A NEW APPROACH REQUIRED TO ADDRESSING ILLITERACY WORLDWIDE

A Glossary of some concepts can be found at the end.

PAGE

2 Summary
3 Introduction
3 Benefits of literacy
3 Illiteracy
3 Changing trends
4 Reliability of reported illiteracy rates
4 Policy in treating illiteracy
5 Assessment
7 Cognitive skills for the acquisition of literacy - a product of genetic inheritance
7 Epigenetic environmental effects - a major cause of ongoing literacy failure
8 Genetic causal factors and possible modification of neurological architecture
9 Evolution of world languages, increasing phoneme usage, phonetic language readability
10 Range of phonemic diversity across world languages
12 Interactions of different orthographies
13 Major areas of literacy failure
14 Environmentally and genetically determined failure of language-disadvantaged students
16 Lifelong problems going far beyond reading
17 Mould-breaking teacher training essential
18 Conclusion
11 Diagram: Map devised by Professor Quentin Atkinson (2012), to show decreasing phonemic diversity in current world languages found along the postulated tribal migration routes out of Africa
18 The author
19 Citations
21 Glossary
Summary

Recently published research across a range of disciplines has revealed important findings about the concept of illiteracy and dyslexia.

In this paper, Dr Harry Chasty considers the implications of these research developments for teachers, psychologists and educational administrators.

The wide range of language learning difficulties identified by teachers in class, across language and literacy development from age 4 years to 18+ years are no longer seen as separate and distinct entities. These should now be recognized as genetically determined effects resulting from deficiencies in cognitive skills, which are a primary cause of illiteracy.

These factors are particularly relevant to meeting the significant special educational needs of indigenous, disadvantaged, white working class students failing in literacy and underachieving educationally across the older industrialized economies of Europe.

Where there is no training in essential cognitive skills, and individual types of language difficulties are treated piecemeal, there will be limited gains in literacy. In the long run this is not cost effective.

Across the orthographies of the world, diminished phoneme usage in languages at the early stages of phonemic evolution leads to complex and obscure phonological structures, which accentuate and exacerbate illiteracy.

As a result, some languages are much more difficult to read, write, spell and think with than others than others, and so students learning in such languages need more prolonged and intensive, specialist, multi-sensory teaching of both cognitive and literacy skills.

Introduction

Across the evolving variations in phonological and linguistic complexity of world orthographies, yesterday’s life struggles determine today’s literacy failure, tomorrow’s limitations in verbal thinking, the next day’s exam failures, the day after’s deprived living standards and the following generation’s continued illiteracy. Breaking this negative cycle requires more than good literacy teaching. It also requires reconstructive development of the inadequate, epigenetically-determined language-learning competencies of these students failing in literacy.

You may be reading this paper because you want to learn more about reading failure and you want to teach more effectively. It is hoped that by the time you reach the end you will understand more about ‘reading’ because the problems of world illiteracy will not be solved by dealing with the ‘effect’ - reading failure - rather than its primary cause, which is an inadequate approach to teaching learning skills. Without addressing the cognitive skills required for the acquisition of literacy, there will be no substantial progress in tackling world illiteracy.
Benefits of literacy

Kofi Annan, the seventh Secretary General of the United Nations, has penned the most complete and moving description of the benefits of literacy, which highlights the handicaps faced by the world’s illiterate section of the population. ‘Literacy is a bridge from misery to hope. It is a bulwark against poverty, and a building block of development, an essential complement to investments in roads, dams, clinics and factories. Literacy is a platform for democratization, and a vehicle for the promotion of cultural and national identity. Especially for girls and women it is an agent of family health and nutrition. For everyone, everywhere, literacy is, along with education in general, a basic human right. Literacy is, finally, the road to human progress and means through which every man, woman and child can realize his or her full potential.’

Annan clarifies that, for some, literacy may be the vital first step on the way to liberty. His words accentuate the pressing need for a better understanding of the full implications of illiteracy.

A wider clearer understanding of the effects of illiteracy could facilitate a more positive worldwide response, resulting in better teacher training, improved classroom practice in multi-sensory literacy teaching linked to the necessary cognitive skills, the development of working memory and ultimately the establishment of meta-cognitive control over literacy and learning by the learner.

Illiteracy

This problem is widespread, costly to world economies and a waste of human resources.

The size of the daunting task to reduce the incidence of illiteracy worldwide is clearly reflected by the arresting statistic given by UNICEF that nearly a billion people entered the 21st century unable to read a book, or sign their name. Two thirds of them are women. Currently, 57,000,000 children do not go to school. With the world population in the year 2000 being just over 6 billion, we are looking at one sixth i.e., almost 17 % of the world population being considered to be illiterate.

Changing trends

Illiteracy halved between 1970 and 2005 yet despite our best efforts in the last decade, the curve of falling world illiteracy rates has now come very close to horizontal.

Indeed some researchers, including UNICEF (1998, 1999, and 2009) and the Canadian Council of Learning (2007 and 2010), have concluded that for genetic, environmental and demographic reasons, which are more fully discussed in Chasty (2014), a reverse is anticipated and illiteracy will increase.
Reliability of reported illiteracy rates

How accurate is the picture gained from published tables for literacy rates?

Close inspection suggests that the literature should be considered carefully.

Some surveys compare the reading standards of countries, or students using average word-recognition ages. This can be very misleading because this skill varies in difficulty according to the complexity of the orthography, as may be seen from the definition of illiteracy given in the glossary. In this paper illiteracy is defined as the inability to obtain meaning from the recognition and interpretation of a basic 5-6 year age-appropriate sample of the orthography of the reader's spoken language.

It is reported that Canada, with only a 1% illiteracy rate (using the UN definition of illiteracy is one of the highest achieving countries in the world. But the picture is mixed. The figures are masked by the higher literacy skills levels in more affluent areas.

In a Canadian Council of Learning (2007) research report, *The state of learning in Canada: No time for complacency*, attention was drawn to the underlying problems. It was reported that some 48% of all Canadians over the age of 16 years had such low literacy skills in prose reading, that they had difficulty in reading, understanding, and functioning effectively with written material. In a further report, *The future of literacy in Canada’s largest cities*, it was concluded that “by 2031, Toronto would witness a significant increase in the total population of adults (citizens aged 16 and over) with low literacy skills”. Similar increases in low literacy skills were predicted for other high concentrations of the population showing a degree of social deprivation and disadvantage.

Similar distortion is evident in all countries across the world with the skills of the literate five-sixths of the population concealing the increasing problems of the illiterate one-sixth. Published national literacy rates do not accurately reflect the frequency and severity of illiteracy.

Illiteracy is a matter of concern for all world nations regardless of the comparative advancement of their economic and educational status.

The costs to society are not being addressed.

Policy in treating illiteracy

Educational policy makers determine the extent of remedial literacy programmes, but it is not possible to be confident that they understand all the factors that impact on illiteracy.
Assessment

Continuous assessment of the development of verbal skills provides a more dynamic and accurate perspective of the illiteracy model.

