

**CLASSROOM IMPLICATIONS OF IMPAIRED
AUDITORY TEMPORAL PROCESSING**

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Classroom Implications
of
Impaired Auditory Temporal Processing

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PREAMBLE

The tendency to name or label conditions and to believe that the condition is now understood and the treatment obvious is an aspect of the medical model that many special education specialists wish would work effectively in dealing with children and their learning difficulties. The infinite variety of learning problems manifested by children and the equally numerous methods of dealing with their difficulties does not support this view. For that reason, I feel it is very difficult to define and clearly separate categories such as dyslexia from learning disabilities. In examining this heterogeneous group of children with learning difficulties we can exclude those with mild, moderate or severe retardation; those with psychological problems which interfere with their learning and those who live in environments which are not conducive to learning. The important commonality remaining is the unexplainable failure in learning to read. This "definition" of the terms dyslexic and learning disabled is rudimentary and does not nearly begin to cover all the aspects related to their different causes, diagnoses and remediation.

The failure to learn to read is, however, a common theme in these areas and for that reason the terms will be used throughout this paper but not interchangeably. An additional facet, and one I hope to show is related, is that of difficulties in listening efficiently to language.

The purpose of this paper is to explore the reasons why a relationship between the ability to listen effectively to language and the ability to learn to read exists. The group of students to whom this applies share characteristics that have been reported by teachers in both the regular classroom and the special education classroom. They also share the labels dyslexic and learning disabled. This paper is, therefore, meant for those teachers who recognize these characteristics in the students they teach, to assist them in understanding how these children learn and to suggest possible methods of remediation.

INTRODUCTION

Teaching special education is always a challenge. Each child we work with is unique; has his or her own abilities or intelligence, gender, experiences, socioeconomic status, and way of learning. The primary task of special education is to provide instruction that is specially designed to meet these unique needs. In order to provide this instruction the special education teacher must evaluate each student for abilities and limitations; decide what teaching method is best for him or her; design a learning program tailored to fit the child; arrange for the time and the opportunity to help the student; liaise with the classroom teacher concerning the student; deliver the program to the student; evaluate the student's progress; and modify the program as needed.

Children requiring special education can be grouped together as learners with exceptionalities; students whose intellectual, emotional, physical and/or social performance falls above or below that of other children (Winzer and Grigg, 1992). Though each child is unique there are some common characteristics among groups of exceptional children and we use labels to describe and identify them. If a child exhibits a certain set of characteristics: growth deficiency, central nervous system deficits which include mental retardation and certain identifiable facial features (LaDue et al, 1992), for instance, he or she is labelled as a child with Fetal Alcohol

Syndrome. Another group of characteristics: poor muscle tone, short stature, mental retardation, and certain identifiable facial features (Cartwright et al, 1989) characterize children with Down's Syndrome. As can be seen, there are some commonalities that cut across areas or exceptionalities, in this case, identifiable facial features. Another example of this is language disorders which are found in both Fetal Alcohol Syndrome and Down's Syndrome (Cartwright et al, 1989; LaDue et al, 1992) and in several other exceptionalities including dyslexia and learning disabilities. Language disorders are problems in the recognition and understanding of spoken language or in the ability to formulate well organized speech (Leonard, 1982; Swift, 1988; Wiig, 1982; Winzer and Grigg, 1992).

Language disorders are common among children who have difficulties learning to read and write in school (Gaddes, 1981; Wiig, 1982). From early theories to more recent studies, language problems have been considered to be one of the most prevalent characteristics of the learning disabled population (Bryan, 1986). Problems with language may be exhibited either verbally, in the use, understanding and development of language; or auditorially, in the processing of language (Stark and Wallach, 1982).

My hypothesis is that children with impaired auditory temporal processing skills are not able to listen efficiently to input from their auditory environment; that is, they are

unable to listen to language effectively. Listening is the process by which auditory information is transmitted from the sound source in a child's auditory environment through the ear and all its outer and inner structures to the cerebral cortex where the information is acted on in some way by the listener (Winzer and Grigg, 1992). Listening requires the active participation of the listener as opposed to hearing which is passive and requires no response on the part of the listener. Unlike a hearing impairment which effects how the ear functions, a listening disability or auditory temporal processing deficit would be the result of some dysfunction in the system from the ear to the cerebral cortex that would affect how the listener's brain receives auditory information, in this instance, language (Butler, 1984).

The purpose of this paper is to chronicle my efforts to understand listening, how it relates to language and learning to read, and what implications this information has for the child in the classroom. I began with my own observations and attempts to demonstrate how certain classroom behaviours which I have observed might be explained in terms of poor or inefficient listening skills. Originally I had thought to explain poor listening skills as the result of defects in the manner in which the ears acquire information from the auditory environment. However, audiograms, or tests of hearing, for my students have not supported this belief. It was at that time that I realized that although listening to language begins at

the level of the ear, the difficulties I had observed were related to the processing of auditory information at the cerebral level. Therefore, I felt it necessary to examine the manner in which the language areas of the brain work. The purpose here was to consider the ways in which the brain handles language, how we listen to language in the normal way and how this relates to learning to read. Thirdly, I present a theory or set of theories that help make sense of this particular auditory dysfunction or listening deficit and how this relates to those observed poor listening behaviours in the classroom. In the final section I present some ideas of classroom implications and what regular classroom or special education teachers might do to help these learners.

LISTENING

Why not listen?

One of the most common expressions one hears around a school is, "I told you I was only going to say this once. Weren't you listening?" This question usually follows a student's all too familiar querie, "What did you say?" or the slightly less eloquent, "Huh?" Of all the indiscretions a child might commit, in the mind of a teacher, "not listening" is the worst. The fact that this is a frequent occurrence leads one to contemplate why it is that so many children appear are not to listen. Is it that they cannot listen? Or is that listening is a choice and for some reason these children will not?

It is by way of language that teachers impart information to their students in schools. Teachers dominate conversation by speaking most of the time and by initiating most of the exchanges (Berlin, Blank and Rose, 1982). Approximately seventy per cent (Cazden, 1988) of the knowledge we pass on is given verbally and at a conversational pace, that is, two or three words per second (Levelt, 1993). To avail themselves of this knowledge a child must listen to, not just hear what is said. Viewed in this manner, it can be said that language is the door to learning and that listening is the key. In other words, the most important language related skill a child can have is that of listening (Tomatis, 1969; Gilmore, 1988).

When children cannot listen or appear to choose not to listen one has to ask the question, "Why?" Very often, teachers question the child's hearing. At this point, the school may send the child to the audiologist for an audiogram, or test of hearing; or to the doctor for examination for problems with the ear, such as an ear infection. In this situation, for the most part, hearing tests are normal, that is, there is nothing wrong with the child's hearing, and the child does not have an ear infection. Consequently, one arrives at the notion that if the ears are functioning normally, then it is not that the child cannot listen it is that the child will not listen. More than ever then, the question "Why?" begs asking in the sense that it is not rational for a child to consistently choose not to listen when so much depends upon the act.

Listening in the Classroom

For most of the children in schools receptive language in terms of comprehending and responding to language; expressive language in terms of speaking, reading and writing; and the related skill of listening are not problematic. But for an estimated 10 to 15 percent of the school population receptive and expressive language difficulties prevent children from reaching their potential (Winzer and Grigg, 1992). Many of these students are recommended, at some point in their schooling, for special education assistance. In addition to

difficulties with language which translate into difficulties with language arts in the classroom, one of the most common complaints that come from the classroom teachers is that these children have poor listening skills. An illustration would be that this group of special needs students are reported as having difficulties with directions and instructions. A teacher often begins a class, for example, with three or four step directions, such as, "Take out your math book, open it to page 45 and begin with number four". These students usually manage to take out the right book, although it isn't always clear if this is a product of following a direction or the result of some other factor, for example, knowing what is presently scheduled. Nevertheless, after getting out the correct book, these children respond to the next two directions by blurting out the ever popular, "Huh?", "What did you say?", "What page?" or if they are shy, will quietly ask their next door neighbour what to do. And they will invariably start on number one! Considering this in terms of listening skills, it appears that in listening to, processing and reacting to the first direction, the child misses the next two and requires repetition or a visual aid.

Another observation that teachers will make is that the noise and busy-ness of a classroom adversely affect these students. They appear to have two primary methods of coping. Some are simply not aware that there is much going on and absorb themselves in the cosmos for most of the day. Their

method of handling the din in a classroom seems to be to shut it out. They are the children who don't budge when directions are given until invited to be present and join in. On the other hand, there are those students who respond to each and every sound in the class. These children appear to hear every eraser fall, each word their classmates whisper to one another, what the teacher says to the teacher assistant, the clatter in the hallway and the roar of the last vehicle going down the street. Their heads are constantly in motion following the newest sound, or trying to tune into two or three. Again, in terms of listening skills, it appears that they do not know which, of all the sounds in their environment, is the one they should listen to.

Listening and Learning to Read

For many of the last fifteen years teaching special education, I have observed a relationship between the factor of listening difficulties and difficulties in learning to read. I am not saying that all children who do not listen efficiently have problems learning to read; nor am I saying that all children who have difficulties learning to read have problems with listening. However, for a particular group of children with whom I work there appears to be a relatively high correlation between this inability to listen effectively to language, handle the noise and bustle in the classroom and the difficulties they have in learning to read. In most

instances, these children are unexpected reading failures in that their families tend to be functioning relatively well, the children do not have intellectual or emotional difficulties, they are well adapted socially and are usually good at math or art or music or sports. However, as I pointed out, this group has extreme difficulty learning to read.

