known to readers for activity at the membership and leadership levels of many professional organizations. Dr. Halverson has long been a student of motor learning. Her extensive background in the elementary school physical education program and her continuous research in motor development suggested she would have a timely and important dimension to contribute to this Quest symposium. Experiences teaching children are, perhaps, directly responsible for Dr. Halverson's current longitudinal investigation of "The Development of Motor Patterns in Children" from which the theme of this selection was taken. It is particularly pleasing to include this article from a capable teacher, administrator, graduate advisor, researcher.
A general assumption of many educators and parents is that in due time normal children will use all or most of the fundamental movement patterns of which they are capable. While it is true that normal children eventually do develop a rudimentary form of fundamental movement patterns, many do not experience the use of these patterns at varying speeds, levels, or tensions, or under varying circumstances. Many do not experiment on their own with new combinations of fundamental activities. And, most important, many do not attain a mature form of these skills even by the age of eight or nine. In fact, many adults never achieve the mature form of fundamental skills, remaining at a very primitive stage of motor development.

For example, the overhand throw pattern frequently used by poorly-skilled college girls fits Wild's description of the throwing stage generally characteristic of the four or five year old child. In this stage, foot opposition is not yet established, and forward rotation of the trunk occurs as a whole with little or no differentiation between pelvic and spinal rotation. Thus, the arm action is superimposed on a rather stiff trunk action. Elbow extension occurs much earlier in the sequence than it does in the mature throw. The result, of course, is a very ineffective throw, which in turn discourages the girls from taking part in activities demanding its use.

Another example of the failure of the adult performer to achieve a mature movement pattern is illustrated by Craig's investigation of the standing broad jump. In this study, only one of five poorly skilled college freshman girls used a two foot take off. The others swung one leg ahead similar to the way in which a child of less than 32 months performed the task. The unskilled subjects also kept their arms close to their body or slightly retracted similar to the "winging" phenomenon of the young jumper of 41 months.

As physical educators we encounter other examples of this almost every time we teach; yet we have failed to recognize and properly diagnose this incomplete motor development early enough. Much of the reason for our failure is due, again, to the basic lack of research on how movement patterns do develop. What the child can achieve, when he can achieve it, and how he achieves it at various motor development levels are fascinating questions. Several aspects within these questions are currently receiving some research emphasis:

1. analyses of mature performance in fundamental motor skills,
2. observations of developmental changes in motor patterns of young children,
3. observations of the effect of environmental conditions in influencing the emergence and development of motor patterns in children.

Analyses of Mature Performance

Skilled adult performance of a fundamental motor activity may be defined as the mature stage of this activity. Detailed analysis of the movement, both in sequence and in timing, provides information against which the develop-
mental level of a child can be assessed. Wild's work, completed in 1937, illustrates one of the early examples of the use of this approach. She based her definition of a mature pattern on a detailed motion picture analysis of the overarm throw of a professional baseball pitcher.

It is important to exercise caution when using the analysis of a skill such as the pitch in the definition of a mature pattern since the overarm throw is slightly modified for a specific purpose. It is also important to recognize that the mature pattern in some skills as used by men may differ from the mature pattern as used by women; nevertheless, such detailed analyses provide a point of departure.

Carefully detailed motion picture studies of mature performance in fundamental skills using increasingly sophisticated methods are now becoming more available. The purpose of using detailed information about the mature stage in the study of the child's movement is not to force him to conform to this pattern, either in timing or in sequence; rather it is to provide a background against which his motor progress can be evaluated.

Observations of Developmental Changes

Information concerning the probable age levels for the emergence of motor patterns is available in the reports of early child study research. Much of this work was valuable but now requires further study to verify, refute, develop, and extend what we know. For instance, Gesell describes the four year old as being able to perform a one-footed skip before he can hop. A skip, by definition, though, contains a step and then a hop on the same foot. It, therefore, must be impossible to skip before learning to hop. However, prediction of the emergence of the skip following successful performance of hopping on the preferred foot and, then, on the non-preferred foot, can now be made from newer observations of the developmental stages leading to this skill.

The general descriptions of developmental stages which are available from early work also contain few detailed observations of the joint action sequences and timing in these patterns. Hellebrandt et al. discuss this in 1961.