The picture constructed of causes and effects in literacy failure is not clear because it takes a 'snapshot' of the failing student. This lacks the depth of perspective, and awareness of developmental progression and dynamic change in skills inheritance, development, selection, operation, control and usage given by repeated reassessments, ranging from the past, through the present, into the future.

Good teaching of speech skills to children with early phonological and speech difficulties does not resolve the ongoing verbal–literacy issues but pushes the student’s problems on to the next stage of literacy development.

If we delay our ‘one–off’ assessment of these students until the age of seven, we would record their reading difficulties and reach a very different conclusion, by classifying them as ‘dyslexic’, and providing structured multisensory literacy teaching. The perspectives of the underlying illiteracy difficulty seen at age four and age seven are very different, focusing upon different age-related developmental language facets. The treatment offered by specialist teachers dealing with these “facets” is also very different, and it is therefore not surprising that, historically, psychologists and specialist teachers have tended to regard these “facets” as separate and distinct entities.

The accuracy of these single assessments at the time they were carried out is not questioned but, by focusing upon different developmental language stages, the class teacher is unaware of what has gone before or what comes after and so misses the full picture. We should question how full and meaningful a perspective each “facet” provides of the scale and scope of the underlying developmental illiteracy difficulty the learner experiences. The yearly or biannual assessment perspective of young students growing and learning through, phonology, speech, word recognition, reading comprehension, reading fluency, spelling, and the written expression of ideas continuum, has shown the close developmental relationship between what were previously regarded as separate and distinct disabilities, revealing the ongoing developmental effects of the cognitive deficits underlying illiteracy.

At successive stages of their development, literacy-failing students have been observed to grow through such age-stage related difficulties as:

- dyspraxia, i.e. difficulty controlling the patterns of motor movements required for speech and writing;
- dysgraphia, i.e. difficulty with the formation of letter shapes in writing;
- dysphasia, i.e. difficulty with speech and language;
- specific language impairment (SLI), i.e. unexplained difficulty in learning speech and oral language;
- attention deficit hyperactivity disorder (ADHD), i.e., difficulty in controlling and focusing attention in working memory;
- dyslexia, i.e. difficulty with reading, spelling and writing;
- dyscalculia, i.e., difficulty with the language and structure of number; and
- ‘dyslectia consilia’, i.e. difficulty in selecting from the student’s current skills repertoire, the literacy strategy relevant to the particular task in hand.

Some of these learning difficulties are observed in the young pre-school child, others in the early to middle school years, and still others in the later stages of the student’s education. If the learner passes through four or five of these eight aspects, then we can see that these are not separate and distinct difficulties, but age-stage-related effects of the same genetically determined neurologically based, ‘illiteracy’ process.

This has been established by Landerl and Mall (2010) and Butterworth and Kovas (2013), who have shown that the significant co-occurrences of these difficulties in normal class groups confirms that they were developmentally interrelated. Butterworth and Kovas concluded that these specific learning difficulties were not separate and distinct entities, but linked genetic factors arising from atypical brain development and usage originating from relevant complex genetic and environmental factors. These link and lead into further more complex language-literacy difficulties at the next developmental stage.

Tracing this developmental failure along the continuum of verbal skills gives greater understanding of the nature and ongoing effects of the underlying causative cognitive difficulties. The problems of phonology, speech, reading, literacy, written expression of ideas, which teachers identify and seek to deal with in the classroom, are not themselves causal. These must be seen as the effects in literacy learning of the underlying cognitive difficulties. It must be pointed out that teaching undertaken to address the language difficulties in phonology, speech, reading, or higher literacy will not resolve these underlying causative cognitive problems. Children who received such early speech-help from very skilled teachers frequently went on to fail in reading/literacy at a later developmental stage.

An example of this continuing failure along the language continuum is found in Hayes and Naidoo (1991), who confirmed that, despite skilled early speech and language teaching, some 90 % of the children attending a specialist school for SLI children went on to experience later literacy difficulties. The speech and language training they received may have aided the development of their speech skills, but did not address the underlying genetically linked, neurologically- based cognitive difficulties that had precipitated their current problems in linking speech sounds with the motor movement patterns necessary to say these sounds and build a speech structure. These cognitive problems persisted and led to cross-modal transfer difficulties preventing the establishment and use of the VAKS (see Glossary) cross-modal linkages necessary for the next stage of verbal development in reading - and beyond, to spelling and the written expression of ideas.

This clarifies: (i) that these are age-related aspects of the same ‘illiteracy’ problem; and (ii) the need for planned treatment that must include appropriate cognitive skills-training linked to the specific language development area at each successive developmental stage from pre-school, through junior, middle and senior school and on to adult continuing education.

This repeated reassessment process has also shed much light upon the now well-recognized developmental difficulties and management procedures necessary for
literacy-failing students with “phonological dyslexia”; the same reservation applies that phonologically-based reading teaching does not address the full range of the underlying cognitive problems these students experience (see Goulandris and Snowling, 2001) and, in the absence of appropriate cognitive skills-directed training, further difficulties should be anticipated for these students in later stages of literacy development.

A similar but longer-term perspective is necessary for monitoring, identifying and treating the much less well known and recognized literacy failures of students whose problems are environmental in causation, and also literacy failing students who, initially, show competent phonology and word recognition, but who later in their education experience much more significant difficulty at the later stages of the development of the verbal skills continuum when establishing reading fluency, comprehension, spelling and the written expression of ideas.

Cognitive skills for the acquisition of literacy – a product of genetic inheritance

In building a more effective developmental model of illiteracy, it is not sufficient to monitor the learner’s current and ongoing development of cognitive-language-literacy skills as these fracture and stagnate, or progress purposefully into the future. Account must also be taken of the contribution to present literacy failure from the relevant past, particularly the learner’s genetic inheritance from the previous generations of family, in whatever formative environmental circumstances they lived, adapted, learned, and worked. It is this genetic inheritance that determines the neurological organization and cognitive skills the learner brings to literacy acquisition and, in the absence of highly skilled intervention from well trained teachers, results in his/her success or failure.

Epigenetic environmental effects – a major cause of ongoing literacy failure

The literacy learner is not born in a social vacuum. He/she is part of a family, a community, a tribe, a nation, with the attendant mores, expectations, pressures and demands of that social situation within its particular language form and economy. He/she has parents and grandparents who had interacted with that environment and adapted to its demands for the development of skills, thinking, language learning, warfare and work. These ancestors passed on their genes, which will affect his/her learning. But even more significantly, these preceding generations may have experienced strong and coercive environments requiring different neurological architecture and hemispheric specialization to support the essential skills necessary at that time in that society. This strong environmental demand for particular skills faced by these immediate ancestors placed epigenetic markers determining which of the available genes from the family genome would operate for this learner and which would not - thus determining the neurological specialization and cognitive competences brought by the learner to literacy acquisition.

