A PERCEPTUAL-MOTOR MODEL OF LANGUAGE
(The Seven Circles of Language)

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ABSTRACT: This paper proposes a perceptual-motor model by which language (as speech, writing, and reading) emerges from the refinement, integration, and application of sensorimotor skills. It appears that proficiency with Space and Time—in the form of rhythm-motor activity—is essential to the development of effective visual and acoustic skills in language. It especially elaborates upon the time element involved in sensorimotor skills. The addition of rhythm-motor activity to perceptual and language therapy programs enhances the rate of clinical progress and of the ultimate success of these programs. Rhythm-motor activities need to be included and emphasized in pre-school readiness programs, elementary education, and remedial visual and perceptual programs.

KEYWORDS: Four Circles of Vision; Language; Rhythm; Speech; Time; Visual Therapy.

SECONDARY SEARCH WORDS: Prosody; Perceptual-motor Therapy; Rhythm-motor Activity; Sensorimotor skills.
“This finding (that motor equivalence and rhythm abilities were strongly related to reading achievement) may well be the most meaningful of the present study, since there is little reported in the literature concerning the temporal dimension in relation to reading.”

Dunsing

POSTULATION

This argument and model proposes that proficiency with Time as an integrated element of both auditory and visual sensorimotor skills is essential for developing the most efficient Language. Proficiency with Time is developed behaviorally as rhythm-motor skills.

ALL BEHAVIOR REQUIRES A MOTOR CONTINUUM

Renshaw, the mid-20th century physiologist who contributed so much to the understanding of visual science, held that all behaviors require a continuum of movements, and thus that motor skills are inherently an integration of both space and time. Vision, speech and kinesthetic skills have understandably been defined as behaviors and they each have a motor component that therefore makes them time-bound. Yet to be efficient, behaviors cannot be merely an aggregation of more or less segmented parts that are independent. They must belong to a flowing, multiple-input, kinetic system. That means they should have temporal components that are inherently flowing, with the brain's perceptual "stage" always set for what is to follow in time in terms with that which has gone before.

THE VISUAL CONTINUUM: If the reader saw the word "cat" flashed onto a screen in a momentary exposure, the brain would be stimulated in a purely simultaneous, episodic fashion. However, if a second exposure contained "The pendulous, prodigious pachyderm was purple and preposterous," then the task assumes a new dimension. It requires oculomotor movement, since the target image is so large that it must be scanned. Undoubtedly, a few observers might be able to process it episodically. Most of us would not, mostly because there is not sufficient time to scan that more data-laden, large-field stimulus.

The scanning required by the oculomotor skills requires a competency with the time qualities of successive visual processing. Our ocular functioning and visual processing need to engage a sequential system of procedures that chains small observations and movement together in a flow that produces a continuum, a whole, a gestalt, not merely a gathering of single pieces (as is often done by poor readers).
THE AUDITORY CONTINUUM: "Auding"—defined in the field of language as the comprehension and use of acoustic stimuli and which is comparable to the word "vision"—is motor, say some authors. The learning process underlying speech is actually much more motoric than would seem immediately apparent. Developmental scientists tell us that the control of the muscle groups involved in speech relies on the child's control of posture as an important precursor. The perception of speech sounds is more closely related to the oral articulation of the individual rather than to the acoustic properties of the stimulus. These researchers believe that motor feedback is the most important part in the mediation of articulation. It is important to note that the motor feedback from articulation must be experienced and perceived as a continuous flow. A series of separate small units never results in either flowing speech (or flowing motions of any sort), no matter how well studied and imitated. An organized, integrated sequence must be created, giving the perception of a single complex event, a process known as Time-binding. There must be a continuum.

THE MOTOR CONTINUUM: Finally, we can observe that children with learning problems are characteristically lacking in motor skills requiring management of sequentially ordered component parts. Because of this, the motoric continuum may be interrupted (and, when one perceptual modality is impaired, the functional unity of the entire organism seems to be upset). These children will customarily exhibit some degree of disorganization in all modalities. In partial illustration of this, children with perceptual defects usually do not gesture, says Myklebust.

SEQUENTIAL PROCESSING

How do we analyze sensorimotor data? Time/sequencing is required.