Much of the motor growth and development information available in the literature is descriptive. Furthermore, the picture is drawn with broad strokes that present changes in form and character of performance in the most general terms. Too little consideration has been given to the details of the evolution of those spatial and sequential components of neuromuscular patterning which grant to purposeful movement the qualities so readily recognized as skill.

Perhaps the most detailed, completed analyses of the developmental stages of a motor skill are Wild's study of the overarm throw and the study of the growth and development of jumping, as reported by Hellebrandt, et al. Such detailed observations of the developmental changes in motor patterning are time consuming; but,
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slowly, the puzzle of what the child can do and when he can do it is beginning to fall into place. Two longitudinal studies, one by Glassow and Rarick in which the collection of data has been completed,11 and one begun in 1962 by Halverson and Roberton,15 should provide more answers to this question when data are interpreted and reported.

Observations of Environmental Conditions

Observations of what the child does do at various developmental stages, does not totally answer the question of what he could do if we knew enough to set the conditions of his environment to stimulate the emergence and practice of movement patterns. Three approaches seem important in exploring this problem:

1. Eliciting the pattern through setting the situation,
2. Designing experiences to help the child refine his available movement patterns,

Eliciting the Pattern

Two basic ideas in devising ways of eliciting patterns easily and naturally from young children with a minimum of direct teaching are as follows: setting goals so that desired movement patterns should emerge, and setting the situation or conditions so that the desired movement response, if present, must emerge.

An illustration of the effect of the goal setting approach may be found in the preliminary observations completed on the overarm throw and the sidearm striking pattern as reported by Halverson and Roberton.15 Wild had observed that the cue, “Throw the ball as hard as you can way over to me” was sufficient to elicit a hard overarm throw pattern from preschool children as early as two years of age.18 In the current longitudinal study, a simple demonstration of the throw elicited a beginning, but far from mature, throw from each of the three year old children. Then the investigators added a distance goal of twenty feet coupled with a cue of “Can you throw the ball hard?” All the children observed increased their range of movement and speed of action, moving them closer to the mature stage of the throw. In general, without the distance goal, and a stress on throwing hard (fast), the response involved only the arm pattern.

A second example of the result of goal setting appeared in a study of the performance of kindergarten children in the standing broad jump. Preliminary observation had first established that the children could perform the jump with a simultaneous two-foot take-off. A white piece of tape, placed as a goal on the landing mat, provided a more effective stimulus for eliciting a mature form of the jump than either demonstration or verbal cues.14 Changing the running pattern of a thirty-three month old boy to a leap by the introduction of a rolled mat in his path is reported by Cooper and Glassow.6 Development of a two foot standing broad jump pattern from a
walking pattern in the same child through a series of jumps beginning from a height eight inches above the floor, and then from progressively increased heights is reported by the same authors.6

A combination of setting goals and of devising a situation in the hope of eliciting the sidearm striking pattern in young children is reported by Halver- son and Robertson.15 Observation of the development of the sidearm pattern as used in striking had not been scheduled in this investigation until the children reached the age of five or six on the assumption that earlier introduction would be premature. However, several lightweight plastic paddles secured in a supermarket toy section were made available to the children in the labora- tory. The two oldest subjects immediately selected them for play at approx- imately age three. The type of play varied from hitting a tennis-sized plastic ball from their own hand, to a re- quest from one of the children to have the ball tossed to him so that he could hit it. This youngster was reasonably successful in contacting a softly tossed aerial ball with a two-handed sidearm swing as early as two years, nine months.

Thus, the paddle and ball had been enough to stimulate the children to want to use them in the first session. The next task was to set the environ- ment and develop a goal so that what they executed in response would result in a sidearm swing. The situation de- signed involved a lightweight plastic paddle and a plastic whiffle ball sus- pended approximately at the height of the child’s waist. The goal set was “Can you hit this ball with your paddle so that it will go as far as your mother (father).” Either a sidearm or an underarm striking response was possible, but with the addition of a direction goal, the sidearm pattern was predicted and consistently obtained. These find- ings have been supported by observa- tions of the responses of kindergarten children to a similar situation.

The idea of setting goals and devis- ing practice situations to bring forth a desired response is not unique. It is the basis for many teaching cues and is perhaps best illustrated in the multi- tude of “sure” methods and gadgets encountered in the learning of golf. Teachers often intuitively use devices to elicit desired movement responses. Some work; some do not. When they work, it is not always clear why, and it is not certain what mechanisms set off the correct response. However, through continued observations of chil- dren in movement, and continued study of the nature of skilled movement, teachers are able to develop better ways to help children learn to move.