The most important and undoubtedly controversial hypothesis, which is advanced for consideration in this paper, is that reading failure is inherited from illiterate, environmentally disadvantaged ancestors whose developed right hemisphere brain
specialism was linked to strong and coercive demands in the society in which they lived, for the particular skills this neurological architecture facilitated. In high priority social, tribal, confrontational, and work situations this brings skills gains and benefits which at those times are vital to the tribe or family. However, when these required brain specialisms are brought to the less culturally and familial critical, lower priority skills of language/literacy acquisition, this neurological structure is particularly inefficient, and results in ongoing genetically determined literacy difficulties in subsequent generations. Some people call this dyslexia.

Literacy failure which was initially caused by severe environmental disadvantages, becomes the genetically determined literacy failure described as dyslexia some two or three generations later. Nor is it currently clear how long such non-left hemisphere dominant epigenetic effects, which give rise to the cognitive difficulties causing the observed illiteracy, last but in my observation, described in some detail in Chasty (2014), the effect may be traced and is still apparent down some four or five generations of the same families.

This genetic process continues even when (i) the original depriving circumstances demanding right hemisphere specialism are no longer part of the family’s current living/working conditions; (ii) literacy skills have much higher familial status; and (iii) the family’s socio-economic status and environmental circumstances have significantly improved. Even though it is no longer relevant to the environmental demands of current and future learners from that family, this anomalous ‘acquired neurological characteristic’ has been inherited by successive generations, leading to ongoing literacy failure, which has become a growing, self-perpetuating and increasingly serious world problem. This causative epigenetic effect must be integrated into the illiteracy paradigm and due account taken of it in determining appropriate strategies for managing and ameliorating world illiteracy.

**Genetic causal factors and possible modification of of neurological architecture**

If this hypothesis is confirmed, it significantly alters the currently fragmented and sometime controversial perspective of the place of dyslexia in relation to language disadvantage within the context of world literacy failure. If a very long-term developmental perspective is taken, dyslexia seems not to be a separate and distinct language condition, but one developmental stage in an ongoing genetic illiteracy process, and seems to be in the middle of that lengthy developmental continuum spanning many generations rather than being the only, or final stage.

Can the right hemisphere specialism that leads to illiteracy be altered? Chasty (1973) and Chasty (2014) have shown that by using multisensory teaching methods and cognitive training procedures, it is possible to develop successful left-hemisphere language processing in learners who previously showed right-hemisphere specialism and failure in literacy. Unfortunately, in the study carried out, the learners gained left hemisphere competences and improved verbal language skills, but lost right hemisphere creative visual and spatial processing skills that were of some value in society and the working world. Clearly the best effect would be to develop teaching procedures that developed the left hemisphere language
processing skills without losing the valuable right hemisphere visual skills, but to my knowledge and in my experience that has not yet been accomplished.

One further very important point remains. I do not know whether this described neurological organizational change from right hemisphere to left hemisphere specialism in the experimental subjects was short term, or permanent. The really important issue must be what neurological architecture the next generation of learners born to those subjects who benefitted from the training described in the previous paragraph, will show. In this field of research linked to multi-sensory teaching much remains to be done. However, there appears to be a strong possibility that teaching advances in linked multi-sensory training procedures across cognitive and verbal domains will provide an approach to reversing this ongoing genetic, neurologically determined illiteracy progression.

**Evolution of world languages, increasing phoneme usage, phonetic language readability**

In the previous section of this paper, an explanation is offered as to why some language learners bring very inefficient learning skills to their language acquisition. We must now consider the effects of aspects of evolutionary language development that may accentuate and exacerbate the problems experienced by learners of languages at a particular evolutionary stage.

Language is a system of signs for encoding, recording and decoding information which can take many forms. Across the world, language systems that have been evolving separately along different environmental, tribal and cultural pathways over a period of more than 100,000 years use very different methods of encoding, recording and decoding their contained information. Evans and Levenson (2009) have reported, “languages differ so fundamentally from one another at every level of description, sound, grammar, lexicon, meaning, that it is difficult to find any single property they share”.

Spoken language develops first in evolutionary history and also in individual development: first in man’s evolution, and also language evolution. For many thousands of years mankind lived, thrived, went forth, migrated, multiplied and peopled the earth using and benefiting from spoken language, but without the long-term communication and storage system for meaning provided by written language. Some 3,500 – 5,000 years ago recorded language developed initially in a pictographic form, with the depicted pictures representing and conveying the meaning. It is in the interpretation of the meaning of those pictograms that we find the beginnings of reading.

Across the world, this pictographic system for recording meaning branched into two very different written language systems. The most widely used logographic form, as found in the Sino-Tibetan languages, used printed symbols to represent parts of meaningful ideas, which when put together, gave the immediate sense of the text without needing to access the phonological system giving the sounds of those symbols. Because of limitations in space this aspect of language, while interesting and providing very enlightening contrasts to phonetic languages, cannot be our
concern in this paper. The second group of phonetic languages is currently in a lengthy process of evolution in using printed symbols to represent the language sounds, which must be accessed and sequenced into words to derive the meaning of the text.

Languages in this evolutionary process of ‘phonetizisation’ have been observed to move through the following stages: (i) the meaningful shape (picture) representing a large diffuse sound chunk; (ii) the shape representing a range of possible sounds, with the actual representation being determined by syntactic, semantic and pragmatic factors; (iii) a more precisely constrained shape representing a much smaller, more precise and less complex unit of sound; (iv) the final stage where the visual symbol in print directly, simply, and unequivocally represents a single phoneme.

English, which is a comparatively recent language, appears to be currently at the very complex stage (ii) of this evolutionary process, while other much older and longer evolving world languages such as Zulu have reached the simplest and most direct representational stage (iv). Having worked with a teenage Zulu student who read very fluently in Zulu but, despite receiving good instruction in reading English, was illiterate in that language. I can confirm that the serious difficulties this student experienced in reading in English were entirely attributable to the complex phonological structure linked to this language’s early position in the evolutionary phonetizisation process described in the preceding paragraph.

**Range of phonemic diversity across world languages**

The human speech apparatus can produce an enormous variety of sounds. Across world languages 163 basic sounds have been identified and documented in the International Phonetic Alphabet (IPA). No language uses this full phoneme range. Each language uses a limited set of phonemes, that are the smallest basic units of sound which can bring about change in the expressed meaning of the language. As languages evolve and are used by populations of increasing size they use more phonemes; this increasing phoneme diversity facilitates the evolving simplicity of the structures used for representing language sounds by printed symbols, which in turn contributes to their simplicity for reading, spelling, writing and thinking.

Atkinson (2011) has argued that the number of phonemes used in a language is positively correlated with the size of its speaker population, with smaller, newly developed populations using fewer phonemes in their language. He advanced the very interesting view that “the more phonemes a language has, the closer it is to the putative origin of human language in Africa. The fewer phonemes it has, the further away it lies along the track of presumed human settlement: Africa, Eurasia, America, Oceania”.