Simply put, learning to read involves the ability to extract visual information from the page and comprehend the meaning of the text (Rayner and Pollatsek, 1989). To read, an individual must make use of sensory information, both auditory and visual; and linguistic information, that is syntactic (grammatical aspect of language), semantic (meaning aspect of language), graphophonic (sound-symbol correspondence) and pragmatic (relationship between language and context) input in order to be successful (Rumelhart, 1977, Shames and Wiig, 1982). At the most basic level, a child must remember what each letter looks like and following that must memorize the letter name and its corresponding sound or phoneme (MacGuinness, 1985). It is at the graphophonic level that these students become frustrated in the process of learning to read.

These children manifest a fairly broad range of phonetic problems. Difficulties remembering letter names and the associated sounds are usually the first sign of the problem. When I work with these children, I find, for example, that they do not seem to hear the differences in short vowel

sounds, most commonly e, i and u. This is manifested both in their decoding (sounding out) and encoding (spelling). While this may have developmental implications in the sense that they may not be ready for the task at the time, I find that this disability persists as they move through the elementary grades. Some of the students have difficulty right up to the time they move into junior high school. Another example is that they will confuse consonants that are similar in shape and sound, like b and d and p or m and n. Even when we take the time in class to learn how each consonant feels when you say it, they will continue to make mistakes in their reading and spelling. It is only with a great deal of practice and effort that they will learn most of the individual letter sounds.

Once the sound-symbol, or graphophonic, relationship is mastered the child must be able to blend those sounds together and to hear the word. Where other students will listen to the sounds in b-a-t and hear bat, these children look at me with a puzzled look and say, "at?" As in the learning of letter sounds and names, sound blending takes a long time. Teaching these students to use phonetic cues when reading is a difficult, but necessary task. Having some knowledge of the phonetic system allows them to be able to use decoding strategies when encountering new words. For some of my students this has taken as much as three years. Interestingly, though they struggle to read what is printed on

the paper once they get to the point where they can decode it they can understand it. In other words, comprehension is not the problem.

What I have observed is that these children will learn how to read by sight or the visual method with more ease. Reading by sight requires that the child take the word as a whole, not as a combination of letters or phonemes each with its own sound (Kirby, 1988). Even using this method, these students make mistakes in their reading. A most example would be that for "huge" the child might read "big". In addition, these children make guesses based on the sound of the first letter of the word, for example, the child might read "person" for "people". Unfortunately when these children encounter a word with which they are not familiar, they must then revert to phonetics and the cycle of difficulty begins again. It appears that they are not able to use their ears to help them read, that is, they have not developed a sense of phonemic awareness, the basic understanding that the sounds in syllables can be broken down into smaller sounds which correspond to letters (Adams, 1991b).

Problems with phonemic awareness are reflected in their spelling. As with reading, the students will confuse vowel sounds and many consonant sounds. They will confuse letters with similar sounds, such as, p and b; even when the spelling word is presented in context in a sentence. As with reading they do learn to spell phonetically albeit not well and seem

to manage. I have observed, however, that if these same students are put in a situation where they are required to speed up or keep up with a "normal" group they are lost. It appears that they need extra time to listen to the sounds in the word, figure out what symbol the sound represents and to get that information down on paper. As in reading, they seem unable to use auditory information to help them spell.

These children are what I call special education "lifers" in the sense that the delay in learning to read persists through to upper elementary and in that time they do not catch up. In other words, while they do progress each year, these students do not seem to close the gap between themselves and normal readers. They do get better at coping as they continue through school, and look less and less out of place but at a tremendous cost in effort and self-esteem (Gaddes, 1981). These children are frustrated by the fact that what appears to be so simple for the other children is so difficult for them. They know that they are not learning to read like the other students and wonder what is the matter with them (Adams, 1991b, Gaddes, 1981).

Questions of Language and Listening

These youngsters constitute one of the many different types of learners who are sent to resource rooms. The most common label for this group would be learning disabled, although the term, dyslexic, is also used (Bauer and Shea,

1989). From my observations over the years, I believe that the key to understanding these students is not the label or labels, but the common factor of their inability to listen effectively to language. It appears that in many of the situations which they encounter in the classroom their ability to listen to language is the basis of their predicament. As Denckla (1993) puts it, these children have a "tin ear for language". It is here I began my search to understand the reason or reasons that the inability to listen efficiently affects the capability of learning to read, specifically in terms of the phonetic aspect of reading and in light of the inexplicable fact that given alternate ways of learning or more intensive instruction these students do not catch up to their peers.

To continue, it was necessary to answer some questions. How do children learn language and how does that prepare them to translate language into literacy? How do the ears function in the act of listening? How does listening to language fit in to learning to read? What happens to children who do not listen effectively to language? What are the classroom implications of impaired listening skills?

LATERALIZATION, LANGUAGE AND LISTENING

Particularly significant for answering these questions and for the better understanding of the educational needs of children with reading, writing, spelling and language difficulties is the knowledge gained through research about how the brain grows, changes and develops its ability to process language and related skills. As investigative techniques for the study of the brain improve, we have more detailed and constantly expanding knowledge of those neural systems of the brain that are involved in learning language, in listening to and understanding spoken language, and the manner in which those systems are involved in learning to read. In order to set the groundwork for answering those questions a review of pertinent general principles of lateralization, language and listening follow.

Lateralization

The brain is composed of two hemispheres, left and right, which are connected by the corpus callosum. The corpus callosum is a thick nerve cable composed of 200,000,000 to 800,000,000 nerve fibres that connect most but not all areas of the two hemispheres (Kolb and Whishaw, 1990) and which integrates the workings of the two hemispheres. It allows the two hemispheres to communicate and to coordinate activities. When looking at the brain, the hemispheres are nearly

symmetrical in appearance. However, they are organized asymmetrically, that is, there are functional and organizational differences between them (Teyler, 1978; Hiscock and Kinsbourne, 1982; Galaburda, 1983; Mateer, 1989).

The motor cortex extends along the top of the head on both sides of the brain. It is organized bilaterally symmetrically, that is, arranged equivalently on both sides. Behind the motor cortex lie the somatosensory regions which receive and process information from the skin, bones, joints, tendons, and muscles; and about the relationship of the body to its environment. Information about sights and sounds in the environment is transmitted from receptors, specialized cells which convert sensory energy into neural activity, to the visual and auditory cortices (Bloom et al, 1985). In the sensory systems the right hemisphere controls sensing and moving on the body's left side whereas the left hemisphere regulates those functions on the right side (Kolb and Whishaw, 1990). Cerebral dominance is this regulation of function by one or other of the hemispheres (Galaburda, 1983).

For hearing and vision, hemispheric control is slightly more complex. The visual cortex, located in the occipital lobes at the back, or posterior of the brain, is also symmetrical in both hemispheres but functions asymmetrically. The human visual pathways are split in order that information from both eyes can project to one hemisphere. What an individual sees is divided into two visual fields; left and

right. Information from the left visual field stimulates cells in the back of the right portion of each eye and that information is relayed by neural pathways to the visual cortex of the right hemisphere. Visual stimuli to the right of fixation, in the right visual field, go to the left hemisphere (Beaumont, 1982; Mateer, 1989). In contrast to the visual system, sensory stimuli to each ear go to both sides of the brain, but the majority of the input is to the opposite or contralateral side in most people (Kinsbourne and Hiscock, 1981; Vitale, 1982; Kolb and Whishaw, 1990).

The asymmetrical organization of the brain is seen in that the speech and language areas are localized to the left side of the brain (Kinsbourne and Hiscock, 1982; Vitale, 1982; Catts, 1989), although the right hemisphere appears to be involved in the execution of some language activities (Curtiss, 1985). Skills related to visual spatial processing are located in the right hemisphere. Such skills would include face and melody recognition (Kolb and Whishaw, 1990).

In addition to the fact that the functions and organization of the two hemispheres are lateralized, each hemisphere has its own role in mediating cognition, the processes involved in thinking. There are two main types of information processing that underlie cognition. Each type of processing is solely or principally mediated by one hemisphere (Witelson, 1985). In most children, the left hemisphere is specialized for the analysis of stimuli that are distinct,

finely timed items within their temporal frame and for the programming of sequentially organized separate events (Mateer, 1989). The right hemisphere is specialized for the synthesis of stimuli over space and time dimensions into configurations. Behaviour such as speech-sound discrimination, syntactic comprehension and speech are processed by the left hemisphere because of their dependence on temporal analysis and programming (Witelson, 1985). Skills such as the perception of complex geometric patterns, face recognition and musical chord perception are processed by the right hemisphere because they require the composition of an assortment of stimuli without regard for sequence or timing (Witelson, 1985).

To understand the different yet complementary functions of the hemispheres it is beneficial to consider the manner in which cerebral lateralization or hemispheric specialization develops. There are several different theories in this area. To illustrate a point two will be discussed. One theory suggests that the two hemispheres develop symmetrically until about the age of four. Up to this time the brain shows a capacity for plasticity or reorganization. By this is meant that if a child were to injure a part of the brain in the left hemisphere, which is specialized for some function such as speech, the right hemisphere of the brain would, to some extent, be able to take over that function. This plasticity decreases as the child matures and the two hemispheres begin

to specialize and acquire concomitant strengths and cognitive functions. By the time the child is five the corpus callosum has developed and the two hemispheres begin to interact. At this stage of lateral integration, for example, a child is able to process sounds from his left ear, send them to the right brain and transfer them to the left brain for processing and interpretation. This theory assumes that by the time most children are nine lateralization is complete (Bloom et al, 1985).

