THE PROCESS CURRICULUM

Psychomotor Competence

General Introduction

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ANISA PUBLICATIONS

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DEFINITION

Psychomotor Competence is defined as (1), the inner awareness of all the bones and skeletal muscles and all the movements they are capable of making, mediated through proprioceptive receptors in muscle fibers and integrated with other perceptions, particularly from the vestibular and cutaneous senses; and (2), the ability to execute the known repertoire of all possible combinations of such movements into patterns which express the purposes of the organism.

Processes underlying psychomotor competence include:

Balance and Posture

- Laterality
- Verticality
- Directionality

Locomotion

Manipulation

Receipt

Propulsion

Contact

DESCRIPTION

While it is not necessary to have a background in zoology to understand psychomotor development, it is helpful to have some idea of the anatomical structures and physiological functions involved.

Bones

A series of bones, supplemented in certain regions by pieces of cartilage, forms the framework of the body (and provides a leverage system making movement possible). The bony part of this framework is held together by ligaments and constitutes the skeleton. The skeletal mechanics of construction and reconstruction continue far beyond the period of actual growth and development.

> Bone growth is a unique physiological process, unparalleled in its nature by the growth of any other tissue. (Rodahl, p. 503)

Nothing is stable and final in bone except its external shape. In the adult, there are 206 distinct bones. The human body contains about 270 bones at birth and early fusion of some of these reduces the number; but from infancy through puberty, there is a steady increase in number. At pubescence there are roughly 350 seperate bony masses; this number increases during adolescence. From that point on, however, fusions bring about a reduction to the final total of 206, a quota often not arrived at until middle age.

The process of ossification has two steps. First, with increasing age, osseous tissue gradually replaces both connective tissue in the bones of the face and cranium and cartilageneous tissue in the other bones of the skeleton. The process of ossification is then completed by the deposition of calcium salts. Vitamin C is necessary for the first step and vitamin D is required for the latter step.

Skeletal age is usually determined by inspection of X-ray. The ossified area, rendered opaque by its calcium content, is compared to a series of charts called standards. The carpus (wrist) is most often radiographed.

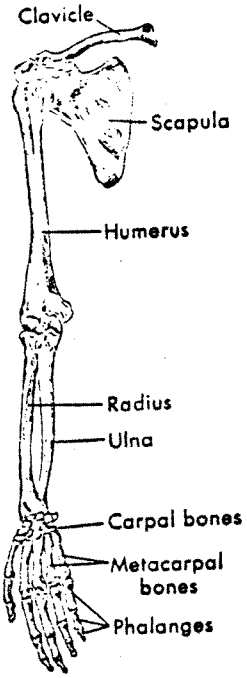
The movements that a bone can make depend upon the kind of joint or articulation it forms with another bone. The joints that allow bones comparative freedom of movement can be classified into three subgroups. (Tokay, pp. 279-80)

One kind allows movement along only one axis of rotation. A second permits movement in two axes of rotation. The third group allows most freedom of movement--movement in all three axes of rotation. The best way to study the joints is to refer to Figure 1 and try the movements yourself.

While these and other joints permit movement of the bones, it is the contraction of the muscles, of course, that is the driving power of such movement. Several muscles may be involved in the performance of any one movement--some contracting and some relaxing. The interplay between cooperating and antagonistic muscles is responsible for the fine gradations and niceties of movement that are characteristic of the actions of man and many of the higher animals.

Muscles

In an adult human, muscular tissue comprises 40 to 50 per cent of the body weight. The enlargement of a muscle, which takes place during growth or from exercise, is due to an increase in the diameter of its fibers rather than an increase in the number of its fibers. The number of fibers in a muscle does not increase after birth. There are three broad classes of muscle; one of these clases is comprised of skeletal muscle. Skeletal,



After Toldt

Joints with one axis of rotation: A joint with only one axis of rotation is called a hinge joint. The articulation between humerus and ulna in the arm is of this type. It allows for flexion and extension of the lower arm at the elbow. Between the first and second, and second and third phalanges of the fingers are other hinge joints.

Joints with two axes of rotation: A good example of a joint that permits rotation along two axes is the articulation of the occipital bone of the skull with the atlas , the first vertebra, of the neck, on which the skull rests. This joint allows the movement of the head towards the chest and the back (one axis) and towards either shoulder (a second axis).