Perreault and Mathew (2012) reported that extremely low levels of phoneme usage were observed in new languages such as Rotohas found in Polynesia and Piraha located in Brazil, both of which used only 11 phonemes, while very much older languages such as Khoisan found in Southern Africa use as many as 140+ phonemes.
While this research has received some criticism, some important facts have been acknowledged and accepted. There is a very wide range of phonemic diversity across world languages, with older African languages having the highest levels of phoneme usage at 140+ phonemes, and the most recently developed languages such as Hawaiian having 13 phonemes, with English having some 40+ phonemes being towards the lower end of the phonemic diversity continuum. A further very important consequence must be added. The more phonemes that a language uses, the simpler its system will be for representing the language sounds by shapes in print. The fewer phonemes it uses, the more complex and opaque its systems will be for representing its inherent sounds by printed shapes.

Map devised by Professor Quentin Atkinson (2012) to show decreasing phonemic diversity in current world languages found along the postulated tribal migration routes out of Africa

The language that will be easiest to learn to read will be a phonemic language with no silent letters, having an unambiguous one-to-one correspondence between letters/shapes on the page and spoken phonemes leading to a very simple phonological structure. This language will have evolved to the final stage 4 of the evolutionary process described above and will most likely be an African language such as Zulu. English, with its short evolutionary time span, is at the early stage 2 of this process, and is amongst the most difficult world languages to learn to read, hence the difficulties that my bilingual Zulu student experienced in learning to read in English.
This principle applies across all world languages. Frost et al (1987) classified orthographies according to their phonological complexity as ‘shallow’ or ‘deep’. Frost explained, “In a shallow orthography … the phonemes of the spoken word are represented by the graphemes in a direct and unequivocal manner. In contrast, in a deep orthography, the relation of spelling to sound is opaque. The same letter may represent different phonemes in different contexts, moreover, different letters may represent the same phoneme”.

Seymour et al (2003) classified 13 European languages according to the difficulty presented by their phonological structures to reading learners. Finnish was considered to be simplest, and English the most complex. Later Seymour reported on the clear link between levels of language phonological complexity, age of reading acquisition, and error rates in reading tasks.

It follows that in the processes of reading across the languages used worldwide, because of fluctuating evolutionary phonological complexities, there is very wide variation in the levels of transparency/opacity and, consequently, in the levels of difficulty the learner experiences in establishing the links between the visual element looked at on paper (V), the sounds conveyed by this section of print (A), the motor movement patterns which must be implemented and controlled to say and write it (K), leading to the required end-product in the construction, storage, manipulation and expression of implicit meaning (S). Some orthographies have very simple and direct linkages between these essential aspects of print and consequently are easier to learn to read. Other orthographies have much more complex linkages and are more difficult to learn to read. The English language is amongst the most phonologically complex and difficult to learn to read, and is therefore, not a good model for developing principles of illiteracy management that are relevant and transferable to all world languages.

**Interactions of different orthographies**

When viewed from a world perspective, it is evident that the reading failure observed across the range of international orthographies is not a consistent universal entity, developing across languages in matching stages, in step-by-step synchronicity. In determining the nature and extent of literacy failure, the varying phoneme usages that lead to the phonological organizational simplicities and complexities of world orthographies interact with the student’s available cognitive skills to produce surprisingly different effects in literacy failure at different stages of literacy development from language to language.

For example, the stage of onset of literacy learning problems and the skills affected in the reading difficulties experienced by a student from a specified language background, with a defined range of abilities and cognitive difficulties, learning to read, for example, Portuguese in Brazil or Portugal, will not be the same as the reading failure experienced by a student from the same environmental background, with the same range of abilities and cognitive difficulties, learning to read English in England.
Different languages, therefore, generally show different patterns of difficulty in reading failure. Consequently, across the range of world languages, breakdown in literacy skills acquisition can occur at different stages of the phoneme recognition/phonological awareness/speech/reading/literacy continuum. In the most phonologically difficult and complex languages such as English, failure will most frequently occur early in the literacy learning process at the sound structure/phoneme identification/phonology stage. But in simpler, more transparent, less phonologically complex languages, failure will most frequently occur at the later stage of reading fluency/reading comprehension/meaning/written expression of ideas. This delayed literacy failure may also be observed in phonologically opaque languages in learners with good basic sound management and phonological skills, but with difficulties in other relevant motor, visual and sequential cognitive skills areas.

Early phonological difficulties are not generally observed in learning to read in more transparent orthographies. This condition seems not to be universal but to be idiosyncratic to very opaque languages such as English.

It is misleading to advance a general theory of dyslexia across the world or any form of international illiteracy based upon the paradigm that the only ‘acceptable’ form of dyslexia or illiteracy requires ‘a priori’ that the failing student experiences demonstrable early phonological difficulties. It has taken more than a forty-year period for researchers and practitioners to establish some appreciation of these implications, and the after-effects of that misapprehension still lead to problems in current methodology for teaching reading.

**Major causes of literacy failure**

Regardless of the simplicity or complexity of the language being learned, an overview of the causation of language/literacy failure shows much greater consistency with the major cause being environmental. When educational research has long established the relative ease with which girls master literacy when compared with boys (see Kimura 1961, also PIRLS, Progress in International Reading Literacy Study (2001), and the OECD Study of 43 developed countries showing that 15 year-old girls were significantly advanced in literacy skills when compared with boys), the fact that 66% i.e., some 666,000,000, a very significant majority of illiterate world citizens identified and described by UNICEF (2000) are women, indicates that across all nations, attitudinal and depriving environmental factors are the major cause of literacy failure.

Here we touch on the Malala Yousafzai effect, where, for a range of social, cultural and religious reasons, girls have been deprived of the same educational opportunities freely given in their society to boys. In Malala’s home town, Mingora, in the Swat Valley of Pakistan, two thirds of girls do not attend school, cannot read and lack basic educational skills. By ‘developed nation’ (G-20) educational standards that is a seriously disadvantaging environment, and even by outlier ‘undeveloped nation’ standards, is a clear example of the exploitation by the powerful tribal central (male) group of the powerless peripheral female group as predicted and described in ‘Dependency Theory’. The use of violence by the
exploiting ‘centre’ to safeguard its advantaged tribal position and lifestyle is an integral part of that system.

Illiteracy results from self-perpetuating interactions between:

(i) strong environmental demands for right hemisphere controlled skills, leading to limitations in the learner’s language background, and negative parent/carer/tribal attitude and language mediation; and (ii) student congenital, neurologically based cognitive difficulties, and (iii) lack of appropriate cognitive skills development integrated into language and literacy teaching, at every stage, within pre-school, normal school and adult education.

If significant defects in vision, hearing and severe broadly based learning disabilities, which are all serious difficulties with recognized, defined, and clearly different special educational needs and which are not related to the illiteracy under consideration in this paper, are eliminated from present consideration, the major causes of literacy failure in otherwise normal children are listed above.

Dyslexia as currently defined, contributes to this international illiteracy problem but very clearly, is not the largest or most significant contributory factor. Nor, given the current research picture, does it now seem to be an entirely separate, distinct and recognizably different condition from other forms of illiteracy. It now seems to me to be the middle stage of the epigenetic ‘illiteracy’ condition, which may persevere in families over many generations. Given current directions in research, it is my opinion that in the near future, the condition dyslexia will be more closely linked to language disadvantage and subsumed into the broader paradigm of illiteracy.