The second theory suggests that cerebral dominance is in place by the time the child is born. As the child develops and reacts with his or her environment the specialized functions of the two hemispheres evolve. Lateralization gradually ensues as the corpus callosum develops. Complete specialization and lateralization are in place by the time the child is about eleven (Curtiss, 1985; Furtney and Willems, 1992).

The point to be illustrated is that the evolution of cerebral lateralization in children is a highly developed, continuous process that involves both hemispheres of the brain and in most children follows some kind of protocol (Curtiss, 1985). One of the more complex systems where this is seen is that of the development of language. Acquiring language is the single most impressive feat many people will ever perform. What is most amazing is that by the age of three a child will have mastered the basic structure of language and be on the

way to communicative competence (Miller and Gildea, 1987).

Lateralization and Language

A child begins the process of language acquisition long before beginning to speak. Soon after being born a baby's brain begins to evoke concepts and generalizations about the environment based on commonalities such as shape, colour and sound (Domasio and Domasio, 1992). It is believed that these concepts and generalizations which cannot be classified immediately in terms of a well established rule system such as language involve the right hemisphere at first. As the ability to speak and understand the spoken word develops, and a relevant rule system for language is acquired, the left hemisphere is activated and has an increasing role in the language process. Finally both hemispheres become involved in the accumulation of complex language skills. In this manner each hemisphere makes a specific but different contribution (Kirk, 1985).

To represent concepts such as word meaning the brain maintains a record of the neural activity that takes place in the sensory and motor cortices during interactions with a given object or event. The records are patterns of synaptic connections that can recreate the separate sets of activity that define an object or event. Also, each record can stimulate related ones. If, for example, a child picks up a glass of milk, visual cortices will respond to the contents, the colour and the shape. The somatosensory cortices will recognize the shape of the hand as it holds the glass, the

movement of the hand and arm as the glass comes to the mouth, the odour, the coolness, and the taste. In other words, the brain does not merely represent external reality, it also records how the body explores the world and reacts to it. In addition to storing this information, the brain categorizes it so that related events and concepts, such as shape, colour and movement can be reactivated together (Damasio and Damasio, 1992).

As mentioned previously a child hears and understands language long before learning to read or write. Utilizing the neural machinery which develops shortly after birth the child begins to generate spoken language through hearing the sound of language produced in the speech of his or her parents, siblings and others in the environment; in songs and in stories; and with a great deal of parental encouragement (Smith, 1978). As the child learns he or she begins by associating the sound of a word with its meaning. Appreciation of words grows as the child assigns new words to broad semantic categories already stored in the brain. In storing information and words within broad semantic categories the child develops the basics of language. Language allows children to categorize the world and reduce the complexity of conceptual structures to a manageable scale (Miller and Gildea, 1987).

Listening to Language

Integral to the process of language learning is

listening, that is, listening as differentiated from hearing. Hearing is a passive process in which sound is simply perceived. Listening is an active process which allows for rapid and precise analysis of words that are heard (Gilmore, 1988). It is listening which brings the neural machinery of language into play. The child must listen to language for the phonemic representation and syntactic rules for combining words. The child must also listen to language to evoke the appropriate concepts when hearing words. The desire to listen as well as the capability to listen, must be present for the successful recognition and analysis of sound, particularly the complex sounds of language. Given that the sounds of language are introduced to the child long before the written or graphic form the ease with which the child integrates the sounds of language will affect the competence with which he or she can understand and express language first in the spoken form and later in its written form (Gilmore, 1988).

THEORIES OF LISTENING AND LANGUAGE

Speech Perception and Production

To summarize, cerebral dominance is the propensity of one hemisphere to regulate function in or receive information from a certain part of the body or the sensory world. Cerebral lateralization is the specialization of function which exists in each hemisphere. As in the development of other cognitive functions, the establishment of the left hemisphere as the location for the syntactic and phonemic nature of language follows certain conventions. Assuming that language development has followed those conventions, the mechanisms for language acquisition are in place. As mentioned previously these mechanisms are necessary for the comprehension of speech and language which in turn influences auditory discrimination, which in turn influences phonemic awareness and the beginning stages of reading. In order to understand the connection it is necessary to know how speech is perceived.

When a child hears the sound of the syllable, /at/, the eardrum begins to vibrate. Those vibrations are transmitted by three small bones, called the ossicles, to the fluid of the inner ear. Movement of the fluid causes a small membrane known as the basilar membrane to move which in turn causes movement of hair-like receptors in the Organ of Corti. The organ of Corti and the basilar membrane are parts of the cochlea. The cochlea is spiral shaped and this allows the

hair cells in the organ of Corti to code the frequency for the sound which the child has heard, in this case the phonological unit /at/ (Kolb and Whishaw, 1990). Neurons attached to the hair cells become excited and send impulses along the auditory nerve to the hemisphere on the contralateral or opposite side of the brain. In addition to sending information about the frequency, the cochlea filters the sound and passes along information about timing and intensity of the sound as well (Konishi, 1993). Timing information is passed along one pathway, known as the magnocellular system, while intensity information is passed along another (Galaburda and Livingstone, 1993). When timing and frequency information reach the auditory cortex the input from each pathway is recombined for analysis by the listener (Konishi, 1993).

Once the phonological unit arrives at the left hemisphere it is processed along with preceding and succeeding auditory information which allows the child to determine if /at/ is the final sound of bat or the beginning syllable of atmosphere. Like the experience of the child drinking the milk, the brain classifies this auditory information, gives it meaning and categorizes it so that related events and concepts can be activated and the child can respond appropriately to the auditory stimulus.

Needless to say that since all this information is arriving at the speaking speed of two words, seven syllables, or ten to fifteen phonemes per second (Levelt, 1992) timing

would be an important component of this process. It has been shown that a young child's ability to isolate and manipulate the elemental sounds of spoken words is directly related to that child's later progress in reading and spelling (Goswami, 1992). In addition, the speed at which the child is able to analyze these sounds is critical for later school performance (Galaburda and Livingstone, 1993).

Listening is the perception of speech. The vocal tract, pharynx, tongue and lips are involved in the production of speech. The process of producing speech is as efficient and as rapid as the process of perceiving speech, so rapid, in fact, that the speed at which these structures operate must be measured in milliseconds (McGuinness, 1985). Returning to the example, in order for the child to read and say /at/, all of these structures must be coordinated to produce the sound. If /at/ actually is the first syllable of atmosphere, then equally as rapidly those structures must be readjusted for the next phoneme or syllable. While the speech sounds are being rapidly processed, the cortex is deriving meaning and updating patterns to determine how /at/ fits in with other information. It has been postulated that one of the most critical aspects of the development of good speech is the rapid coordination of these auditory fine motor pathways (Netsell cited in McGuinness, 1985).

The Role of Reading

Reading is more than just trying to match 26 letters to their corresponding sounds. As mentioned previously, reading requires that the reader make use of sensory, linguistic, syntactic, semantic and graphophonic information. In other words, a very important aspect of reading is the nonvisual information that exists in the reader's mind (Smith, 1978).

Information in a child's mind develops when he or she is actively engaged in experiencing the environment and in generating language for and about those experiences. A child's vocalizations help make sense of the world (Halliday and Hasan, 1985). Children come to make sense of the world and understand how language works by participating in conversation, by using the language resources they have available and in the process, building their knowledge of the world and the semantic and syntactic constructs through which meaning is expressed (Goodman, 1986). Through conversations they receive demonstrations of language in action (Smith, 1978).

Insights into how children learn language are relevant to how they learn to read as well. Reading like language is developmental (Cullinan and Strickland, 1990). Children use freely what they know about language and the world in general to make sense of print. Because children expect print to be

meaningful they are compelled to use whatever knowledge they possess to create a meaningful message when they read (Newman, 1985).

Readers construct meaning by coordinating information received from print with the graphophonic, syntactic and semantic knowledge they are supplying (Harste et al, 1988). The more nonvisual information, general knowledge in conjunction with specific knowledge about language, possessed by the reader the less detailed the attention they are required to give to what is on the page. Conversely, the less prior knowledge, the more they must depend on print cues (Smith, 1978, Newman, 1985).

Nonvisual information available to the reader is a major component of skilful reading. Using the phonemic code is another. Skilled reading has a strong phonological component (Richgels and McGee, 1991) particularly when children encounter text which is unfamiliar in content or phonology. When fluent readers decode print with which they aren't familiar, they have at their disposal the skills which make decoding automatic. As a result the phonetic aspect of reading requires limited attention (Hagaboam and Perfetti, 1975; Pirozzolo, 1985; Samuels and Eisenberg, 1981). The reader is able to integrate syntactic, semantic and graphophonic knowledge, a left-hemispheric function, with the experiential, analogic, intuitive, fantasy-oriented pragmatic information that is right hemispheric.

The beginning reader, on the other hand, does not automatically decode and must devote attention to the phonology; the visual discrimination of the letter, the sound/symbol relation and the blending of sounds into syllables and words (Samuels and Eisenberg, 1981). The left hemisphere is very involved in the reading process at this level and less attention is given to the right hemispheric aspects of reading. As a result, comprehension is not at the same high level as with fluent readers. The temporal lag in decoding which is not automatic demands much of short term memory for beginning readers. This, too, affects the level of comprehension (Pirozzolo and Campenella, 1981). Thus, beginning readers tend to be less efficient at integration and inferential strategies than fluent readers (Stark and Wallach, 1982).