Spatial perception requires motion, and motion, as noted earlier, is time-based. Disorders of spatial localization of the individual, of his ability to integrate movement, and of timing affect the perception of form, size, position, and distance as well as motion. We don't take in a visual stimulus—a painting, say—all at once. We peruse it and make discoveries about it little by little. We stabilize each new element as we scan the stimulus, mull it over, relate it to what we have just recently processed. Then we reference it to what we already know, form a modified gestalt, comprehend its meaning, and only after all these steps have occurred can justly say, "I see it."

Spatial "stuff" and temporal "stuff" mix naturally in the dynamic sensorimotor input we call "vision". (Interestingly, we can differentiate the terms vision and sight in a very important functional way: vision is not static and episodic as is sight, but is indeed, dynamic and sequential—motorically time-bound.)

Acoustic events are inherently time-based and not generally thought to have spatial qualities. (See the discussion below for a significant exception.) Perception of speech deals mainly with the time management of the input. This is because acoustic data is kept organized and classified not with the x, y, and z coordinates of space, but through the imposition of timing, of rhythm. It is never a stepwise function, but a flowing continuum during which the input elements can be missed if the individual has not been paying attention, or if they are obscured by extraneous sound sources.

Rhythm, as in poetry, recitation, music, nursery rhymes, etc., gives the listener a way to "chunk" auditory information. A person without rhythm proficiency can learn language, no doubt, but may deal with it piecemeal, erratically, and may or may not make the connection.
Kinesthetic perception is also sequential by nature: a block, pressed onto the skin, is merely an episodic experience: its shape cannot be determined in that manner. It must be traced with the fingers and processed as a succession of events. Harold Helson described another phenomenon, the “Tau Effect”: if one stimulates a point on the inside of one’s forearm, then two seconds later stimulates a point a certain distance away and then one second after that stimulates a third point exactly the same distance apart as the first pair of points, then the brain perceives the last pair of points as at about half the distance apart as the first two points (cited in Renshaw, Motor Thinking, Vol. 7:10). Kinesthetic input is time-bound.

Through these observations, we see that the very nature of the sensorimotor behaviors most closely associated with the learning of language—vision, audition, and kinesthesia—are sequential and intrinsically time-based. If the brain’s processing of sequential information is inadequate, the inputs cannot be effectively arranged and accessed, and performance will be slowed because retrieval and output (perception) are affected. Kephart and Strauss believed that higher order cognitive functions like abstraction and generalization are also impaired.

Proficiency with time is a necessary skill for the establishment of effective visual, language and -- even -- reasoning skills.

THE FOUR CIRCLES OF VISION

Vision is the dominant sense. Our brain greatly favors visual input when presented with two or more stimuli, one of which is visual. Renshaw’s work at Ohio State University in the forties showed us how our kinesthetic perceptions are actually bullied around by vision: moderately strong prisms yoked base right or base left will change not only the appearance of vertical lines but also the feel of the vertical lines, as with doors or doorways. Because vision gives us more information per unit of time and incorporates a far broader area of space than any of the other senses, we tend to build up our operating schemes about the world and of the relationships about us in terms of visual perceptual input. (Throughout this discussion, perception is defined as the ability to extract meaning from the environment and then to respond appropriately.) All efficient behavior is altered when visual effectiveness is reduced for any length of time.

FIGURE 1

Dr. A.M. Skeffington introduced a four-ring model into optometric thinking that illustrates how vision is the emergent of separate component systems. (See Fig.1)

Identification in his model represents not only the ocular but also the mental process of attending to the selected data that reaches the brain. When the retinal image is one that is poorly defined, we can’t give our attention precisely, and so all the processes that follow—which are meant to rely on accurate data—are delayed. Figure-ground relationships and the accommodative control of the eye are the most significant processes of the Identification function.