Language disadvantage, stemming from stressful and demanding living, employment and language-learning circumstances is the widest and most prolific cause of literacy failure worldwide, and the ongoing genetic effects of this environmental deprivation over succeeding generations have never been fully or properly considered or evaluated. Definitions of aspects of literacy failure which, in the past, excluded environmental determination may now be seen as being too restrictive and socially elitist and should also be revisited.

**Environmentally and genetically determined failure of language-disadvantaged students**

In the past, I have been a strong advocate for the need to identify all the abilities, difficulties and special educational needs of dyslexic students, so that they could receive the appropriate special teaching provision (see Chasty and Friel 1991). At that time, this was necessary to counter the regrettable attitude advanced in some powerful governmental, educational and political organizations, that dyslexics were actually ‘stupid middle-class children’ and their special needs and also those of deprived and disadvantaged students need not be taken into account. (See Baroness Mary Warnock, 2010.)

But as a former headteacher, who has kept a close eye on educational developments worldwide, I have become increasingly concerned by the enormous
waste of talent represented by the huge number of students, whether classified as dyslexic or not, who fail in their tribal learning/education systems because they lack the language and literacy skills required to work effectively and benefit from the learning experiences provided there. Consequently, I have given further thought to the kinds of problems faced by dyslexics and also the larger and more significant group, whose literacy failures are attributable to language disadvantage, or in the currently more fashionable psychological jargon, language learning impairment.

From these considerations, three major questions are posed:

(i) Is reading failure a product of the child’s environment; is it genetically determined; or is it both?
(ii) Is genetically determined reading failure similar to, or different from, environmentally determined reading failure?
(iii) How important are any perceived differences for the class teacher who has to meet the special educational needs of these children?

As a teacher, psychologist and researcher, let me clarify my position from the outset. I have noted clear and significant neurological, cognitive and special educational needs similarities underlying the language, literacy and curriculum failures of language disadvantaged, language learning impaired and dyslexic students. All these categories show neurological architectural differences, motor, short-term memory and perceptual differences, which appear to be genetically inter-related. In the classroom, when determining the essential cognitive skills development and language/literacy programmes that these students require, the similarities between what have been regarded (mistakenly?) in the past as totally separate and distinct difficulties are much more important than any perceived differences and individually tailored structured multi-sensory cognitive skills and language – literacy teaching is entirely appropriate for all these learners. The supporting evidence for this is presented in detail in Chasty (2014).

It is important to deal quickly with literacy failure before serious damage is done to the learner’s educational development and outlook (Chasty 1996). In the practical background of the busy classroom, the teacher must be encouraged to act immediately and effectively when language/literacy failure is recognized, whatever the causality, and without making outdated ‘elitist’ distinctions between literacy failure arising from congenital cognitive factors, and that arising from environmental circumstances of socio-economic disadvantage. The nature versus nurture dialectic implicit in the previous sentence is now considered to be outmoded, and no longer relevant, having been overtaken by recent mould-breaking (2012) research in genetics. This suggests that through environmentally acquired epigenetic effects, determining which genes from the learner’s genome are operating and which are not, previous familial environmental experience actually determines the neurological organization, representational competences, learning style and cognitive skills brought to literacy acquisition by the learner.

Whatever the genetic succession that determines causality across succeeding generations may be, if untreated the effects of these difficulties can be catastrophic, leaving the student totally out of touch with the learning process and the school curriculum. In such challenging circumstances, at the end of the United Nations
Literacy Decade, one must ask, ‘What do the inspiring UNESCO policies of *Education for All*, *Quality Education*, and *Inclusion* really mean for the literacy failing student?’ Equally, what does a government's stated policy of ‘individual entitlement’ to a full national curriculum really mean for these failing students? Without greatly improved basic training for all teachers in what these difficulties entail, and what should be done about them, the short answer to these questions must be “Not a lot!”

**Lifelong problems going far beyond reading**

Nor is literacy failure the only problem that these students experience in school. The initial educational effects of literacy failure are twofold. There is: (i) an obvious limitation in the development of the skills continuum of key phonology, speech, word recognition, reading comprehension, reading fluency, spelling, writing, and written expression of ideas. But there is also (ii) a much less evident but much more important ongoing limitation in the underlying causal, neurologically based cognitive skills in fine motor control, working memory and perception, which has not been and will not be addressed by normal ‘in-class’ speech and reading instruction. Nor is it dealt with fully and effectively in many of the currently available and popular remedial reading programmes. For these literacy failing students, regardless of whatever literacy development programme their teachers choose to use, it will be necessary to implement a cognitive skills development programme. This will be most beneficial and effective if it is closely linked to and secured within a structured multisensory language programme, addressing the ‘cause’ as well as the ‘effect’, thus facilitating the transfer of the vital multisensory learning principles and techniques derived from this key skill area to all others, and with the right teaching management and practice, eventually enabling the establishment of metacognitive control of the processes of learning as well as those of literacy by the learner.

Whilst reference has been made to the use of structured multi-sensory methods in developing literacy, the priority must be on using, with the learner’s full knowledge and co-operation, multi-sensory techniques derived from language and literacy learning, to overcome the cognitive deficits leading to and continuously underlying his/her literacy failure which, if untreated, will exacerbate literacy difficulties experienced in secondary education and can eventually lead to major limitations determining their on-going quality of life.

If untreated, these cognitive deficits when related to the student’s contrasting abilities in other cognitive dimensions lead to a different ‘preferred learning style’, which can interfere significantly with later work across the school curriculum. Further attitudinal and adjustment problems arise because the different learning style preferred by these students also limits their development of effective working relationships within school, the wider educational establishment and on into the working world.

It is evident that the handicapping effects of illiteracy are not restricted to the early years in school and only to the educational setting. If untreated, these persist through and beyond school, throughout the illiterate person’s life, limiting to a very significant degree, social status, social mobility, life circumstances, income, rewards and achievements.
This perspective of illiteracy resulting in a long-term social and economic handicap is supported by Ritchie and Bates (2013), who investigated whether early reading and mathematics skills might have significant social effects going way beyond the classroom. They set out to examine the extent to which early childhood literacy and maths skills were linked with a rise through the social ranks resulting in a better job, and a higher income as an adult. They used data from the National Child Development Study based upon a very large sample of some 17,000 people in England, Scotland and Wales over a 50 year period to establish that a student’s attainments in reading and maths at age seven years, were linked to and accurately predicted their social class, housing, job status and income some 35 years’ later. Offering a further explanation of the underlying relationships they had highlighted, Ritchie and Bates said, “Genes underlie many of the difficulties among children on all the variables examined in the study”. They hoped that their planned twin study would clarify the extent to which environmental interventions might strengthen or ameliorate the effects of the links they had identified.

Mould-breaking teacher training essential

This research demonstrates that the long-term effects of literacy teaching upon students’ later lives is very significant. It is therefore, essential that teachers are trained to understand the learning, thinking, communication, and social co-operation implications of the different cognitive styles preferred by literacy failing students.