Disabled readers have difficulties at the constituent level of decoding (Pirozzolo, 1985). Their first difficulty may lie at the level of graphophonic representation, at the sound blending level or at the level of making sense of the auditory equivalent of the text. Reading for these students is a strictly left-hemispheric task.

At the most basic level, the child must remember the appearance of each letter, some of which are difficult to tell apart visually, such as b and d (Rayner and Pollatsek, 1989). The next task is to memorize each letter and its corresponding sound or phoneme. In order for this to be possible, the child

must be able to discriminate phonetically, that is, to listen for the differences in all the letter sounds and to be able to produce these sounds in speech. In addition the child must be able to distinguish a series of related sounds from surrounding noises. In other words the child must be able to identify a pattern of sounds, foreground noise; against generalized noise, background noise (Robeck and Wallace, 1990).

When phonemes are combined into syllables or morphemes (smallest meaningful unit of speech) short-term memory becomes a factor in that it allows the reader to remember a series of items in the correct temporal sequence (McGuiness, 1985). An example of this is that the child remembers at-mos-phere instead of at-phere-mos. Short term memory deteriorates rapidly over time. What this means is that unfamiliar information is not stored in short term memory for long durations and so the speed at which each individual item can be decoded is extremely important. After the information has been sorted in short term memory the mind fits the new word in with existing information or creates new concepts (Wallace and Robeck, 1990).

The two processes; that of making meaning of print based on nonvisual information and that of making meaning of print based on the recognition of individual printed words are parts of the complex system that makes up skilful reading. In order for connections between the two to develop they must develop

concurrently. One is dependent upon the other. This dependency works in both directions. A child cannot properly develop the lower-order phonemic processes without constantly clarifying and experiencing the connection with the higher-order, meaning, ones (Adams, 1990). Children who are successful readers have the capacity and the attention to read without attending to the phonemic aspect of reading because they have overlearned and internalized it (Adams, 1991a). Children who are successful readers have phonemic awareness while children who lack phonemic awareness are unsuccessful (Adams, 1990). One of the reasons that these children have not developed phonemic awareness is because of auditory temporal processing deficits.

Auditory Temporal Processing

Success at reading has been shown to be highly correlated to general facility in the perception and production of speech (Goswami, 1993; Tallal and Piercy, 1974; Tallal, 1980; Tallal et al, 1985; Vellutino and Scanlon, 1982). Studies with children who have reading disorders have consistently demonstrated that these students are specifically impaired in their ability to perceive verbal stimuli that change rapidly in succession. (Mezernich et al, 1993; Tallal, 1980; Tallal et al, 1985; Rennie, 1991). Tallal (1985) suggests the existence of a basic perceptual mechanism, auditory temporal processing, which controls timing for the

normal processing and production of speech and which may underlie difficulties in analyzing the phonetic code efficiently and ultimately affect the ability to learn to read.

Auditory temporal processing refers to the processing by the central nervous system of rapidly presented acoustic information (Tallal et al, 1993). The ability to process rapidly changing acoustic information has been shown to play a crucial role in the efficient analysis of the phonetic code in normal speech perception (Tallal, 1980). Children who have a deficit in this area are impaired in their ability to identify, discriminate and sequence acoustic information that is occurring at the rate of ongoing speech. Tallal, Miller and Fitch (1993) show that the result of this inability is the impairment of the development of phonological processes. Phonological processing refers to the awareness and use of the sounds of one's language, that is, phonological information, in the processing of oral and written information (Wagner, 1988). One phonological process which is impaired by this deficit is that of phonemic awareness, the awareness and access to the sound structure of one's language (Wagner and Torgeson, 1987). Phonemic awareness involves the knowledge that syllables can be broken down into small, frequently occurring sounds or phonemes and that these smaller sounds correspond to graphemes, that is, letters (Adams, 1991a). This knowledge allows the student to construct a link between

the letters and the sounds (Blachman, 1989). Children who have difficulties making this link are likely to become poor readers because they have difficulty analyzing written words into their phonetic components, that is, in determining and using a sound representation or code in order to decode the words (Tallal, 1980). In addition, deficits in temporal processing adversely affect the process of learning to spell by preventing the formation of spelling to sound correspondence (Tallal, 1980; Galaburda and Livingstone, 1993).

Finally, speech is processed and produced in the left hemisphere. Tallal (1992), agrees with Witelson (1985), that the left hemisphere is better equipped to analyze temporal events that arrive rapidly regardless of sensory modality and regardless of whether the stimulus is verbal or nonverbal. Thus, a child with reverse lateralization, that is, right-hemispheric dominance for language, would be less well equipped to process the temporal aspects of language.

Many researchers believe that there are temporal mechanisms in the nervous system which play a central role in the fundamental aspects of information processing and production and which may be critical for normal development and maintenance of sensorimotor systems as well as phonological systems. Mezernich et al (1993) offer two hypotheses about the origins of speech and language disabilities that are characterized by longer than normal temporal analysis and integration times that apply to inputs

in all three senses; audition, vision and somatosensation.

One hypothesis is such disabilities arise because some infants develop, or learn, global listening or looking strategies. A global form of listening suggests that the child attends to a wider, less precise, field of audition. This results in a lack of facility in the perception and production of speech that in turn results in difficulties in learning to read. (Mezernich et al, 1993) Although the evidence is not conclusive, what this may mean is that these students process what they hear bilaterally or with both hemispheres and thus inefficiently (Pirozzolo, 1985). Like the students in the classroom, they pay attention to all auditory stimuli in the environment. Over time the neural pathways which develop amid all this auditory overload would be less efficient. Once an inefficient listening strategy is in place it would be reinforced by the hundreds of thousands of input repetitions. When listening for reading began it would be initiated in a brain that had been trained to listen to a wide spectrum of sound and not to the specific phonemic sounds of the language. Even when the reading lesson is over the auditory operations would continue to reinforce and sustain the inefficient listening patterns (Mezernich et al, 1993).

The second hypothesis is that of a physical defect in the mechanisms that assist in the development of language (Mezernich et al, 1993). Galaburda and Livingstone (1993) suggest that it is the magnocellular system, that is, the

system which transmits timing information to the auditory cortex that is faulty. They also postulate a universal defect in systems which send timing information to the visual and sensorimotor cortices (Galaburda and Livingstone, 1993). Neither of the Mezernich et al theories are developmental in nature. Both suggest the existence of defective neural circuitry (Denckla, 1993) which will continue to influence how a person reads into adult life.

CLASSROOM IMPLICATIONS

Back to the Classroom

How does all this relate to the students in my classroom?

The students I work with are characterized by listening deficits in perception of verbal stimuli particularly in following directions, attending to appropriate classroom stimuli and developing phonemic awareness. In addition to these characteristics they do not seem to catch up to the other students which suggests that their difficulties are not developmental in nature. Therefore, the explanations by Mezernich et al that children learn a more global listening strategy and thus develop less efficient neural pathways fits in with the description of my "learners with listening deficits". His theory of learned poor listening patterns seems most able to explain what I have observed with these particular students. Tallal's research concerning the difficulties these children have with the perception of rapidly changing auditory stimuli is appropriate since the nonefficient circuitry with which these students listen hampers their ability to fine tune their listening skills for phonetics which causes them to have difficulties learning to read.

In the classroom, as previously mentioned, students must rely heavily on their ability to listen. Information arrives

rapidly at the left hemisphere for processing and the child must be able to put each piece of auditory detail into the context or contexts of the information that is already there in order to act upon it. For a child who has auditory processing difficulties we can assume that the information does not always arrive in its original form (Richards et al, 1990). Consider the case of the instruction with the math book. The direction of opening the math book needs to be processed separately from the information about the page which needs to be processed separately from where to begin. Each discrete piece of information arrives in a brain in which there is no previous context to make predictions about what is wanted, therefore, the listener needs to hear each element precisely in order to respond. A child who does not hear each element of the direction set correctly is not able to react appropriately thus turning to alternate coping skills such as watching the other students or shouting out in frustration.

In today's busy classrooms a child must be able to distinguish between background, or classroom noise, and foreground, or teacher's voice sounds. In so doing the child is able to tune into the teacher's voice and the information he or she is giving without the background noises interfering. For a child who has adopted a global form of listening, this is very difficult. A possible explanation is that all the noise in the classroom would appear to resound at the same level. If that were the case, the child's two responses would

make sense. Being sensitive to the noise the child's head may be turning like a radar to each sound. On the other hand the child who is overwhelmed by the plethora of noise may simply tune it all out (Berlin, Blank and Rose, 1982).

In the noise and bustle of the classroom these children will have difficulty attending to the fine differences in phonetic sounds. However, even in classroom situations that are more conducive to listening, such as small groups in special education rooms, these children will have difficulty fine tuning their listening to accurately decode words using phonemic segmentation. Faulty neural pathways and resultant inefficient listening would explain this difficulty. A possible result is that phonetic information is not transmitted quickly or intact to the left hemisphere (Holligan and Johnson, 1988; Richards et al, 1990) or once there the brain may not be able to handle the rapidity of incoming acoustic information. Consequently, although these children produce and perceive phonemes, they are not explicitly aware of such things as the fact that "bat" and "hat" each have three phonemes and that the first one is different. Successful readers achieve this awareness quickly and with ease, but disabled readers with this specific difficulty do not (Mann and Brady, 1988).