Localization represents both mental and visual centering: the conscious, simultaneous convergence of our ocular and attentional faculties to the point in space where a stimulus is located. Kephart noted that inaccurate oculomotor control can result in what he called an insecurity in space: the child is unsure of precisely where his eyes are oriented or of his physical relationship to the object. Precise control of the extraocular muscles is essential to this task. A child with vergence and oculomotor inefficiency will be unsure of where to spatially project the image he is receiving. Stereopsis, tracking, and scanning are the most significant processes of the Localization function.
The Anti-Gravity circle in this present hypothesis is renamed Proprioception, not to minimize any importance of the anti-gravity process, but because the antigravity response is merely one category of input to one's proprioceptive data. These three circles of function integrate to allow the observer to project an estimation of distance between him and the object being regarded. The calculation is primarily based in feedback from gamma spindles in postural muscles—motor kinesthesia—and is combined with feedback from the vestibular system. This is then factored in with one's prior experience, which must be readily available at the cognitive level. The resultant is projected into space and only then the observer can say to himself, "...There it is." The highest degree of accuracy is attained when the visual system is able to function stereoscopically.

(Surprisingly, perhaps, the vestibular process is important as a factor in written language. Pyfer, a kinesiology and adapted physical education expert, notes that until good automatic balance develops, fine motor skills are slow to develop because trunk control must precede hand and finger control for writing.)

Speech/audition, in the original presentation was the fourth circle—and is now labeled Time. This change is made because it is observable that speech and audition have a purely psychosocial function. Because one's perceptions are totally unique constructions within the individual, it is only through the development of language and social relations that any individual can have communication with others and compare his percepts and ideas with them. In the scope of Language, Vision is the primary enabler of speech/audition and therefore is not properly considered to emerge from that behavior. Speech/audition, when modulated and regulated into language, is in reality an emergent from vision. We use vision to isolate objects of our mental regard with ever increasing sophistication and we define, assign, and refine language as its own emergent that is integrated with vision. Verbal symbols become governors and mediators of all forms of behavior. In fact, they are even able to create greater intellectual and emotional reactions than the real situations themselves. And so, speech/audition does not belong to the "Vision" model in the same manner as the other elements do.

However, Time does belong in the visual process for the reasons set out in the earlier paragraphs: vision is not static and it requires motor movement. Movement always operates in the time domain. And just as importantly, it is necessary for the brain to encode when an event happened as well as where it happened in comparison with other events.

**THE FOUR CIRCLES OF SPEECH**

In a parallel manner to the visual process, the brain seems miraculously designed for speech. Speech is the output process -- an emergent -- that is modulated as the brain constructs language. Speech has four component parts in the same fashion as Vision. Those parts are audition, vocalization, proprioception and time. (Fig. 2)

**FIGURE 2**

Audition begins prenatally, just as light reception does. Experiments have shown that it is relatively well developed by birth: by two weeks of age, sucking reflexes will change when differing phonemes are presented for comparison; and Berry reported heart deceleration (which indicates a change in attending) in an experiment that showed that infants can
discriminate the differences in all the phonemes of their native language by four months of age.\(^6\)

**Vocalization** is available to an infant as soon as oxygen is. Refinement of purely random sounds (at the outset, at least) by articulatory efforts then occurs at fairly predictable developmental rates. The motoric theory of speech presumes that proprioceptive discrimination of the articulatory elements is present and allows auditory modification of speech. Both the skills of vocalization and audition perceptually hinge upon motor memory, in great part.

**Proprioception** is inherent to both vocalization and audition. We must have feedback from lips, teeth, tongue, voice box, head and body position to be able to articulate accurately and to stereophonically project sounds outward spatially in relationship to one’s self. The movement patterns of greatest significance in the perception of linguistic units are thought to be the shifts in our muscular action between the phonemic and morphemic sequences, both of which are units “written” upon time. (Note: Morphemes are the smallest units of sound that convey meaning. They can be either free, as in the word “dear”, or bound, as the “en-” and the “-ing” are in “endearing”.\(^6\)

Time. Speech, as noted above, is time-based: temporal processing, modulated by rhythm, is the warp and woof of vocalization, audition, proprioception, and therefore speech. Rhythm provides a sequential map by which the brain plots phonic events, ordering time -- it also may facilitate the figure/ground discrimination of speech. And so, the last circle in this model must be **Time**.