Whilst it may be agreed by everyone that such a basic teacher-training programme is necessary, in no sense is this paper intended as part of an essential initial training for teachers. Those seeking such a programmed will find it in Dyslexia International's course, Basics for teachers: Dyslexia - How to identify it and what to do, directed by Dr. Vincent Goetry, the applicability of which goes much beyond the confines of dyslexia. This programme is offered as an Open Educational Resource and anybody, anywhere, can access it. However, Dyslexia International also encourages ministerial or educational authority commitment so that the course is more than an adjunct – and it forms part of essential pre- and in-service training programmes.

This paper seeks to challenge the relevance of the current ‘reading difficulty’ paradigm which determines the understanding of the interrelationships between the major causes of illiteracy, language disadvantage and dyslexia. It seeks to acquaint teachers who know something of literacy failure, dyslexia and the relevant assessment, literacy and cognitive skills teaching methods with further details which go beyond what would be included in a basic training programme. The focus is not directed narrowly to the identification and amelioration of the particular complexities of phonological dyslexia in English, which some practitioners consider has received more than appropriate attention. But is more widely directed towards understanding and providing for the commonalities of the hereditary, environmental and pedagogic factors contributing to the developing science of illiteracy across the major world languages.

The intention is to provide a wider, more inclusive model of the close causal inter-relationship between language disadvantage, dyslexia and the resulting literacy failure. In the light shed by recent relevant research, questions arising from personal
observation and experience will be posed for others to consider, follow up, and perhaps, after further research and discussion, find more definitive answers.

This more constructive perspective on long-term illiteracy is supported by current developments in the field of neuroplasticity. The former position held by neurologist throughout the 20th century was that after puberty, the architecture, structure and neural linkages of the brain were relatively immutable. This implied that for older students and adults, teaching was much less beneficial, and resulting improvements in adult literacy and cognition were limited. This negative perspective has been superseded by recent research establishing that through experience (appropriate teaching) the brain’s physical structure (anatomy) and functional organization (physiology) may be changed. In the right educational circumstances, even in adults, the brain can and does change, leading to more effective literacy learning, improved cognition and environmental problem solving.

Based upon this more constructive and dynamic paradigm, the aim of this paper is to empower teachers, so that with improved understanding of the different learning styles that illiterate students bring to the acquisition of language, literacy and the curriculum, teachers can enable students with these difficulties not only to acquire more appropriate standards in literacy, but also to widen, improve and more effectively coordinate their cognitive competences.

Conclusion

The clear intention must be to address the challenge I first posed to teachers some 30 years ago: ‘if these children fail to learn the way you teach, can you teach them the way they learn, and can you then go on to develop their learning as well as their literacy skills?’ It is vital that literacy-failing students learn how to learn, so that with meaningful, relevant, mediated, teaching/learning experience, they can monitor, control and eventually direct not just their own literacy development, but their wider learning and problem-solving across the curriculum and in their working life, so that they do not become the next generation of socially immobile, deprived, disadvantaged and embittered world citizens, further inflating UNESCO’s total of a billion illiterate. That is the ultimate intention of this paper. Those who seek further detail should look at the wider development of these ideas in Chasty (2014 Enduring World Illiteracy: Breaking the cycle of failure).

The author

Dr. Harry Chasty was a teacher and principal teacher of a local education authority primary school in a deprived area in Ireland where reading difficulties were prevalent.

He won a research fellowship in the Department of Psychology at Queen’s University, Belfast, UK, where he explored and documented the relationship between the young child’s neurological development, genetically-determined preferences in visual/verbal problem-solving and subsequent development of speech skills, leading to consequent strengths and weaknesses in the acquisition of literacy and verbal thinking.
In 1978, he was appointed Professional Director of the Dyslexia Institute, UK, where he developed its national teaching, teacher training and psychological assessment facilities.

He was Chair of the British Dyslexia Association’s International Conference Committee, a founder member of the Council for the Registration of Schools Teaching Dyslexic Children, and was also consultant Psychologist to several major independent schools, carrying out all the psychological assessments, training the teachers, advising on the teaching programmes, and monitoring and reporting on student progress for parents and the school.

He has wide experience in education across Europe and is currently a member of the Scientific Advisory Panel of Dyslexia International, Brussels, a non-governmental partner organization in consultative status with UNESCO.

More recently, at the World Dyslexia Forum at UNESCO, Paris, 2010, he participated in the session devoted to ‘Good practice in teaching dyslexic students across all languages’.

CITATIONS


‘Ritchie S.J. and Bates T.C. (2013)’Enduring links from childhood mathematics and reading achievement to adult socioeconomic status’, Psychological Sciences, 0956797612466268


UNICEF (1999) The state of the world’s children


Glossary and explanation of the key concepts used in this paper

It is anticipated that there will be differences between the particular meanings attached to technical terms, when used by teachers, psychologists and educational
administrators. This can result in controversy and conflict which impedes the understanding of the ideas being put forward. The definitions, descriptions and explanations given below will clarify how the author uses a particular term. It is appreciated that others may use it differently.

AKS SPEECH STRUCTURE

When a young child is learning to speak, he/she listens to the available speech sounds from the language heard in his/her environment, and focuses upon them so that he/she can store, retrieve, organize, and manipulate them in rudimentary phonological memory. He/she then learns to apply his developing motor memory and movement skills to move muscles controlling the jaw, tongue, lips and teeth to make these sounds repetitively, and links his/her meaning to the sound and motor movement pattern he/she has developed, and stored in his/her growing memory system. With the help of parents, carers, and teachers he/she refines these skills to build the essential Auditory – Kinaesthetic – Semantic (AKS) framework for speech which enables him/her to listen to speech, derive, sequence, structure and make sense of the sounds he/she hears, interpret the meaning, and in response, express his/her ideas through moving muscles to make sounds in spoken words. This AKS framework is a key procedure in representing incoming information, preparing it for storage in long-term memory, and managing the expression of meaning to others. It also provides a necessary foundation to working memory, compacting and minimizing the memory loading of the contained three-dimensional information and skills so that speech processing is more economically managed in working memory. This strategy for the reduction of the load placed upon working memory by this three dimensional material, is the essential foundation to all the child’s later learning in the phonology, speech, literacy and verbal thinking hierarchical skills continuum.