Joints with three axes of rotation: Articulations that allow movement in many directions are of different kinds. Some restrict action somewhat more than others and have been called pivot joints. One example of such a joint is that between the humerus and radius of the arm which makes possible the turning of the hand to the palm-up or palm-down position. A joint of the type that restricts action least of all is that between scapula and humerus (shoulder joint). This is a ball-and-socket joint and allows movement of the arm in almost every possible direction. Other joints also permit considerable fredom of movement. Those between the ulna and radius and the carpals, and between the phalanges of the fingers and thumbs and the metacarpals allow up-and-down, side-to-side, and rotary movements.

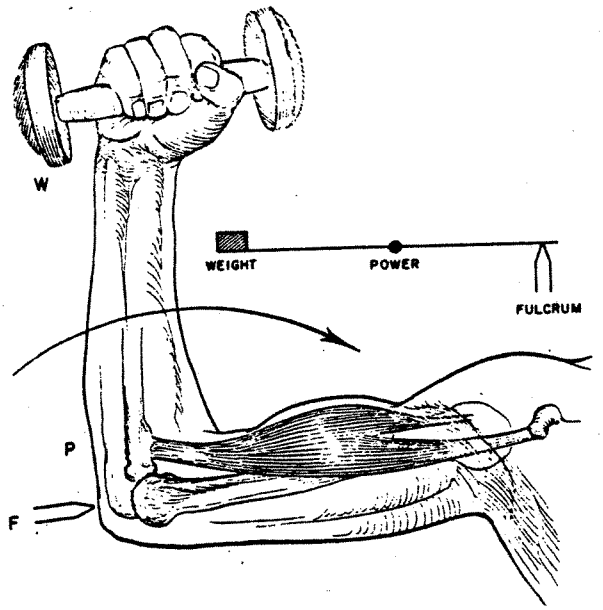
Figure 1.

After Toldt

or voluntary muscles as they are called, are primarily concerned with movements adjusting the body to its external environment. Skeletal muscles lack the capacity to produce new fibers, so that regeneration of muscle

after an injury is slight. An injured fiber can repair itself, but any large defect is replaced by connective tissue. The function of the skeletal muscle is to operate the bones of the body, thereby producing motion.

Contraction of skeletal muscle is very rapid, and some movements occur faster than the eye can follow them. Sleight-of-hand takes advantage of this phenomenon. However, direct muscular contraction alone is not generally responsible for bodily motions. Intermediate action of bony levers is usually essential. In the body, cooperative functioning of bones and muscles form levers.



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For example, when the forearm is raised, the elbow is the fulcrum, the weight of the forearm is the resistance, and the pull is due to contraction of the biceps muscle is the effort.

Muscles are attached to parts of the skeleton by tendons. Most muscles are attached to two different bones. One end of the muscle is attached to a bone which remains immovable when the muscle contracts. This attachment is called the origin. since this is a more fixed attachment than the other (called the insertion), the muscle pulls toward this point

when it contracts. So we say contraction of the muscle pulls the bone to which it is attached towards the origin.

Nerves

Muscles are supplied with two types of nerve fibers--sensory fibers, conveying to the central nervous system the state of contraction of the muscle, and motor fibers, conveying impulses from the central nervous system to the muscles, controlling their contraction. Motor fibers from the cerebrospinal supply break up, after entering the epimysium (the concentration of connective tissue which envelops an entire muscle), into bundles of fibers which gradually divide until a single fiber terminates on a number of muscle fibers. If the muscle fiber is long, more than one nerve fiber may enter it. Each motor nerve fiber and the muscle fibers supplied by it constitutes a motor unit.