**TEMPORAL ANALYSIS: SPACE-TIME RELATIONSHIPS**

Temporal order perception, particularly in auditory processing, is an essential skill: it can differentiate between normal and reading disordered subjects.\(^15\) A Michigan study, using a program of exercises of sound awareness resulted in the experimental group rapidly overtaking and surpassing children in control groups.\(^16\) Phonological analytical skills are the entry point to reading and the ability to perceptually deal with speech continuum is more important than phonic data alone.\(^6\) One of Rosner’s reasons for his seminal research into perceptual remediation was his clinical frustration over children who were spatially competent yet learning disabled. He recognized in some of them that their difficulty seemed to be their lack of skills in auditory processing.\(^17\) He believed this to be a central problem in dealing with the demands of its time matrix. The **Auditory Analysis Test**\(^18\) effectively probes this skill, and Rosner later published a curriculum of activities that were criteria-referenced in remediating a child’s auditory analytical abilities.\(^8\) The curriculum is believed to be unique in the literature because of its validation. It is a major disappointment that its researched validity with its proven remedial abilities -- alone -- has not decreased resistance to its application.

Unlike mathematical time, present time is ephemeral and irreversible. Yet, according to Jaynes\(^19\), time absolutely cannot be thought of except by “spatializing” it (i.e., consider the dual spatial and time meanings of the words “before” and “after”; “ahead” and “behind”). He noted that space words are developed in language before time words, suggesting that children cannot handle time order until they have mastered spatial order. When time is spatialized, it adopts more manageable proportions when dealing with the concepts of past and future (in addition to the present), and then the individual can more readily assign and access learned schemes and operations in memory and plan one’s problem-solving strategies.
The phoneme/grapheme relationship requires a competency with analysis of space and time in the construction of, integration of, and interpretation of the language code. Is there a functional interface between visual/spatial performance and verbal/temporal performance?

**LANGUAGE: THE INTEGRATION OF VISION AND SPEECH ACROSS TIME**

An instant mental snapshot of a target -- an episodic exposure to a scene or stimulus, like the word "cat" in our earlier example -- does not require much of a time element. One doesn't need to read "cee-ay-tee", it can be recognized: "Cat", the image being matched with one's mental data bank. And while an observer may recognize some or all of the words in the improbable sentence used in the previous illustration, most would have to slow down, scan and perhaps even decode one or more of the words. One would have to read it, using a more successive motor element. That takes time. And, decoding words, "one-at-a-time", like that, is not reading. There needs to be the continuity spoken of earlier, a continuum of both vision and speech motor activities. Motor activity invariably means the need for a degree of competence with space and time.

Therefore, fluent reading and writing blends visually temporal as well as acoustically temporal skills, and they must be integrated in a continuous flow. There is a rhythm. Every native language has its own rhythm, called prosody -- the melody of language -- sometimes called intonation. It is a rhythm of speech that is the result of a total response from large and small muscle synergies; it is the temporal-spatial patterning of words and phrases. Prosody is established very early in a child's development, with the babbling of babies taking on the intonation of their parents' cultural tongue and becomes distinctly discernible as early as six months of age. Without it, meaningful speech becomes difficult to interpret. Rhythm is intrinsic to language.

We can demonstrate a significant theoretical overlap, with the elements of Time -- primarily auditory rhythm/prosody and visual sequential processing -- and of Proprioception as overlapping spheres of jointure in the two models. (Fig. 3)

**FIGURE 3**

*Language* becomes the emergent: the integration of the functions of Vision and Speech, with Vision's scanning, identifying and labeling; and Speech's articulation, modulation and intonation, and the automatic, rhythmic flow and integration of data between both modes.

**TIME, SPACE, AND MIND**

Strauss and Kephart held that the two fundamental dimensions to the child's world were the spatial and the temporal, and they believed that they were united by memory. They reasoned, in part, that when comparisons are to be made between impressions (or experiences), they can be managed a great deal better if we can deal with their parts as a temporal succession. The successive impressions of visual scanning are processed and stored in memory in a way so as to be available simultaneously to one's mind, and thus the temporal becomes spatial. Conversely, one can change a complex spatial series into a time series to be less complicated and thus more readily comprehended. Perception and reckoning can only efficiently occur when the individual has dealt easily with all four demands of an event or experience: x, y, z, and t (Time). This ability must be learned, they believed, and when a child has learned it, "...he (sic) has available a tool toward the understanding of his world which gives him superiority over any other species." (p.52)

It is known that learning takes two general forms: explicit, conscious learning, and implicit learning that does not require conscious participation. Explicit learning tends to be episodic, implicit learning is sequential and permits storage of information about the predictive relations
between tasks. The former is fast, the latter is slow and requires many repetitive trials, often involving the association of the sequenced stimuli. Implicit memory appears to alter operations without the individual being able to say exactly just what has been learned. It is thought to be expressed through activation of the particular sensory and motor systems engaged by the learning task. Object permanence in memory may well be related to and developed from the individual's ability to effectively relate time and space.

