

Psychological and Educational Aspects of Specific Learning Disabilities

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Abstract

This paper discusses a two-stage model of more generalised assessment followed by fine-grained diagnoses of children with specific learning/reading disabilities. Two clinical cases with severe language/reading impairment, one in English and one in Chinese, are outlined. The related issues of using a discrepancy approach and the role of "intelligence" in diagnosis are examined. The neuropsychological aspects of dyslexia in Chinese are delineated. Multi-disciplinary cooperation is needed in helping children with specific learning disabilities.

Key words

Developmental dyslexia; Diagnosis; Two-stage modal; Role of intelligence; Reading/spelling disorders in Chinese

Introduction

I will discuss some general principles and specific examples of diagnosis of specific learning disabilities and to link them to Chinese children in Hong Kong. Under the broad umbrella condition of learning disabilities, estimated to occur in some 15% of the school population, there are those children with **specific learning disabilities** or severe disorders in reading, spelling and composing, and in mathematics. My estimate is that at least something like 3% to 5% of our students may be so classified. These disorders may persist to adulthood and require early diagnosis and systematic, sustained treatment in great measure, in good time and in great intensity. The core deficit in the literacy domain is in the language area, and, in particular, in phonological processing linking symbols to speech sound, at least in alphabetic language systems.

Studies on the cross-linguistic aspects of learning to read and spell, including Chinese and Japanese,¹⁻² have shown that there are processing mechanisms common to both the alphabetic English and the morphosyllabic

Chinese writing systems. There are of course elements specific to each language system. In the diagnostic process there are common principles applicable to Caucasian children and to Chinese children learning to read, to spell and to compose. There are common factors that may explain why some children fail to do so despite so-called normal intelligence, intact home background, competent teaching and generally fairly favourable environmental conditions. We thus need to know the **why** of the failure in specific reading disabilities and the **how** in working with the children so affected.

Assessment and Diagnosis

We have come a long way in assessment and diagnosis. I recall one of the twelve scenes in a large stained glass at the Mayo Foundation House at the Mayo Clinic depicting a page boy in a medieval physician's office presenting a bottle of urine to the "urine caster". The explanatory text goes on to say that "according to the belief of the time", the caster "could tell the patient's disease or diseases by the color of the specimen". In modern diagnosis we now have classification schemes such as DSM-IV by the American Psychiatric Association³ and the earlier DSM-III or DSM-III-R, and the ICD-10 by the World Health Organisation.⁴ While these atheoretical diagnostic scales of DSM-IV and ICD-10 are not immune from controversy, the classification schemes have led to some healthy debate of developmental disorders of psychological functions.⁵

Assessment in the present context refers to the more global mapping of the strengths and weaknesses in

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reading, spelling and composing. Diagnosis refers to the fine-grained delineation of the condition and the profile of the child for effective instruction. Both generalised assessment and specific diagnosis are needed. Assessment can be performed by competent teachers prepared in special education and is based on the cumulative reading, spelling and writing of the children. Diagnosis should be done by clinicians trained in psychology, the neurosciences and/or speech/language pathology. Classroom teachers, psychologists and speech/language pathologists and allied health professionals should work together and consult with parents to map out effective instructional programmes appropriate for each child.

Elsewhere,⁶ I have discussed in detail this **two-stage process** of assessment using classroom teachers, followed by diagnosis using clinicians. The aim is to increase the **precision and specificity** of the classification of specific developmental disorders such as developmental dyslexia. This concept of increasing precision by maximising the "hits" and by minimising the "misses" is shown in Figure 1.