> The smooth execution of any limb movement requires synergistic interaction of a considerable number of muscles. Most skeletal muscles are arranged into agonistic-antagonistic pairs. If one muscle contracts, the other has to relax or, more generally, an increase of tonus in one muscle will be accompanied by a proportional decrease of tonus in its counterpart. If this reciprocity is interfered with by diseases such as Parkinsonism, tonic rigidity ensues. In the movement of a limb, an intricate timing mechanism comes into play in which the muscles of, for example, the shoulder-girdle, the humerus and forearm, of the hand, and of the fingers are activated in very rapid sequence and with great precision. In addition to the timing mechanism regulating the musclar activities in a single limb, there must be coordinating mechanisms which relate the whole movement of one limb with that of all others, such as in the performance of forward or retrograde ambulation, of swimming, and scratching. (Lenneberg, p.13)

Lenneberg compares this central regulatory mechanism of motor coordination to a huge train-switching yard ("that is, trains of nervous impulses!"). The trains are dispatched according to schedules; there is one schedule for each motor pattern. In order for the yard to operate smoothly, each schedule calls for hundreds of simultaneous dispatches as well as a program of staggered dispatches where each successive train must start a fraction of a second after its predecessor.

DEVELOPMENTAL CONSIDERATIONS

We think it important to reveiw some important principles that affect the development of psychomotor competence. Some have been unequivocally established as general laws; others have not. They all possess certain descriptive and explanatory powers that will serve in a useful way until more specific definitions are established.

Cephalo-Caudal Trend

Growth and development proceeds in a cephalo-caudal direction, that is, from the head towards the feet. The head is most mature at birth and voluntary movement of the head is the first achievement of a baby when he learns to differentiate the movements of the shoulders, torso, hips, knees, ankles and toes. Ossification is an example of this trend. Since the bones undergoing ossification most rapidly are most affected by nutritional deficiencies, the principla site of rickets during the first year of life is in the cranium. During the second year of life, the site shifts to the thorax, and during the trhird year to the extremities.

Proximo-Distal Trend

The proximo-distal trend in motor development signifies that those parts of the body closest to the spinal column are brought under coordinated control before the more distant portions. Thus, the movements of the shoulder are differentiated first, and then the elbow, wrist, and lastly the fingers. Unfortunately, thus far, the principle's usefulness in predicting developmental sequences has been almost completely limited to the first two years of life.

The Purpose of Movement

He was a very ugly and unattractive creature, and quite small in addition. Long, coarse hair covered his body and he had thin, strong fingers, a forehead that was low, and the jaw of a wild animal. He was naked. He lived in the damp blackness of vast forests. Once in a while, after a long and patient chase, he would catch a sparrow or perhaps a rabbit.

> Man, the complicated muscular organism we know today, has progressed through a long period of evolution from a lower form of life. Throughout his evolutionary period, physical activity was essential for survival in that it was and remains important to optimum growth and development. (Harrow, p. 6)

Movement remains a crucial component for many reasons. First, interaction with the environment is the only way development can occur. If movement is limited, obviously opportunities for interaction are limited. If interaction is limited, then development is slowed. Second, since the other domains build upon the psychomotor domain, any blocks which appear here can be disatrous for the trajectory of actualization.

Piaget is known as the author of the phrase: The child learns by acting on the environment. We believe that this statement comes, not from his research on Laurent and Lucienne, but was probably lifted from Italy's first woman doctor, Maria Montessori. Be that as it may, the phrase might well serve as the slogan for the psychomotor domain. It is in this action, this acting on, which is the active and initial mode of interacting with, that we must consider. In the words of the patrician Gandalf,

> Knowledge is not a copy of reality. To know an object is not simply to look at it and make a mental copy or image of it. To know an object is to act on it. To know is to modify and to transform the object, and to understand the process of this transformation, and as a consequence, to understand the way the object is constructed. (Piaget, p. 176)

Initially, physical action is the only way to act upon an object.

> To explore and learn about his environment, the child must move about in his environment, and this movement must be for the purpose of contacting and interacting with the environment or parts of it. The more extensive the exploration demanded, the more comprehensive must be the possibilities of movement. The more intensive the exploration, the more precise must be the movements. (Kephart, p. 97)

Brief Developmental Outline

The theories of both Piaget and Kephart, the two leading exponents of motor-based developmental constructs, deal with four movement categories. Without going into detail, they are:

1. Reflex Responses
2. Movement Differentiation
3. Movement Integration into Patterns
4. Pattern Generalization

The categories are hierarchically conceived, and each is characterized by the appearance of original structures whose construction characterizes it from the previous category. Furthermore, all movement within a category responds to a need. The child does not execute any external or even entirely internal act unless impelled by a purpose.

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