Designing Experiences

Cooper and Glassow point out that even innate patterns improve with prac- tice and if these patterns are not prac- ticed at the time in which they appear naturally, it is possible they will never reach their full potentialities.5 If the beginning form of basic skills can be elicited by the age of three, can these skills develop toward more mature forms earlier than might ordinarily be expected? It would seem that children
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can do more than we know. An im-
portant question, then, is how can we
know enough to take advantage of
optimal learning opportunities in the
development of motor skills?

In previous examples, the situation and
goals used to elicit the pattern in its
beginning form also stimulated the chil-
dren to improve the skill through prac-
tice. This was evident in the observa-
tions of the thirty-three month old boy
reported in Cooper and Glassow. It
was also observed in the previously
cited longitudinal study. For example,
an increase in range of movement was
observed in both the throw and the
sidearm striking pattern when the dis-
tance goal was increased. Coupled with
the cue "can you throw (hit) it
harder," the usual response of the child
was an increase in the speed of move-
ment as well.

With small children, however, the
problem of the development of a ma-
ture form in some of the complex skills
presents a challenge. In the overarm
throw or sidearm striking pattern, the
beginning stage of the skill may differ
even in the sequence of joint actions.
As previously indicated, some children
and even adults do not achieve a ma-
ture pattern on their own. An early at-
tempts to devise methods of leading the
cild from the beginning stages to a
mature form of the overarm throw was
a part of the Glassow et al. two-year
study.12

The project teachers identified spe-
cific movement problems involved in
the throw as a result of a preliminary
detailed study of this skill in mature
performers and from their own experi-
ence in working with children. This list
of problems formed the basis for move-
ment experiences designed to refine the
throwing behavior of the children in
their study. The following were identi-
fied:

(1) The ability to rotate the pelvis
keeping the feet in place,
(2) The ability to differentiate be-
tween pelvic rotation and spinal
rotation in movement response
keeping the feet in place,
(3) The ability to shift the rate of
movement suddenly from com-
paratively slow movements (as
needed in the preparatory phase
of the throw) to rapidly accel-
erating movements (as needed
in the delivery phase of the
movement),
(4) The ability to keep the head
steady while the trunk rotates,
(5) The ability to maintain a re-
laxed wrist while retaining a
grasp on the ball.

One of the experiences* then de-
veloped to help the children learn to
vary the speed of pelvic rotation, was
the game of "snap." The children were
asked to get into a position with one
foot ahead of the other. Keeping their
feet "planted" on the floor, they then
were asked to turn away from the for-
ward foot until they could see the wall
behind them. At the word "snap" they
were to turn back again as fast as they
could without moving their feet. For
many children who could keep their
feet in place, this game resulted in the
natural emergence of the sequence of
pelvic rotation (or "hip lead") fol-

* Many of the ideas in this project were de-
veloped by JoAnn Heckroth Janson and
Sue K. Hanson.
lowed by spinal rotation, as observed in the mature throw. However, some needed more practice in problems designed to develop the ability to keep the feet in place while moving other body parts. A further step in this design involved keeping eyes on the throwing area marked by a big clown or colorful flag, while slowly twisting back with the body as far as possible and then snapping forward. This served as a method of helping the children keep the head steady while the trunk rotated.

Not all of the ideas worked well for all children. Some had to be dropped and modified as the teachers discovered which situations and goals developed the desired responses and which seemed to be ineffective or even inhibitory. But the concepts leading to the development of the teaching ideas were useful and new ideas continually emerged.

Hanson, a teacher in the two-year study, applied the same general principles in developing practice situations designed to influence the development of the overarm throw pattern of five year old children. The guided practice group in this study was taught for a total of fifteen quarter-hour periods. These lessons were designed to give the children practice and instruction in the skill and to increase their understanding of the basic movement of the throw. The investigator did not discuss specific lever actions at any time; rather, the children were guided into situations which demanded the correct movement response. For example, rather than attempting to distinguish between the “same” and “opposite” foot, she placed them in a situation which demanded opposition in the throw. Two lines were drawn down the length of the gymnasium, six feet from each of the side walls. The left handed throwers were asked to straddle one line and the right handed throwers the other. All the children faced the instructor who was standing at one end of the gymnasium. This placed them in a starting position consistent with the mature pattern when throwing at the side wall. Hanson concluded, as a result of her work, that the throwing patterns of the instructed group did mature more rapidly than those of the children in the non-instructed group.