‘DYSLECTIA CONSILIA’

If we follow the developmental continuum of reading from its earliest foundation stage in the infant, through to the final stage in teenagers and adults, the schema progression increases in complexity, with each successive stage being linked, and giving access to the next stage in this verbal skills progression. This skills continuum starts in the very young infant with phoneme identification, where the child learns to listen to, segregate and identify the particular phonemes used in the language found in his/her background. This leads into phonological awareness, where the learner has the ability to tune into, identify, sequence,
manipulate and recall the sounds required to interpret his/her orthographic system. This gives the ability to identify words in the process of word recognition. In the next stage, the recognized words are formed into a meaningful unit and the learner derives the implicit sense of that section of text, in reading comprehension. With lengthy practice these skills across the Visual, Auditory, Kinaesthetic, and Semantic (VAKS) dimensions become smoother, more closely integrated, and more automatic, with the learner developing reading fluency. But that is not the end of reading development. In the final stage of this skills development continuum, the student will have available a range of word recognition strategies, and another range of reading comprehension strategies, which may be used across the variety of purposes for reading. Some of these purposes are simple, and do not tax the student’s reading skills heavily, but others are complex and tax the reading skills to an extreme level. When reading skills are severely stressed, (which happens at a low level of complexity for reading failing students, but at a very much higher level of complexity for competent readers,) it is essential that the reader selects the most suitable reading strategy (or strategies) from the available repertoire. The failure to make this selection leads to extremely inefficient reading, as described by Perry (1959), in Students’ use and misuse of reading Skills. This break-down in command and control of reading skills has been labelled ‘dyslectia consilia’ by Chasty (2014), and is the final effect in the range of language learning difficulties that reading failing students experience.

**EPIGENETICS** is the study of the layer of chemical switches and signals that activate, stimulate, limit, or shut down the actions of our genes without affecting the underlying familial genetic code. In 2012, genetic research established that major environmental factors may interact with the learner’s DNA, placing ‘molecular markers’ determining which genes from the family genome are switched on and which are switched off, thus establishing key aspects of the individual’s learning and behaviour. In this paper we are particularly interested in how epigenetics affect the actions of genes determining neurological architecture, neuronal linkages and working memory development, which can lead to language and literacy failure. The hypothesis is advanced that significant coercive environmental effects that make strong demands for right hemisphere skills may result in acquired epigenetic changes affecting the child’s early neurological development and later cognitive skills development, to produce the required and environmentally valued visuo-spatial skills, but this development also leads to illiteracy. This environmentally acquired neurological structure is passed on to subsequent generations of that family resulting in ongoing genetically determined literacy failure or dyslexia.
this term was originally used and defined in population genetics, where founder effect is the loss in genetic variation that occurs when a new population is established by a very small number of isolated individuals offering only a limited gene pool. More recently this term has been adapted and used to describe the significant phoneme reduction found in languages spoken by very small tribes, as they migrated out of Central Africa to populate the wider world, eventually reaching Northern Europe, remote South America, and South Pacific Polynesia. Analysis of the older Central African languages which have had much longer time to evolve undisturbed, shows that they use as many as 140+ phonemes, while more recently developed languages, at the end of the postulated migratory track, such as those found in remote South America and South Pacific Polynesia, use only 11 phonemes. It has been suggested that repeated ‘founder effects’ experienced by the migrating tribes resulted in these substantial differences in the observed level of language phoneme usage. In languages having significantly fewer phonemes, the much more complex structure required to express the spoken language sounds by printed symbols leads to a very complex and opaque phonological structure. In such languages, this results in much more frequent early word recognition and literacy learning difficulties. Some researchers have suggested that over a very long time scale, languages evolve to use many more phonemes, and so develop simpler grapheme-phoneme correspondence, resulting in more transparent underlying phonological structures, thus becoming easier for learners to read.

results from an environment that makes strong demands for right hemisphere dominant visuo-spatial processing leading to a degree of ambidexterity or left-handedness, within a depriving language background. This fails to provide the child with the operating genes, learning experiences, cognitive skills and adult mediation necessary to facilitate his/her development of left hemisphere specialism, and subsequent appreciation of the interrelationship of the sounds of his/her language. This leads to weakness in the development of phonological short-term memory, phonology, vocabulary, syntax and semantic understanding, so resulting in difficulty in establishing the AKS linkages required for effective speech. Literacy difficulties follow as a consequence or effect of these environmentally determined learning circumstances.
There are very wide variations in phonological complexity across the language systems used worldwide. The observations of Frost et al (1987) and Seymour et al (2003) have highlighted the differences in levels of difficulty in the early acquisition of word recognition skills across European languages. It is therefore easier to read words in some languages rather than others. For this reason, reading development comparisons between nations and between individual students should not be defined by the ability to recognize and say the names of words as represented by the language’s printed symbols. Comparisons based solely upon word recognition skills will not accurately reflect the contrasts in individual or international literacy acquisition being studied. In the Rose Review of the Teaching of Early Reading (2005), the point is strongly made that reading is not just recognizing and naming word shapes, “It is an obvious truth that the goal of reading is comprehension”. In the USA reading practitioners have long questioned the relevance of word recognition as an indication of ‘literacy development’. The Education Commission of the USA in (ED 133 704) declared the term ‘functional literacy’, as used to describe a basically adequate standard of literacy, was an abstract term without standards, and could have almost any meaning. Sylvia Read Taber (1987) referred to the Education Commission’s conclusions in some detail and stressed that ‘literacy’ should not be regarded as a minimally effective (word recognition) competence, but should be defined as “requiring not only the ability to decipher a simple written passage …but also the ability to interpret such written passages inferentially as well as literally’. In this paper, illiteracy is therefore defined as an absence of the ability to gain meaning from the recognition and interpretation of a basic 5-6 year age-appropriate sample of the written or printed orthography of the reader’s spoken language.

PARADIGM is a model of developed thought patterns composed of distinct concepts, leading to definitions and practices that relate, at a particular period of time, to a scientific discipline, such as the study of dyslexia. The paradigm or model determines the accepted body of knowledge at that stage in the development of the theme, the questions to be asked, the investigations to be set up, how they should be constructed, how the results should be interpreted, and the answers to be given. This process is constructive and helpful when working and thinking along the dimensions conforming to the paradigm. But is particularly limiting in that it leads to the non-acceptance and inevitable rejection of thinking outside the paradigm ‘box’. Hypotheses, experiments and results that do not conform to the rules and
dimensions of the paradigm in vogue are inevitably found to be unacceptable by the paradigm advocates for a range of reasons. A further limitation that is obvious from a careful study of the relevant literature is that key researchers working at the periphery of the paradigm may hesitate to express views that are contradictory to the paradigm because this may result in them losing their credibility, professional status and position within the established network hierarchy. In seeking to implement progression and change in the underlying psychological theory and literacy teaching procedures, a degree of iconoclasm is inevitable, which may have unacceptable implications for leading establishment academics. It will be necessary to question the relevance, effectiveness and appropriateness across the world of the teaching approaches derived under the existing paradigm and offer a viable more practical alternative that leads to demonstrably more effective and individually appropriate teaching.