In instances where children have difficulties perceiving and producing correct speech sounds, the process of decoding is slow. When sounding out the word bat a child actually says

something like buh-ah-tuh. To hear the sounds blend together to form a word requires the rapid and clear transmission of the sounds to the auditory cortex where they are stored in short term or working memory. Since short term memory deteriorates rapidly over time and the sounds are arriving slowly, it makes sense that the child remembers only the last two sounds, ah-tuh, or /at/. With instruction and practice most students are able to progress and become more competent at identifying letters visually and associating the corresponding sound (Blachman, 1989). Over time students are more likely to be able to store sounds in working memory and thus be able to decode more effectively (Wagner and Torgeson, 1987).

Because this particular group of students do not hear the fine differences in sound they have difficulties with spelling to sound correspondence and they are not good spellers (Foorman and Liberman, 1989). As in decoding they will confuse similar sounding vowels, like e, i and o; and consonants, like p and b. An example of a common problem is that they will not hear the second or third consonant in words beginning with consonant blends. When asked to spell stain, for example, the child might spell sain. In other words, these children tend to be correct about the first letter in a word but have difficulty with subsequent letters; and they have more problems with vowels than consonants (Mann and Brady, 1988).

Although these children struggle with the phonetic aspect of their reading, as mentioned previously, they appear to be able to comprehend what they read. Comprehension requires the translation of written language into a form that is usable by the reader's cognitive system (Rayner and Pollatsek, 1989). It requires the integration of that information into the network of existing knowledge stored in the reader's long term memory. The facility and extent of comprehension is related to the degree to which there is a match between the incoming information from the text and knowledge and information stored in the reader's mind (Samuels and Eisenberg, 1981). A child listening to a story is able to put the sequence of events into some kind of context based on previous knowledge about stories, sequence and predictability. Likewise when reading the story, the child, although stumbling over the words, is able to use previously stored semantic and pragmatic knowledge to create meaning which allows for filling in the gaps. Thus when encountering the word huge, he or she might read big. The word is different but it maintains the sense of the story. If the child attempts to use some phonetics and identifies the beginning sound he or she will still try to maintain the sense of story, as in reading people for person. Returning again to the case of the directions, when the child hears the directions there is no context about which page and therefore no match between incoming information and knowledge and information stored in the reader's memory. Therefore, the

child has no way to predict what may come next if parts of the information are missing and/or coming too fast. As previously mentioned each piece of information must be processed discretely and in isolation.

Finally, these children struggle along to the end of Grade 6 and do not catch up with their peers. This, also, is an indication that their difficulties are probably not developmental. They must learn compensatory strategies in order that their reading will improve. As the child reads more and grows in reading competence, the Matthew effect comes into play, that is, the more a child reads, the better he or she is at reading (Stanovich, 1986).

Improving the Classroom

Many of the strategies for assisting children with auditory processing deficits are valuable because they are beneficial to all students. In assisting these students the teacher can help others who do not fit the parameters of learning disabilities or dyslexia but who are struggling in other ways and who fall through the cracks. Suggestions for improving existing classrooms include structure and organization in the class; the use of whole language, an approach that attempts to integrate the child's knowledge of syntax, semantics, grapho-phonics and pragmatics; modifying curricula; and teaching phonetic skills. One of the keys of success in these endeavours is the use of multiple modalities

to help children get the information they need in order to succeed.

1. Structure and Organization of the Classroom

Bryan (1986) points out that when messages are fully informative and the situation is highly structured learning disabled students fare much better. When information is ambiguous these students are not able to put the information in context with knowledge already stored in memory. Furthermore, she points out that learning disabled students find it difficult to take active steps to get additional information. In other words they cannot always tell someone what they need to know, thus, the infamous, "Huh?" reaction. In addition, Bryan has shown that students may be more willing to ask their peers rather than their teacher for clarification.

The context of the classroom, the match between the personality of the child and the teacher and the linguistic demands placed on the child influence a child's behaviour (Bryan, 1986). These children need to be in classrooms where the teacher is organized, gives clear directions, supports the directions with visual aides and allows the students time to respond. The teacher must also realize that for these students expectations in assignments must be made very clear. The teacher may have to spend some time assisting the student in getting started and/or in modelling what is expected. It

also may be beneficial for administrators to consider placing these students in a quieter, more structured classroom so that they are not affected by the background noise. Finally, because these students are not always able to understand instructions as well, or, as quickly as their peers, they should be allowed to ask their classmates for help when all else has failed to make assignments clear.

2. Modifications of Existing Curriculum

Educational curricula are designed for the normal achiever, who learns at a predictable rate and requires a typical amount of instruction and practice. The problem with this is that not all learners are typical and learn at a predictable rate. It is ironic that all students are acknowledged to be different but when it comes to curricula it is assumed that all will learn the same material at the same rate with the same methods (Grady, 1984). Simmons (1992) points out that it is important for teachers to look at curricula and simplify it or separate stimuli which are confusing. This is beneficial to all students.

A spelling list from the Grade Four Ves Thomas Canadian Spelling Program (1979) offers the following word list for learning long a: hate, late, paper, nails, paint, past, swam, safe, saying, places, bat, wait, were, and told. These words represent three different variations of long a, include short a words, and two unrelated words. A less confusing spelling

lesson for all students would be to teach the child the patterns of long a. The teacher might begin with the consonant-vowel-silent e pattern and teach gate, ate, plane, blame, and so on. This could be followed by a lesson on long a that follows the rule of vowel digraphs. Children learn, "when two vowels go walking the first one does the talking." This word list would have words like chain, raid, plain, and hail. This type of modification is easily done, the same concept is covered, yet the confusing stimuli are removed and the expectation of success for all students is higher.

3. Use of Whole Language

Whole language theory is based upon the concept that children are seeking meaning when they read and that they use their prior learning and experience to make sense of print.

Whole language teaching is based on four principles; a theory of learning, a theory of language, a basic view of teaching and a language-centred view of curriculum. The theory of learning states that children find learning easy when it is whole, real and relevant; when it makes sense and is functional; when it is encountered in the context of its use and when the learner chooses to use it (Goodman, 1986).

Whole language is also based on knowledge and theories about language. Language is inclusive and indivisible. Whole language teaching recognizes that there is a phonemic aspect of language, and that there are words, sentences and

paragraphs and that these are all elements of language, thus, it is inclusive. However, language must be studied not as parts but as a whole, therefore, it is indivisible. Whole text is the minimal functional unit. Consequently teachers and pupils investigate phonetics, words, phrases, and sentences in the context of the whole (Goodman, 1986; Newman, 1985).

Teaching whole language requires respect for and understanding of learning and language. Teachers of whole language use a range of natural functional materials to build literacy. They integrate oral and written language development with conceptual learning. Accordingly, whole language teachers do not use behavioral objectives, textbooks mastery learning or standardized tests. In their planning they create opportunities for pupils to use language in authentic, richly contextualized functional ways. They believe that children learn to read and write while they read and write to learn (Goodman, Goodman and Hood, 1989).

Curriculum in a whole language class is integrated. Speaking, listening, writing and reading happen in the context of the exploration of the world of things, events, ideas and experiences. It begins with the learner and where he or she is in terms of language and builds from there. Whole language accepts learner differences and is child-centred (Goodman, 1985).

Whole language practitioners believe that children will

discover relationships between letters and their sounds as part of their language learning. They also feel that children in whole language classrooms will move toward conventional spellings in their writing. Thus, readers and writers develop control over phonetic rules in the context of using written language. Whole language teachers do not ignore phonetics but rather keep phonetics in perspective of real reading and real writing (Newman, 1985; Goodman, 1986).

Goodman (1986) believes that whole language affects an alternative to remediation for unsuccessful readers based on the fact that children who have trouble reading and writing have learned language and, therefore, have the necessary basis for being successful. He calls his remedial program reevaluation because his two main objectives are supporting pupils in reevaluating themselves as language learners and getting them to believe that they can learn to read and supporting them in reevaluating reading and writing as functional and meaningful processes. Further, Goodman concludes, and from classroom observations, I concur, that children who begin learning in whole language classrooms are less likely to be in trouble or see themselves as failures (Goodman, 1986).

4. Reader's and Writer's Workshop

Reader's and writer's workshop are child centred approaches to teaching reading and writing that bring the real world of reading and writing into the classroom. Like adult readers, children select their own reading material, read at

their own pace and talk to others about what they have read (Hansen, 1987). A basic philosophy of reader's and writer's workshop is that writing is the foundation of reading, that is, it may be the most basic way to learn about reading. When writers read they use insights they have acquired when they compose (Hagerty, 1992). Reader's and writer's workshops take into account elements of time, choice, response, community and structure (Hagerty, 1992, Hansen, 1987).

Children need large blocks of time to read and write. In a reader's workshop children read in a natural unhurried way. They have daily opportunities to browse and select books and reflect on their reading (Hagerty, 1992). In writer's workshop children write often and on a regular schedule. They spend most of their time working on the information in their writing, and not the mechanics of their writing. In addition they spend some time sharing, seeking help and responding to others (Hansen, 1987).