Our American society has developed the art of the purely informational, episodic experience to a high degree in the electronic and, to some extent, in the print media -- and, far too often, in the classrooms of America. However, the brain appears to develop its deepest thought processes through implicit learning brought about by experiential -- motor -- learning events that are less frequently stressed in the American style of education and by our modern American family styles.

To summarize the observations thus far:

1) Vision has an essential motor component -- it is "motor";

2) Audition-speech is motor;

3) Kinesthesia is motor; and,

4) Memory has temporal-motor aspects.

All experience has motoric aspects, and each observer can only efficiently experience learning in a succession of space-time sections that we arrange in a flowing time sequence. It has been said that all learning is motor. Yet, thus far, the basic motoric component in this model is absent. The position of this postulation is that the motor sphere is properly illustrated as the platform of skills that underlies each of these six elements. (See Fig. 4)

RHYTHM, MOTOR SKILLS AND LANGUAGE

The motoric component appears to be the unifying, underlying foundation bonding vision, audition/speech, and language. As some wit said, “Reading is talk wrote down.” (i.e., Motorically-encoded speech.)

We can form a complete space world around us only to the extent that we are able to effectively translate a time-bound series of impressions and observations into a simultaneous impression in space. Taking this concept a step further, if one is not able to readily integrate spatial concepts and visualization with the rhythmic qualities of speech/language and auditory conceptualization, the individual will experience difficulty in expressive language and, ultimately, in reading and writing (the coded concretization of language, the end points of the vision/speech/motor model).

To use language most effectively, the sequential processing from each sensory modality must be smoothly interwoven with the others: kinesthetic rhythm must be integrated with visual rhythm, and auditory rhythm. Time sequencing in these ways is traditionally learned by, and associated with, rhythmic behaviors like skipping, rhythmic hopping or dance, rhythmic clapping, or music. Recent experiments have shown distinct and pervasive changes in visual-spatial skills abilities in pre-schoolers in response to training in music.
This model postulates two foundational elements binding spatial and acoustic data in our world: proprioception and temporal/rhythmical abilities. They are bound in an integrated model founded upon the motoric system and when highly developed, they result in the most efficient development of language and, ultimately, cognitive abilities.

The motor sphere is responsible for ocular movement and its agility, arm and finger skills, lip, tongue, jaw and voice box movements. Proficiency in each of these areas is learned and practice effect increases the degree of sophistication. Each is important in the development of language and its coding. Yet there is good reason to question if all children are exposed to adequate learning experiences, in our modern society, with its emphasis on episodic learning, fragmentary teaching and testing trends, and reduced adult language interaction (i.e., the daycare phenomenon, VCRs video games, computers, et al). In many respects, the internal architecture of the microchip is being allowed to replace the internal competency with space and time -- with growing apparent consequences -- in brains.

The clinical implications of this model have significance not only diagnostically, but also remedially.

**TEMPORAL ANALYSIS AND SENSORIMOTOR THERAPY**

The most effective development of language appears to occur when all our sensorimotor skills are thoroughly integrated. This should happen naturally through normal child development, but that is less of a given now in modern society than perhaps at any other time in history.

The trend away from the motoric and rhythm-motor activities in our society may account for a good portion of the growing language problems and thinking problems that appear to pervade our educational system. American schools generally have been cutting back on primary grade level developmental motor programs, as well as music programs with their rhythm bands and singing. Metrical poetry and its memorization are no longer in vogue. We have no strong native folk music or dance traditions as an endowment. To the extent that they are reducing these emphases, schools are shortchanging a significant sector of children who greatly need this sort of skill practice. However, rhythm-motor abilities can be therapeutically addressed.