		STATISTICAL PREDICTION (Assessment and Diagnostic Tests)	
		Positive +	Negative -
ACTUALITY	Positive +	Diagnosed AND Actually Disabled HIT	NOT Diagnosed but ACTUALLY Disabled FALSE NEGATIVE (MISS)
	Negative -	Diagnosed but NOT ACTUALLY Disabled FALSE POSITIVE (FALSE ALARM)	NOT Diagnosed and NOT Actually Disabled CORRECT REJECTION

Figure 1 Schematic of statistical and actuality in assessment (After Leong, 1987).⁶

I would like to think that the same general principle of using teachers' cumulative assessment to arrive at a broad estimate of the number and the actual children to be diagnosed in greater depth by clinicians should apply equally well to Hong Kong. Teachers after parents are the ones who know the children best. This first-level assessment can be reasonably accurate and can capitalise on the time and specialised training of clinicians. Teachers could use classroom assignments, individual and group works assembled over a period of time for this stage 1 work. Clinicians can use standardised tests and diagnostic instruments to pinpoint specific weaknesses for effective instruction. Both groups working together should increase

the specificity and the sensitivity of the whole diagnostic process.

Accounting for the Condition or the Phenomenon

This question is sometimes asked: "What if Hong Kong does not even have all the diagnostic tools for effective and efficient diagnosis?" My plea is that we should not let this paucity of standardised instruments hamper our work. There is no need to wait for ALL the assessment and the diagnostic tools to be assembled before we do further work. There are children to be served and parents to be advised and we must help them without delay. Nor should we expend more energy and time to debate so-called controversial issues. While there have been many enlightened policy decisions on specific learning disabilities in particular and special education in general, there are also "disputable" issues according to the late Cruickshank,⁷ the doyen of special education and the Founding President of the International Academy for Research in Learning Disabilities (IARLD). One of these "disputable" decisions, according to Cruickshank, is the appointment of people without advanced training in special education to leadership positions in school boards or divisions.

The other question relates to a more precise definition of specific reading or learning disabilities for Hong Kong. I gather progress is made and there is some consensus among allied professions. The philosopher Sir Karl Popper⁸ said it well when he argued that definitions should be read from right to left. In other words, we should pay attention to the condition with the presenting symptoms, and keep refining an acceptable operational definition. This was how Alfred Binet⁹ devised his intelligence scale at the turn of the century, even though he did not have a clear idea or a working definition of what "intelligence" was. Building on the early Binet concept of intelligence as an omnibus general ability, we now have much firmer theoretical grounding, whether we subscribe to the triarchic theory of Robert Sternberg¹⁰ of Yale University, or to the belief system of multiple intelligences of Howard Gardner¹¹ of Harvard University, or to the concept of rationality of Jonathan Baron¹² of the University of Pennsylvania.

For specific reading disabilities, the condition is one of severe impairment in reading, spelling and composing and one that persists to adulthood.¹³⁻¹⁵ These impaired psychological functions follow a developmental course; they have a genetic origin¹⁶ and a neurological basis.¹⁷ They are "modular" and quite impenetrable against a background of adequate and even above average general

intellectual functioning. The developmental aspect is important because the manifestations may change somewhat with age. In the case of developmental dyslexia with Caucasian children, it has been well documented that mapping the sound of heard words to the printed symbols, segmenting speech sounds into phonemes (phonological processing) are important in acquiring the written language with young children. With older children sensitivity to the internal structure of words (morphological processing) and understanding of these internal structures are important for the productive aspect of word knowledge and also word order and meaning.

Two Clinical Cases

An example of a 13-year old Caucasian child with severe written expression problems in word formation, grammatical and thought process and with well above tested intelligence is shown in Figure 2a.⁶



Figure 2a Drawing and spontaneous writing of a disabled reader (From Leong, 1987).

There is almost a parallel example of the Chinese written composition of a secondary 1 student in Hong Kong, courtesy of Dr. Catherine Lam of Child Assessment Service. While it is clear that this fairly bright student has lots of deficiencies with the writing of Chinese characters and words, there are also other psycholinguistic problems. Note the comments of the teacher: "There are too many errors. If there are words that you don't know, raise your hand and ask the teacher." This banal comment ignores the obvious reality of the same teacher having to work with 30 other secondary students in the same room and