Children make choices in selecting their own reading material. The teacher gives them opportunities to select from a wide variety of quality literature but also teaches the students to make appropriate choices. It is believed that choice leads to ownership. Students who choose their own reading material are much more likely to be involved with reading and text (Hagerty, 1992). Similarly, writers write best when they write about what they know or want to learn. They also write well when they know their writing will be

shared with others (Atwell, 1987; Hansen, 1987).

Children enjoy telling others about or recommending books to their classmates in the same manner as adults like to tell friends about books. Response in reader's workshop refers to students responding orally to their own reading and that of others, conferring with the teacher, talking with each other in peer conferences or sharing in small or large groups (Hagerty, 1992). Children can respond to their reading by writing about it as well. Teachers also respond to the children's writing and in so doing they teach (Hansen, 1987).

In reader's workshop where students actively support each other community is established. Students work cooperatively with each other, assume leadership roles when appropriate, help each other learn, encourage each other to do well and learn to be active listeners. Everyone is a teacher and everyone is a learner and everyone's input is valued (Hagerty, 1992, Hansen, 1987).

Structure refers to the organization of the workshop and the management system that the children can count on. Reader's and writer's workshop isn't just having students sit around and read and write. Students learn to read because the teacher teaches and models strategies that good readers and writers use and allows the students time to practice these strategies. Mini-lessons are the technique teachers use to teach what the students need to help them become better at reading and writing. During mini-lessons children would learn

about specifics such as grammar, usage, punctuation and spelling as needed (Atwell, 1987; Hagerty, 1992; Hansen, 1987).

Hansen (1987) believes that children learn the purpose of phonics when they read and write. Invented spelling focuses the teacher's and the child's emphasis on the meaning of a book, helps children develop the expertise they need with sound-symbol relationships, and permits children to take initiative in their own learning. In spelling words for children the teacher takes attention away from the process of creating meaning and focuses it on perfection. Then, children stop sounding out words because they no longer need phonics. However, if teachers do not spell words, children come to realize that sounds are a tool they must acquire in order to write. Teachers who have taken the risk and given invented spelling a full chance see growth, and research backs what these teachers see (Hansen, 1987).

Adams (1991b) agrees that invented spelling leads to growth in conventional spelling. Commitment to early writing and attempts at spelling allows children to be in charge of their progress and when in charge they are more likely to attend to what they are doing. Although the purpose of reader's and writer's workshop is not to teach phonics as such, it is a good vehicle for teaching writers to notice how words are conventionally spelled as they become more and more expert at writing. Finally, Adams concludes that children who

have begun with inventive spellings learn exceptionally quickly when learning spelling to sound correspondence (Adams, 1991b). A strong basic understanding of spelling to sound correspondence can assist in the growth of phonemic awareness which in turn will allow for growth in reading (Wagner and Torgeson, 1987).

5. Teaching Phonemic Awareness

At present there is evidence that children with auditory temporal processing deficits can be identified early (Turner and Nesdale, 1988; Vellutino and Scanlon, 1987). There is also evidence that teaching these students phonetic skills is effective (Olson et al, 1989; Vellutino and Scanlon, 1987).

Chall and Mirsky (1978) suggest that practice and stimulation at the right time may foster advancement in phonemic awareness. They point out that a young child's brain is plastic and that over time, proper stimulation could modify neural language structures (Chall and Mirsky, 1978). Thus, experiences designed to stimulate language processing abilities might aid the development of the necessary cognitive mechanisms for recall of grapho-phonetic correspondence. Such experiences would include instruction in the segmentation of words, syllables and sounds (Sawyer, 1992).

Vellutino and Scanlon (1987) believe that training in phonemic awareness (discrimination) has a beneficial effect on the acquisition of skill in word identification. The Auditory Discrimination in Depth Program (Lindamood and Lindamood,

1969) is based on the premise that children can be taught phonetic skills by teaching those skills in conjunction with visual cues, that is, using a mirror and watching themselves; and motor-kinaesthetic feedback of feeling where the lips and tongue are placed in making the sound. With this system the child has auditory, visual and motor feedback all directed to the same objective (McGuinness, 1985). Because of the time and intensity involved in the teaching of this program it may be better suited for the special education classroom.

Changing the Program

Cognitive styles are relatively stable ways that individuals perceive, conceptualize and organize information (Wittrock, 1978). Learning styles include the cognitive or knowledge processes as well as affective and physiological processes that a person accesses when learning (Robeck and Wallace, 1990). There are different ways of examining learning styles based on the major dimension of cognitive style affecting learning, such as, impulsive and reflective learning styles; or global and analytic learning styles; or right-brained and left-brained learning styles (Schmenk, 1988). Particular academic tasks children are asked to do in school could be considered hemisphere specific. Skills or curriculum area strengths attributed to the left hemisphere are handwriting, recognition of symbols, reading, phonetics, locating details and facts, talking and reciting, following

directions, auditory discrimination and listening. Right hemispheric skills include spatial relationships, recognition of shapes and patterns, mathematical computation, sensitivity to colour, singing and music, artistic expression, creativity and visualization (Vitale, 1982) Most of the tasks children are asked to deal with on a day to day basis in the classroom are left hemisphere specific and strongly related to the spoken, graphic (text) or written form of language.

Although most of the curriculum and instruction in schools allows children with left-brain language competencies to fare better, the right brain and its abilities merit consideration because of the ability to enhance the linear sequential aspect of learning with the more creative aspects of learning. Webb (1983) suggests that there are activities we can add to the curriculum to improve skills in children who are more right brained. Like the suggestions for improving the classroom, they are based on encouraging children to access another modality. She suggests that teachers should introduce activities to the left-brain and then add activities which develop the right-brain aspect or vice versa. Teachers should learn to introduce a task visually, instead of auditorially and then translate it into language. Furtney and Willems (1983) suggest that introducing a task visually helps create a stimulating learning environment. Finally, Webb suggests that teachers should assist learners to understand their individual preferential learning modes and help children

realize the need to use both sets of competencies (Webb, 1983).

Bernice McCarthy, originator and author of the 4Mat System (1987) shares this philosophy and takes it a bit further. She agrees that as educators we need to develop methods of learning that allow students to develop their own natural gifts, to understand and appreciate the gifts of others and to grant each child the opportunity to refine the child's best learning style while experiencing and developing alternative learning styles. 4Mat is based on hemispheric specialization and lateralization (McCarthy, 1987).

McCarthy bases her program on the premises that human beings perceive experience and information in different ways and they process both experience and information in different ways. The combination formed by an individual's own perceiving and processing techniques form their unique learning styles. She identifies four learning styles. Type one learners are interested in personal meaning, type two are interested in the facts as they lead to conceptual understanding, type three are interested in how things work and type four are primarily interested in self discovery. For each type of learner there are teacher expectations for how these learners need the teacher to teach. She adds that all students need to be taught in all four ways in a cycle format. The 4Mat System requires a specific cycle of teaching in all four modes incorporating the four combinations of

characteristics. In addition each of the four learning styles needs to be taught with both right and left mode processing techniques (McCarthy, 1987).

The disadvantage of this method is that it requires a wholesale change in the classroom, the curriculum and the teacher beliefs. The advantage is that the integration of the learning styles and the development and integration of right and left brained processing is the goal. In teaching to a child's learning style, McCarthy believes that students will come to accept and utilize their strengths for instruction.

Making Sense

The hypothesis that children with impaired auditory temporal processing are unable to listen to language effectively has been shown to be a factor which influences how children respond to classroom situations, and learn to read. The fact that these children are not able to listen in class or use listening to learn to read phonetically answers the question of "Why?". They do not choose not to listen, rather, they are not able to listen effectively due to the inability to process temporal auditory input. This fact has important implications for how these children operate in classrooms. Teachers need to be aware that there are aspects of classroom situations, such as following directions, and using phonetic cues to read and spell over which these children have no control. Accordingly, teachers need to observe their students in action in the classroom to determine whether or not these difficulties do in fact exist. Much can be done for these students to assist them to cope by simply assuring that the students have understood directions and assignments.

While research supports the belief that these particular students have difficulties with background and foreground noise in the classroom and the phonetic aspect of reading, it did not support the idea that these children experience difficulties in language learning in general. In other words, it could be acknowledged that these children had experienced and learned language much as their peers had. This would

justify the fact that they seem to be able to comprehend print if and when they can decode it. Because they do not have difficulties in comprehension I feel that the whole language approach or reader's and writer's workshop would be beneficial for these students. Both programs begin at the child's current level of competence and are child-centred. Thus, progress would not be measured in accordance with the curriculum, but rather in accordance with the child. Allowing the child to use his or her own knowledge and experience as part of learning to read and write is an invaluable tool. We can most effectively meet and respond to each student's needs by building on his or her interests and experiences. This allows children to be in charge of their learning and being in charge stimulates children to attend to what they are doing.

The fact that these children need direct instruction to increase phonemic awareness has been shown. In order to grow in phonemic awareness children need to be exposed to print that interests them. Whole language and reader's and writer's workshop do not ignore the importance of phonetics but rather see it as being taught in the context of other forms of exposure to print. In these situations children learn phonetics not by drill, but in a interesting and stimulating way by connecting the learning of sound-symbol correspondence to the child's own desire to progress in reading. Again, teachers need to be observant and determine those students whose progress is curtailed by difficulties with phonemic awareness and assist them in its development. This can be

done either in the classroom in the form of mini-lessons, or by involving the special education teacher with direct phonetic instruction related to what the child is reading or writing.