Kephart\textsuperscript{10} recognized the diagnostic value of the brain's ability to perform rhythmic hopping. Rosner continued the diagnostic as well as the therapeutic value of rhythm-motor skill as an activity in the gross motor portion of the *Perceptual Skills Curriculum*.\textsuperscript{24} Rhythm motor activities are the concrete manner in which the body engages the time dimension. Dunsing's study\textsuperscript{25} lends significant support to the relationship of rhythm to reading achievement. He suggested that the relationship uncovered in his study, the connection between rhythmical skills and reading achievement, might well have been the most important finding of his entire study of the relationships between reading achievement and visual and perceptual-motor skills.

The technique called Mental Gymnastics requires a child to demonstrate the ability to rhythmically coordinate the motor activity of the two sides of the body, a skill called bilateral integration. Its clinical success appears to stem from the direct development of interhemispheric integration, enhancing language development. The reasoning is straightforward: we know that the left brain is not only responsible for language and computation, but also for sequencing and organization, among other functions. The right brain handles whole thought concepts, spatial relationships, and rhythm. Thus, bilateral integration exercises plausibly assist in the binding of rhythm and sequencing -- right brain functions and left brain functions -- giving increased
neurological foundation to the development of the prosody of language. This catalyzes the development of both visual and auditory perceptual skills and, eventually, language.

It appears to catalyze the rest of the clinical protocol we use to remediate visual function and learning problems. The demands it puts upon a child, requiring him or her to learn to think and do simultaneously may also be highly significant.

THE MECHANISM OF INTEGRATION: NEUROPLASTICITY

The brain's structural plasticity was speculated upon, if not actually postulated, by visual therapists many decades ago, but only demonstrated anatomically by neurobiologists in the last decade or so. The literature now supports the concept that the brain structure changes during learning. Neurobiologists now accept as a given fact that the brain changes with use -- and -- that the way that it is used determines its final pattern. Synapses are formed, strengthened, and maintained by interaction with experience.

It seems plausible that bilateral integration training activity may be accelerating the growth of connections across the corpus callosum and probably also influences the reticular system (which assists in the coding of all varieties of integration, including perception, learning and motor response). The corpus callosum may be the primary site of structural change, since it is one of the latest maturing parts of the brain (between ages 8 and 14) and may be extremely vulnerable to lack of practice. The connections will mature as the youngster practices using them through physical and mental activity. Authorities now suspect that the ability to activate and coordinate the work of both hemispheres may be even more important for efficient learning than developing either side individually.

Bilateral integration therapy, clinically applied through activities like Mental Gymnastics, appears to be catalytic to the sensorimotor integration process. It may developmentally establish or restructure essential temporal rhythm-motor relationships and build or reinforce interhemispheric connections.

CONCLUSION

With this paper, the function of Time as a factor in vision and speech has been reviewed and these two essential perceptual functions shown to be intimately interwoven. This marriage underlies efficient language development. Ultimately it allows mankind to develop and share each individual's mind with the others, founding the basis of society. If this is true, then the reverse is also true: the poorer our perceptual skills, the poorer our expressive language functions will be, and the more at risk our social fabric may also be, for a child must be able to impose organization on relatively undefined visual, auditory, and even emotional inputs. Mental growth and wisdom are based in these competencies.

For all these reasons, rhythm skills activities need to be included as an essential component of all readiness programs, elementary school curricula, visual therapy programs, and with perceptually dysfunctional children in academic as well as therapeutic settings.

This paper is based upon a graphical presentation at the 37th Annual Skeffington Invitational Symposium, Wash. D.C., Jan 18-20, 1992
Appendix: Mental Gymnastics

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A CLINICAL PROBLEM

It is interesting to note that clinical practice doesn't always rely on clean scientific principles when science has run out of answers for a particular patient's problem. Eclectic techniques may become the norm in trying to assist the patient. But once an unusual method has demonstrated some degree of reliability and validity in relieving a type of problem, this in turn suggests that there may in fact be a scientific principle being employed.

A therapeutic technique, called Mental Gymnastics (see Appendix) -- a variation upon a common trampoline procedure used to develop rhythmic bilateral integration -- was observed to double the child's rate of progress in visual, visual-perceptual, auditory-perceptual, and fine motor skills development. This had been tested informally several times over the years in this clinician's facility and a non-profit multidisciplinary clinic. The technique had been empirically incorporated into the therapy protocol and seemed to have little to do directly with the development of those skills, yet withdrawal of the technique slowed down the child's progress and re-implementation of the technique restored the former rate of progress.