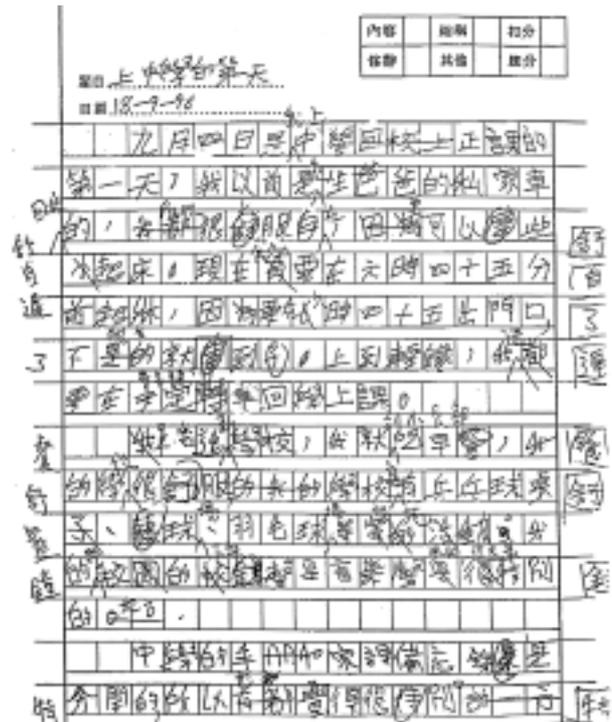


Figure 2b Writing of a Chinese student with specific learning disabilities.

this particular student may get only a couple of minutes. Moreover, the anticipated admonition by the teacher of using the Chinese dictionary overlooks the fact that this latter tool is likely to present many more problems to this learner with reading and severe written language disorder.

What is more serious is the teacher's inability to work with this student, to give him very specific help. This student needs help in segmenting the internal structure of each character, of knowing the role of the meaning and the phonetic radicals, and of the relatedness of similar dictionary or lexical items. He needs to be taught the concepts of text cohesion and coherence. Cohesion refers to the "syntagmatic relations" of text and accounts for the structure of text.¹⁸ These relations are signalled by certain grammatical and lexical features. These features include: anaphoras, inter-sentential connections, contrastives, subordination and other linguistic devices. Coherence refers to the overall "flow" of the text. This particular student is deficient in the use of these linguistic devices, and the teacher does not seem to have the knowledge of the Chinese [or the English] language to be of effective help to the student. Just as important is that this student uses what Bereiter and Scardamalia,¹⁹ two noted cognitive psychologists, term the "knowledge telling" strategy in written composition in simply providing a running commentary of events of the day (the first day in school).

A more able student might have used the "knowledge transforming" strategy¹⁹ to focus on specific episodes of interest.

It should be noted that for both the English and the Chinese clinical protocols, problems in spelling, handwriting and grammatical expression are all grouped together under the categorical classification of Disorders of Written Expression in Axis I of Learning Disorders in the multi-axial DSM-IV.³ The same written language disorder is coded as Specific Developmental Disorders of Scholastic Skills in the multi-axial system of ICD-10.⁴ Difficulties in spelling alone do not warrant the diagnosis; it must be the impairment of written expression.

Two Related Issues - Discrepancy Scores and "IQ" in Diagnosis

The classic Isle of Wight study by Rutter, Tizard and Whitmore²⁰ in showing a "hump" at the low end of the distribution curve in psychiatric disorders has been applied to reading disorders and this distributional aspect is still debated. The bimodal type of frequency distribution of a disorder suggests the existence of a subtype and qualitative differences between this subtype and those at the low end of the continuum. More recently, this "hump" is seen as an artifact. The Dunedin group of Phil Silva found no evidence for this bimodal distribution in a longitudinal study of five- to eleven-year-old Dunedin boys.²¹ Similarly, the Yale and Houston group of Shaywitz, Escobar, Shaywitz, Fletcher, and Makuch²² argued from their longitudinal data of a follow-up study of a cohort of grade 1 through grade 6 children that developmental dyslexia represents the lower end of the continuum of reading scores. The ultimate test for either the bimodal frequency distribution or for the lower end of the normal distribution is to validate externally the diagnostic distinctions and the subtypes. The presence or absence of a "hump" in the distribution of reading disorders is less important because "the shape of the phenotypic distribution does not necessarily dictate the underlying etiological mechanisms".²³

The related issue of the role of "intelligence" in diagnosing children with specific reading disabilities looms large in Hong Kong. This is not a straightforward matter. In the 1989 Special Issue in the **Journal of Learning Disabilities** (Vol. 22(8)) the lead article by Linda Siegel²⁴ on the subject, with open peer commentary by a number of colleagues including myself, addresses this important issue. I will not repeat the arguments here. My view then and now is that there is a role for some measure of general ability as a lower threshold to differentiate specific reading disabilities from mild mental retardation,

but this general ability test may not be the traditional WISC-III, WISC-IV or its progeny.