PHONEME

is the smallest linguistic unit that may bring about change of meaning in a language. Phonemes are considered to be the basis for alphabetic writing systems, where the spoken sounds of the language must be represented by graphemes in writing or printing. In reading, the first skill to be mastered is recognizing a sequence of graphemes and linking these in the same sequence to the represented language phonemes. In many languages this is far from a simple one-to-one process. The correspondence between the spoken unit of sound and its written counterpart may be simple, or very obscure, and at the extreme obscure end of that dimension, greatly increased incidence of word recognition difficulties will be observed in the user population. So the evolving number of phonemes in a language and the underlying structure for representing these phonemes in print is critical in determining the ease / difficulty of literacy acquisition in that language. The International Phonetic Alphabet (2008) suggests that a total of 163 phonemes are used across languages worldwide. However, there is a great variation across world languages in the number of phonemes each actually uses. There is evidence that the oldest languages which have had the longest time to evolve undisturbed use most phonemes, while the more recent languages which have had the shortest time to evolve undisturbed use significantly fewer phonemes. Khoi-san, a very old Central African language, uses 140 phonemes, while Polynesian, a comparatively recent language, uses only 11. These variations in phoneme diversity seem to have little effect upon the use of the language for its primary purpose of communicating meaning through speaking, but may have much more significant effects when the language and its users apply its printed or written form for the long-term recording of information, and reading, spelling and writing become necessary. In some languages, where many phonemes
are used, one phoneme may have a relatively simple place in the sound structure of the language and may always be represented by the same graphical symbol in print. This simple phoneme usage and representation system generally found in languages with high phoneme diversity is easier to read, write and spell. Some researchers have concluded that languages evolve to become increasingly 'learnable' for speaking and reading. While higher phonemic diversity resulting from a long evolutionary period seems to broadly indicate the level of simplicity for learning to read that language, the number of phonemes used in a language should not be taken to determine its level of literacy difficulty precisely and accurately. Modern European languages have evolved for a comparatively short time, and range in phoneme usage from only 24 in Spanish, through English at 40 +, to 49 in Italian. Within the context of phoneme usage across world languages (11 – 140 +) this is not a particularly wide variation, yet these European languages show marked differences in ease/difficulty for reading and spelling. It is the complexity of the underlying rules determining phoneme usage and representation, rather than the actual number of phonemes used in the language, which most accurately indicates its level of difficulty for reading, writing and spelling.

**PHONEME INVENTORY**

is the total number of perceptually distinct units of sound used in a particular language. Through the evolution of language this has been predicted to increase (see Nettle, 1999 and Wintz, 2010) leading to shorter words, reduced inflectional morphology, increased transparency between word forms and meanings, so resulting in improved learnability for speaking, reading, writing and thinking with the language.

**PHONEMIC DIVERSITY**

is the variation in the number of perceptually distinct units of sound, consonants, vowels and tones observed across world languages

**PHONOLOGICAL AWARENESS**

is the learner’s ability to tune into, remember and manipulate the sound system of the language independently of meaning. In language learning, it is a further developmental step above hearing, auditory acuity, and being able to say sounds. Sound storage, recall and management systems are an essential part
of phonological awareness. There is some evidence that this is a genetically determined skill. (See Gluttorm et al, 2006)

**STRUCTURED MULTI-SENSORY PROGRAMMES**

The term ‘structured’ means that the sounds of the language being learned will be taught to the student in their order of importance and frequency of usage within that particular language structure. It cannot be assumed that this phoneme frequency order is the same for all world orthographies, and local experts ‘translating’ a programmed originating in English into their local language must be aware of the implications of inter-language differences in phoneme usage frequencies for the new letter order they must construct. The underlying psychological approach to learning to read, write and spell a language must take account of the four essential perceptual elements, visual, auditory, kinaesthetic, and semantic, inherent in the orthography of the printed language. A language phoneme is represented (more or less regularly, depending upon whether the language is at the transparent or opaque end of the phonology dimension) by a printed symbol. Through accurate motor movements by the learner the depicted sound can be said or written. When linked and sequenced with other sounds, this ongoing process gives access to meaning. The initial problem for learners is that printed shapes in the orthography have to be recognized as the sounds they stand for. This requires the transfer of information received and perceived in the visual modality from that input register into the auditory modality to find and say the appropriate sound. This cross-modal recognition process is a vital pre-reading skill, which must be taught to all 3 to 4-year-old infants in the nursery education stage, because ongoing cross-modal transfer difficulties will inevitably lead to later reading/literacy failure. Students with (i) phonological short-term memory weakness find the process of linking letter-word shapes with sounds to be difficult, and show consequent weakness in phonological awareness and word recognition skills. Other students with (ii) visual or (iii) motor short-term memory weakness will have difficulty in cross-modally linking the shape seen with its motor movement pattern for spelling and writing, or the motor movement pattern for writing with the semantic – meaning element, giving rise to difficulties in the written expression of ideas. The cross-modal transfer difficulties listed at (i), (ii) and (ii) will lead to failure in literacy acquisition at (i) the earliest stages of literacy skill development in word recognition; (ii) later stages of literacy development in reading fluency and comprehension; and (iii) still later stages of literacy development in comprehension and the written expression of ideas. The literacy failing student’s
difficulties may be summarized as being recognizing, linking, and using these visual, auditory, kinaesthetic and semantic aspects of the orthography as an integrated automatically controlled unit giving immediate access to all aspects of the stimulus/idea, to say the depicted words and extract and store the meaning in working memory and later recall it and use it in the written expression of ideas. Unfortunately, it seems to observers across the world, that psychological /reading research has focused, (some would say too narrowly, and others would say too long, at 40 + years) upon cross-modal transfer difficulties at stage 1 of the reading development process and not given appropriate consideration to stage (ii) and stage (iii) difficulties, which seem to have been excluded from that paradigm. This has resulted in the questionable proposition that has gained prestige support, that ‘all reading failing students need phonics-based reading tuition’. The great advantage of multisensory teaching is that the programme does not assume that students can manipulate cross-modal linkages, but sets about building these sound by sound. Using ‘reading pack’ (letter shape – sound) and ‘spelling pack’ (sound – motor pattern for writing) cards in very frequently practiced drills, the teaching programme directly links these modalities, providing the learner in a step-by-step fashion with the evolving cross-modal V-A-K-S language structure he/she has been unable to build for himself/herself, from the language experience available to him/her. Clearly using a multisensory language programme will enable a literacy failing student to by-pass his/her cross-modal transfer problems and eventually develop competent literacy skills, but this will require hard work and application from both student and special teacher. But, this will not ameliorate the learner’s original deficiencies in short-term memory skills, nor will it facilitate cross-modal memory transfer required for the skilled and effective use of working memory in problem solving across the curriculum. I strongly believe that these essential cognitive skills must be developed as part of the multi-sensory teaching procedure using that structure as a peg to develop metacognitive control over the multi-sensory techniques required in cognition as well as literacy development.

**VAKS**

There are three major senses used in learning: visual, through the eyes, auditory through the ears, and kinaesthetic through touch- feeling- motor movement. These three aspects should be linked by teacher, and later by the learner to give direct access to the semantic (meaning) aspects of the stimulus. In maximizing the learner’s skill in recognizing and recalling the stimulus, and minimizing its load upon working memory, it is important simultaneously to use all four of these VAKS modalities. In learning to read, teacher builds upon the AKS structure the learner has already established for speech. For reading, the orthographic stimulus, (letter, syllable, or word)
should be presented visually, auditorally and kinaesthetically, and the implicit semantic-meaning element should be stressed. Teaching based upon these principles is usually referred to as multi-sensory or multimodal.