Evidence of results of this approach to teaching young children, while limited, was encouraging. There is mounting evidence that the preschool and elementary school child can respond to more complex motor demands than previously expected. And it seems certain that with proper environmental stimulation and opportunity, more children could reach first grade with more mature forms of basic patterns than may now be true.

Observing the Effects of Equipment and Stress

Equipment forms an important part of the environmental conditions set for children in the development of motor skills. A child usually will respond to a large ball, for example, with some type of two handed throw—often an underhand high toss—but prefers a single arm medial rotation pattern with a
The small child of five or six will most often respond with an "arm" catch when a large ball is tossed to him, but the same child will try with a "hand" catch when a small ball is tossed.\(^1\)

Not only will the size of the equipment affect the probable motor response of children, but weight may also have an influence. The effect of the weight and size of a paddle on the patterns of small children has been dramatically illustrated in observations by Halverson and Roberton.\(^1\) Both of the older subjects, when given a heavier paddle, regressed almost immediately. From a free, well-developed sidearm swing, which had been established over several filming sessions, they changed to a poking, arm-action pattern. Both then returned to the sidearm swing when the lightweight plastic paddle originally used was returned to them. However, one subject continued to exhibit a less mature sidearm pattern for some time after the disrupting influence of the heavy equipment.

One three year old in the study was first presented with a shortened lightweight badminton racket in her introduction to striking activities. In this session she consistently used a medial rotation overarm pattern no matter what problem was presented. Subsequently in that filming session, she was given her choice of equipment. Although she had not observed the other subjects she chose the lightweight plastic paddle previously used by them for the striking situation. When presented with the suspended ball problem, she did use a well defined beginning sidearm pattern for the first time.

The commonly observed tendency for small children to regress to a less mature pattern was also observed when the demands of the problems set created too much stress on them for their stage of motor development. At age four, one of the subjects, having successfully used a one-handed sidearm swing to contact a suspended plastic ball, was asked to "Really hit it hard this time." She responded with an increase in the range of movement and with an increase in the speed of movement. However, in her effort, she also increased the flexion at the knees and hips, resulting in a failure to contact the ball. The movement pattern was good in almost all respects, especially for a four year old. But following the failure to contact the ball, she immediately reduced the range of the swing and used less force on all subsequent trials in this session.

Another interesting observation was the same children's response to a bouncing ball with the sidearm pattern. Following consistent success at four years of age in contacting a softly tossed aerial ball with the plastic paddle (a next step after the suspended ball problem), the children were presented with the problem of contacting a bouncing ball. When confronted with this problem, their well-defined, one hand sidearm pattern, became a poking, medial rotation attempt executed while facing the tosser. At age four, in only one instance did any of the children attempt the sidearm pattern in response to the bouncing ball. In this
instance, the change to the poking, medial rotation pattern was immediate after failure to contact the ball.

These illustrations serve to point out the need for carefully developed environmental situations in which the child is challenged enough to grow in motor maturity and skill, but not frustrated by over-challenge. While the ability of children to respond successfully to demanding motor problems is surprising, it is also obvious that much more experimentation with practice situations, goals and equipment is needed. Further, more research in the area of performance under stress will be required before the riddle of how children develop motor skills can be slowly solved.

The need to discover more about this course of motor development must lead us into many avenues of research. No one aspect of the study of children's movement or the study of children in movement will provide all needed answers. Work in the areas of perception, neurophysiology, psychology, kinesiology, and motor learning will all be essential in providing background knowledge for the designing of environmental stimulation that will enhance maximal motor growth. The physical educator who knows both movement and children must take his place in this search.

REFERENCES


15. ---- and Mary Ann Robertson, "A Study of Motor Pattern Development in Young Children." Study in Progress, University of Wisconsin.


“Movement is the natural immediate effect of feeling, irrespective of what the quality of the feeling may be. It is so in reflex action, it is so in emotional expression, it is so in the voluntary life. Ideomotor action is thus no paradox, to be softened or explained away. It obeys the type of all conscious action, and from it one must start to explain action in which a special fiat is involved.”

Principles of Psychology
—William James