Much of the curriculum in schools at the present time is sequential and linear, which indicates left hemispheric influence. Educators and writers of curricula should certainly be aware that children's brains do not develop according to the curriculum. It would seem that educators and developers of curriculum must be much wiser and acknowledge the present knowledge base that indicates that children grow and develop these aspects of their learning persons differently; and consider changes to the curriculum to celebrate that fact.

Philosophies such as reader's and writer's workshop and whole language do in fact celebrate the belief that children have different styles of learning. In addition they are holistic in that they encourage children to be creative and to access both right and left hemispheric information in the learning process. Another important aspect of reader's and writer's workshop and whole language is the child-centred philosophy that allows children to start where they are and move forward. For those children labelled dyslexic or learning disabled who are encountering failure in regular classrooms, the challenge of learning to read could then become a joyful and rewarding experience.

Bibliography

- Adams, M.J. (1990). *Beginning to Read*. The MIT Press. Cambridge, MA.
- Adams, M.J. (1991a). Beginning to Read: A Critique by Literacy Professionals and a Response by Marilyn Jager Adams. *The Reading Teacher*, 44(6), 370-395.
- Adams, M.J. (1991b). A Talk With Marilyn Adams. *Language Arts*, 68, 206-212.
- Atwell, N. (1987). *In the Middle: Writing, Reading and Learning with Adolescents*. Boynton/Cook Publishers. Portsmouth, NH.
- Bakker, D. (1992). Neuropsychological Classification and Treatment of Dyslexia. *Journal of Reading Disabilities*, 25, 102-109.
- Bauer, A.M., T.M. Shea. (1989). *Teaching Exceptional Students in Your Classroom*. Allyn and Bacon. Needham Heights, MA.
- Beaumont, J. G. (1982). *Divided Visual Field Studies of Cerebral Organization*. Academic Press. New York, NY.
- Berlin, L.J., M. Blank, S.A. Rose. (1982). The Language of Instruction: The Hidden Complexities. In G.P. Wallach, K.G. Butler, (eds). *Language Disorders and Learning Disabilities*. An Aspen Publication. Rockville, MA.
- Blachman, B.A. (1989). Phonological Awareness and Word Recognition. In A.G. Kamhi, and H.W. Catts. (eds). *Reading Disabilities: A Developmental Language Perspective*. College Hill Press. Boston, MA.
- Bloom, F., A. Lazerson, L. Hofstadter. (1985) *Brain, Mind, and Behaviour*. W.H. Freeman and Company. New York, NY.
- Bryan, T. (1986). A Review of Studies on Learning Disabled Children's Communicative Competence. In R.L. Schiefelbusch. (ed). *Language Competence: Assessment and Intervention*. College Hill Press. San Diego, CA.
- Butler, K.G. (1984). Language Processing: Halfway up the Down Staircase. In K. Butler, G. Wallach. (eds). *Learning Disabilities in School-Age Children*. Williams and Wilkins. Baltimore, MD.
- Cartwright, G.P., C.A. Cartwright, M.E. Ward. (1989). *Educating Special Learners*. Wadsworth Publishing Co. Belmont, CA.

- Catts, H. W. (1989). Defining Dyslexia as a Developmental Language Disorder. *Annals of Dyslexia*, 39, 50-64.
- Cazden, C. (1988). *Classroom Discourse: The Language of Teaching and Learning*. Heineman Educational Books. Portsmouth, NH.
- Chall, J., A. Mirsky. (1978). The Implications for Education. In J. Chall, A. Mirsky (eds). *Education and the Brain: The Seventy-seventh Yearbook of the National Society for the Study of Education*. University of Chicago Press. Chicago, IL.
- Cullinan, B., D. Strickland. (1990). Afterword. In M.J. Adams. (ed). *In Beginning to Read*. The MIT Press. Cambridge, MA.
- Curtiss, S. (1985). The Development of Human Cerebral Lateralization. In D. Zaidel (ed). *The Dual Brain: Hemispheric Specialization in Humans*. The Guilford Press. New York, NY.
- Denckla, M.B. (1993). A Neurologist's Overview of Developmental Dyslexia. In P. Tallal, A. Galaburda, R.R. Llinas, C. Von Euler. (eds). *Temporal Information Processing in the Nervous System: Special Reference to Dyslexia and Dysphasia*. New York Academy of Sciences. New York, NY.
- Domasio, A., H. Domasio. (1992). Brain and Language. *Scientific American*. September, 89-99.
- Foorman, B.R., D. Liberman. (1989). Visual and Phonological Processing of Words: A Comparison of Good and Poor Readers. *Journal of Learning Disabilities*, 22(6) 349-355.
- Furtney, C., A. Willems. (1983). The Hemispheric Nature of the Brain and Elementary School Language Arts. *Reading Improvement*, 39, 293-299.
- Galaburda, A. (1983). Developmental Dyslexia: Current Anatomical Research. *Annals of Dyslexia*, 33, 40-53.
- Galaburda, A., M. Livingstone. (1993). Evidence for a Magnocellular Defect in Developmental Dyslexia. In P. Tallal, A. Galaburda, R.R. Llinas, C. Von Euler. (eds). *Temporal Information Processing in the Nervous System: Special Reference to Dyslexia and Dysphasia*. New York Academy of Sciences. New York, NY.
- Gaddes, W. H. (1981). An Examination of the Validity of Neuropsychological Knowledge in Educational Diagnosis and Remediation. In G.W. Hynd, and J.E. Obrzut. (eds). *Neuropsychological Assessment and the School-Age Child: Issues and Procedures*. Grune and Stratton, Inc. New York, NY.

- Gilmore, T. (1988). Overview of the Tomatis Method. In T. Gilmore, P. Madaule, and B. Thompson. (Eds). *About the Tomatis Method*. Listening Centre Press. Toronto, Ontario.
- Goodman, K. (1986). *What's Whole in Whole Language?* Heinemann Educational Books Inc. Portsmouth, NH.
- Goodman, K., Y. Goodman, W. Hood. (1989). *The Whole Language Evaluation Book*. Heineman Educational Books Inc. Portsmouth, NH.
- Goswami, U. (1993). Phonological Skills and Learning to Read. In P. Tallal, A. Galaburda, R.R. Llinas, C. Von Euler. (eds). *Temporal Information Processing in the Nervous System: Special Reference to Dyslexia and Dysphasia*. New York Academy of Sciences. New York, NY.
- Grady, M. (1984) *Teaching and Brain Research*. Longman Inc. New York, NY.
- Hagerty, P. (1992). *Reader's Workshop: Real Reading*. Scholastic Canada Ltd. Richmond Hill, Ont.
- Hansen, J. (1987). *When Writer's Read*. Heinemen Educational Books Inc. Portsmouth, NH.
- Halliday, M., R. Hassan. (1985). *Language, Context, and Text: Aspects of Language in a Social Semiotic Perspective*. Deakin University Press. Victoria, Australia.
- Harste, J.C., K.G. Short, C. Burke. (1988). *Creating Classrooms For Authors: The Reading-Writing Connection*. Heinemen Educational Books Inc. Portsmouth, NH.
- Hogaboam, T., C. Perfetti. (1978). Reading skill and the Role of Verbal Experience in Decoding. *Journal of Educational Psychology*. 70: 717-729
- Holligan, C., R.S. Johnston. (1988). The Use of Phonolglcal Information by Good and Poor Readers in Memory and Reading Tasks. *Memory and Cognition*, 16(6), 522-532.
- Hynd, G.W., M. Cohen. (1983). *Dyslexia: Neuropsychological Theory, Research and Clinical Differentiation*. Grune and Stratton. New York, NY.
- Kinsbourne, M., M. Hiscock. (1981). Cerebral Lateralization and cognitive Development: Conceptual and Methodological Issues. In G.W. Hynd, and J.E. Obrzut. (eds). *Neuro-Psychological Assessment and the School-Age Child: Issues and Procedures*. Grune and Stratton, Inc. New York, NY.

- Kinsbourne, M., M. Hiscock. (1982). Laterality and Dyslexia: A Critical View. *Annals of Dyslexia*, 32, 177-227.
- Kirby, J. (1988). Style, Strategy and Skill in Reading. In R.R. Schmenk. (ed). *Learning Strategies and Learning Styles*. Plenum Press. NewYork, NY.
- Kirk, U. (1985). Hemispheric Contributions to Graphic Skills. In C. Best. (ed.). *Hemispheric Function and Collaboration in the Child*. Academic Press. Orlando, FL.
- Kolb, B., I. Wishaw. (1990). *Fundamentals of Human Neuropsychology*. W.H. Freeman and Company. New York, NY.
- Konishi, M. (1993). Listening with Two Ears. *Scientific American*, April, 66-73.
- LaDue, R.A., A.P. Streissguth, S.P. Randels. (1992). *Perinatal Substance Abuse: Research Findings and Clinical Implications*. John Hopkins University Press. Baltimore, MA.
- Leonard, L. B. (1982). Early Language Development and Language Disorders. In G. Shames, and E. Wiig. (eds). *Human Communication Disorders*. Charles E. Merrill Publishing Company. Columbus, OH.
- Levelt, W. (1993). Timing in Speech Production with Special Reference to Word Form Encoding. In P. Tallal, A. Galaburda, R.R. Llinas, C. Von Euler. (eds). *Temporal Information Processing in the Nervous System: Special Reference to Dyslexia and Dysphasia*. New York Academy of Sciences. New York, NY.
- Lindamood, C.H., P.C. Lindamood. (1969). *Auditory Discrimination in Depth*. Teaching Resources Corporation. Boston, MA.
- Mann, V.A., S. Brady. (1988). Reading Disability: The Role of Language Deficiencies. *Journal of Consulting and Clinical Psychology*. 56(6), 811-816.
- Mateer, C. (1989). Neural Correlates of Language Function. In D. Kuehn, M. Lemme, J. Baumgartner. (eds). *Neural Bases of Speech, Hearing and Language*. Little, Brown and Company. Boston, MA.
- McCarthy, B. (1987). *The 4Mat System*. Excel Incorporated. Barrington, IL.
- McGuiness, D. (1985). *When Children Don't Learn*. Basic Books, Inc. New York, NY.