With the possibility in mind that some obscure scientific principle might be underlying these observations, this clinician examined the bases of vision, speech and language. Spheres of commonality and a thread of logic was found binding them together. It has resulted in the postulation of a perceptual-motor model of language:

*****Having established that all behavior is motor and that all perception requires a sequentially based continuum, let us consider the component parts of the dynamic processes of language.

********** Therefore all behaviors require time, just because they involve movement.

******Space and time are inseparable, the philosophers, physicists, and mathematicians tell us. Some visual behavioral clinicians have historically acted as if spatial relationships can be remedied in isolation through activities that are, in reality, engaging time and motion (i.e., stereopsis, tracking and scanning, rotations and fixations). As mentioned at the outset, the consistent clinical experience is that the more a rhythmical time element is introduced into a perceptual therapy program, the greater and faster the clinical success, and the more comprehensive the changes that occur in language skills.
Appendix:

MENTAL GYMNASTICS
(Bilateral Integration - Cognitive Loading)

WHY - Research at the University of Illinois in 1990 showed that simple mental tasks are best handled by using one hemisphere of the brain at a time, and that complex mental tasks were best handled by the use of both hemispheres of the brain simultaneously. Schoolwork requires complex thinking.

The smooth usage of both sides of the brain together is an acquired skill, in large part. We become more adept at interweaving their activity as neuromaturation occurs and spatial-motor skills become refined. Unfortunately, our "modern" society and sedentary lifestyles have de-emphasized pure motor skills activities and have tended to replace those activities with adult, thought-oriented activities in their place. This appears to be a totally inadequate preparation for thinking for a significant sector of our school-age population (estimated at from 15-30%).

And so, we have a growing number of children who are taught to think, perhaps also taught to do, but who have had less than adequate opportunities to think and do simultaneously. The performance of any one skill degrades when an additional sensory or motor stimulus is added to input, in a phenomenon known as cognitive loading. (The old story about people so uncoordinated that they can't walk and chew gum at the same time illustrates the folk awareness of this.)

This new activity first builds bilateral integration and then adds cognitive loading by requiring mental problem solving, training the automaticity of both. The inclusion of this technique in training for over twenty years has been shown to be catalytical, doubling the rate of progress, cutting in half the length of therapy in virtually all cases, with only a few exceptions.

WHEN - This activity should take about five minutes, the child's endurance providing, for each daily session. This activity is so important as to require priority over any other technique - please do not omit it, and please do it even though no other may be performed.

EQUIPMENT - The ideal piece of equipment is a "rebounder" - type trampoline. Many families have one; many others can borrow one for a few months from a relative or a neighbor. They are often found at garage sales and/or flea markets for a few dollars. Brand new ones are available for $15.00 - $50.00 at discount houses. In lieu of a tramp, an old cushion or a folded Orlon blanket, or even a couple thick shaggy rug samples available for under a dollar at a flooring center will suffice. The object is to reduce ankle impact force with the floor, if at all possible. It may be done on the floor itself, as a last possibility.

HOW - the purpose of tapping the four rhythms is to assure that the child can generate them from the auditory sections of the brain. They should be smooth, even, and steady - missing no beats as if a metronome were beating (but don't use one, it is too demanding at this point). Watch for signs of "segmenting" of the production (a conscious switch from right to left hemispheres of the brain ["tap-TAP -- tap-TAP" is generally heard]).

The training uses tapping to train the rhythm in the brain, the actual value comes from hopping, which is gradually added in as noted.

A. TAP 1 and 1 - Goal: slow, steady, even and automatic production. ("TAP-TAP-TAP-TAP", etc.)

B. TAP 2 and 2 - GOAL: as above. You may now start hopping 1 and 1 as part of the training session.

C. TAP 1 and 2 - Goal: as above. Watch for and avoid "tap-tap-TAP -- tap-tap-TAP" - a segmentation with a rest included. There should be no emphasis on any of the beats. Try both the right and left hands as the "1" beat - then use whichever way seems easiest as the mark for this step. Also, start 2 and 2 hopping if skills allow - 1 and 1 hopping must appear very automatic before you do, however.