- Mezernich, B., C. Schreiner, W. Jenkins, X. Wang. (1993). Neural Mechanisms Underlying Temporal Integration, Segmentation, and Input Sequence Representation: Some Implications for the Origin of Learning Disabilities. In P. Tallal, A. Galaburda, R.R. Llinas, C. Von Euler. (eds). *Temporal Information Processing in the Nervous System: Special Reference to Dyslexia and Dysphasia*. New York Academy of Sciences. New York, NY.
- Miller, G., P. Gildea. (1987). How Children Learn Words. *Scientific American*, 257(3), 94-99
- Morgan, G. (1988). Listening and Learning Disability. In T. Gilmore, P. Madaule, and B. Thompson (eds). *About the Tomatis Method*. Listening Centre Press. Toronto, Ontario.
- Newman, J. (1985). Insights from Recent Reading and Writing Research and Their Implications for Developing Whole Language Curriculum. In J. Newman. (ed). *Whole Language: Theory in Use*. Heineman Educational Books Inc. Portsmouth, NH.
- Olson, R., B. Wise, F. Connors, J. Rack, D. Fulker. (1989). Specific Deficits in Component Reading and Language Skills. *Journal of Learning Disabilities*, 22(6), 339-348.
- Pirozzolo, F.J. (1979) *The Neuropsychology of Developmental Reading Disorders*. Praeger Publishers. New York, NY.
- Pirozzolo, F.J. (1985). Neuropsychological and Neuroelectric Correlates of Developmental Reading Disability. In C. Best. (ed). *Hemispheric Function and Collaboration in the Child*. Academic Press, Inc. Orlando, FL.
- Pirozzolo, F.J., D.J. Campenella. (1981). The Neuropsychology of Developmental Speech disorders, Language Disorders and Learning Disabilities. In G.W. Hynd and J.E. Obrzut (eds). *Neuropsychological Assessment and the School-Age Child: Issues and Procedures*. Grune and Stratton, Inc. New York, NY.
- Rayner, K., A. Pollatsek. (1989). *The Psychology of Reading*. Prentice Hall Inc. Englewood Cliffs, NJ.
- Rennie, J. (1991). Dyslexia: A Problem of Timing. *Scientific American*, November, 26.
- Richards, G., S. Samuels, J. Turnure, J. Ysseldyke. (1990). Sustained and Selective Attention in Children with Learning Disabilities. *Journal of Learning Disabilities*, 23 (2), 129-136.

- Richgels, D.J., L.M. McGee. (1991). Beginning to Read: A Critique by Literacy Professionals and a Response by Marilyn Jager Adams. *The Reading Teacher*, 44(6), 370-395.
- Rico, G.L., M.F. Claggett. (1983). *Balancing the Hemispheres: Brain Research and the Teaching of Writing*. University of California. Berkeley.
- Robeck, M.C., R.R. Wallace. (1990). *The Psychology of Reading*. Lawrence Erlbaum Associates, Inc. Hillsdale, NJ.
- Rumelhart, D.E. (1975). Toward an Interactive Model of Reading. In S. Dornic. (ed). *Attention and Performance VI*. Erlbaum. Hillsdale, NJ.
- Samuels, S.J., P. Eisenberg. (1981) A Framework for Understanding the Reading Process. In F.J. Pirozzolo, and M.C. Wittrock. *Neuropsychological and Cognitive Processes in Reading*. Academic Press. New York, NY.
- Schmenk, R.R. (1988). An Introduction to Strategies and Styles of Learning. In R.R. Schmenk. (ed). *Learning Strategies and Learning Styles*. Plenum Press. New York, NY.
- Simmons, D. (1992). Perspectives on Dyslexia: Commentary on Educational Concerns. *Journal of Learning Disabilities*, 25(1), 66-70.
- Smith, F. (1978). *Reading Without Nonsense*. Teacher's College Press, Teacher's College. New York, NY.
- Stanovich, K.E. (1986). Matthew Effects in Reading: Some Consequences of Individual Differences in the Acquisition of Literacy. *Reading Research Quarterly*, 21, 360-406.
- Stark, J., G. Wallach. (1982). The Path to a Concept of Language Learning Disabilities. In K. Butler, and G. Wallach. (eds). *Language Disorders and Learning Disabilities*. Aspen Systems Corporation. Rockville, MA.
- Swift, C.A. (1988). Communication Disorders. In E.W. Lynch, R.B. Lewis. (eds). In *Exceptional Children and Adults: An Introduction to Special Education*. Scott Foresman and Co. Boston, MA.
- Tallal, P. (1980). Auditory Temporal Perception, Phonics and Reading Disabilities in Children. *Brain and Language*, 9, 182-197
- Tallal, R. (1988). Research Implications: A Perspective. In R. McCauley (ed). *Language, Speech and Reading Disorders in Children: Neuropsychological Studies*. Little, Brown and Company. Boston, MA.

- Tallal, P., M. Piercy. (1974). Developmental Aphasia; Rate of Auditory Processing and Selective Impairment of Consonant Perception. *Neuropsychologia*, 12, 83-93.
- Tallal, P., R. Stark, D. Mellits. (1985). The Relationship Between Auditory Temporal Analysis and Receptive Language Development: Evidence from Studies of Developmental Language Disorder. *Neuropsychologia*, 23(4), 527-534
- Tallal, P., S. Miller, R.H. Fitch. (1993). Neurobiological Basis of Speech: A Case for the Preeminence of Temporal Processing. In Tallal, P., Galaburda, R.R., Llinas, R.R., Von Euler, C. (eds). *Temporal Information Processing in the Nervous System: Special Reference to Dyslexia and Dysphasia*. New York Academy of Sciences. New York, NY.
- Taylor, T.J. (1978) The Brain Sciences: An Introduction. In J.S. Chall, and A.F. Mirsky. (Eds). *Education and the Brain: The Seventy-seventh Yearbook of the National Society for the Study of Education, Part II*. University of Chicago Press. Chicago, Illinois.
- Thomas, V., C. Braun. (1979). *The Canadian Spelling Program*. Gage Publishing Company. Toronto, Ontario.
- Tomatis, A.A. (1969). *Dyslexia*. University of Ottawa Press. Ottawa, Ont.
- Turner, W.E., A.R. Nesdale. (1985). Phonemic Segmentataion Skill and Beginning Readers. *Journal of Education Psychology*, 77(4), 417-427.
- Vellutino, F.R., D.M. Scanlon. (1987). Phonological Coding, Phonological Awareness, and Reading Ability: Evidentce from a Longitudinal and Experimental Study. *Merrill-Palmer Quarterly*. 33(3), 321-363.
- Vitale, B. (1982). *Unicorns are Real*. Jalmar Press. CA.
- Wagner, R. (1988). Causal Relations Between the Development of Phonological Processing Abilities and the Acquisition of Reading Skills: A Meta-Analysis. *Merrill-Palmer Quarterly*, 34(3), 261-279.
- Wagner, R.K., J.K. Torgesen. (1987). The Nature of Phonological Processing and Its Causal Role in the Acquisiton of Reading Skills. *Psychological Bulletin*, 101(2), 192-212
- Wallach, G.P., J. Stark. (1982) The Path to a Concept of Language Learning Disabilities. In K. Butler, and G. Wallach. (eds). *Language Disorders and Learning Disabilities*. Aspen Systems Corporation. Rockyville, MA.

- Webb, G. (1983). Left/Right Brains, Teammates in Learning. *Exceptional Children*, 49(6), 508-515.
- Wiig, E. (1982). Language Disabilities in the School-Age Child. In E. Wiig, E. Semel. (eds). *Human Communication Disorders: An Introduction*. Charles E. Merrill Publishing Company. Columbus, OH.
- Wiig, E., E. Semel. (1982). *Human Communication Disorders: An Introduction*. Charles E. Merrill Publishing Company. Columbus, OH.
- Wiig, E., E. Semel. (1976). *Language Disabilities in Children and Adults*. Charles E. Merrill Publishing Company. Columbus, OH.
- Winzer, M., N. Grigg. (1992). *Educational Psychology in the Canadian Classroom*. Prentice Hall, Canada. Scarborough, Ont.
- Witelson, S.F. (1985). On Hemisphere Specialization and Cerebral Plasticity. In C. Best. (ed). *Hemispheric function and Collaboration in the Child*. Academic Press. Orlando, FL.
- Wittrock, M.C. (1978) Education and the Cognitive Processes of the Brain. In J.S. Chall, and A.F. Mirsky. (eds). *Education and the Brain: The Seventy-seventh Yearbook of the National Society for the Study of Education, Part II*. University of Chicago Press. Chicago, IL.
- Young, P., C. Tyre. (1983). *Dyslexia or Illiteracy? Realizing the Right to Read*. Open University Press. Milton Keynes, England.