D. TAP 2 and 1 - Goal: as in C. Now use the opposite hand from C. as the "1" beat. Also, start 1 and 2 hopping if ready for it, testing as you did the hands in C. for best performance. If not ready, continue 2 and 2.
E. ALTERNATE TAPPING - Switch C. and D. upon command. Also, start hopping 2 and 1 hopping if 2 and 2 and 1 and 2 patterns are automatic by now.

F. HOPPING - Work on 1 and 2 and 2 and 1 patterns until your child is able to switch easily back and forth (with the loss of no more than one beat) upon your command.

[This activity integrates at least five sensory and motor skills: Visual (for balance); Auditory/time (the rhythm); Gross Motor; Fine Motor (ankles and toes used in balancing); and Vestibular (balancing/bodily coordinates).]

Automaticity needs to be stressed, so that the production of the rhythm appears virtually effortless. When adding to the tapping routine, spend about half of the time on the hopping - about two or three minutes of the five-minute total.

COGNITIVE LOADING - After all the rhythms can be easily produced (or upon the instruction of your therapist) these activities are added to the hopping:

A. FAMILIAR TERMS - have the child repeat all the family names that he/she can, known addresses, telephone numbers, the alphabet, nursery rhymes, give directions on how to drive to school, to church, how to get to different rooms in the house from the front and back doors, describe pets, etc. - all while maintaining the rhythm. Stress that it is more important to keep the rhythm going than to keep talking - and not to stop hopping while thinking of the answers. Extra demand is added by having your child do these things in reverse order to the extent that he/she can -- but not the alphabet -- yet. Practicing math facts is also good, but this is not the time to teach the math facts. Practice with all the rhythms (hopping only - tapping will no longer be needed).

B. FAMILIAR CONCEPTS - count by ones to 100 (less for younger children), counting by twos, then by fives, counting by odd numbers, then threes, fours, sevens. These demands can be reversed at any time - but at all times, tailor the task to assure success with a bit of "reaching". We don't want to expose the child to repeated failure - there's enough of that already in your child's life. Use the alphabet in sections forward and backward (your child shouldn't have to recite from a to e to give you f through m) - only do them backwards in three, four, or five letter segments at first - whatever your student can succeed with.

C. UNFAMILIAR CONCEPTS - spelling words backwards, counting by adding and then subtracting sums (i.e., add 3, then subtract 2 from each answer starting with 1 - or another, different starting number). Vary the sequences. Also, present math facts in unique ways: "How many 4's are there in 24?" or, "How many times can I subtract 3 from 27?" etc.

D. OTHER - You may also be given a chart of arrows to have the child recite the directions of while hopping and pointing with their arms in a whole-body, exaggerated way. This helps to embed a sense of directionality in the child's mind and helps to minimize the tendency to visually scan words backwards (word reversals).

For those with oculomotor problems, the following will be recommended: imagine cards at the four corners of the wall in front of you at the floor and ceiling. While hopping 2 and 2, look to each of the corners for the two beats of each foot's hops. Continue for at least ten times around. If this is easy and automatic, switch to the uneven hops, using a three count for each number. (1 and 1 is done after these have been mastered, using a two count: R - L, SHIFT, R - L, SHIFT, ETC.) NOTE: You do not need to do this procedure unless directed.

CONCLUSION - The object of Mental Gymnastics is to develop an internalized pattern of being able to think and do simultaneously with motor production. Clinically, this technique has proven both highly effective and expedient. It gives us the clinical impression of enabling the child to "multitask" his daily routine when he hasn't been able to previously. This affects the rate of therapy and reflects itself in the child's daily work and grades.

Enjoy!          MDB 7/97
THE FOUR CIRCLES OF VISION
(SKEFFINGTON)

FIGURE 1
THE FOUR CIRCLES OF VISION
(ADAPTED – SEE TEXT)

IDENTIFICATION  PROPRIOCEPTION

LOCALIZATION  TIME

VISION

FIGURE 2
THE FOUR CIRCLES OF SPEECH

FIGURE 3
VISION AND SPEECH: INTEGRATION INTO LANGUAGE

FIGURE 4
READING AND WRITING: MOTORICALLY CODED LANGUAGE

FIGURE 5