There is considerable relevance and urgency regarding the use of the WISC-III or WISC-IV here in Hong Kong. The 1996 Hong Kong Board of Education Report of the Subcommittee on Special Education²⁵ calls for updating the Hong Kong version of the WISC and the Raven's Progressive Matrices. While the recommendation is well-meant, I am not in favour of it. My objections, as stated in Leong,²⁶ are that we should start anew and devise what Robert Sternberg¹⁰ terms "non-entrenched" intelligence tests. We should aim at testing novelty, testing "practical intelligence" and the like. We should not cling onto a traditional intelligence test, which still relies in the main on testing for information acquired. Some examples from the WISC are: "What is the distance between City X and City Y?", "What do you mean by ruby?" the answer to which is often given by African Americans as "the name of my sister", which is equally correct. "Who wrote *A Midsummer Night's Dream*?", the answer to which could be Shakespeare or Mendelssohn, although the former is the only correct answer according to the WISC manual. It should be noted that in the well-known *Larry P. vs. Wilson Riles* case in California and the *PASE* (Parents in Action on Special Education) case in the U.S. mid-West, precisely the same kinds of considerations led to the moratorium against the WISC.²⁷ The crux is that if we attempt to measure general ability we should go beyond what the developmental psychologist Margaret Donaldson²⁸ terms going beyond the "embedded" to the "disembedded thought."

To summarise this section, I have argued for a diagnostic framework of a two-stage process of classroom assessment using teachers followed by fine-grained diagnosis using clinicians as equally applicable to Hong Kong and beyond. I have drawn on specific clinical cases, one in English and one in Chinese, to show the importance of understanding the underlying psycholinguistic processes for effective instruction. I have discussed briefly the bimodal frequency distribution and the implications. I have taken a stand against expending time, energy and resources in re-standardizing the WISC, as recommended by the 1996 Hong Kong Special Education Report. We need non-entrenched tests, testing for novelty and are multi-dimensional, rather than uni-dimensional ones such as the Raven's Progressive Matrices. If general ability tests are used at all in the diagnostic process they should simply be one more measure to be taken into account in terms of aptitude and should not be seen as some kind of "gold standard" and this caution applies to the WISC and other standardised instruments. Language processing including reading and its disorders is modular and is reasonably impenetrable by general cognitive ability.

Developmental Dyslexia in Chinese

Recall Sir Karl Popper's⁸ notion that "objective knowledge" should aim at explaining phenomena and not get bogged down with precise definitions and precise tools. In applying this notion to the diagnostic process, we may well ask: "What needs to be done in reading disabilities in Chinese and for Hong Kong children?" In the first part of this paper I have provided a diagnostic framework, which can bypass a well-standardised individual intelligence test. Having stated this, diagnosis should aim at helping the individual learner and the family.

Alfred Binet said it well almost 100 years ago: "After the evil, the remedy" (after the diagnosis there must be treatment). Since specific reading disabilities are of a developmental nature, the diagnostic framework should use appropriate tasks to tap the various levels and components of functioning. By definition, reading disorders occur during school age but there are also clear manifestations before schooling for "at risk" children. Research findings and clinical practices clearly show the increasing importance of early diagnosis and early prevention. In the January, 1999 Hong Kong Education Commission²⁹ document **Aims of Education** there is recognition of "early identification of students with learning difficulties" (p. 24 (iv)). The rhetorical question that follows is redundant and is answered in extant literature. Let me quote: "... do we need to put in place a comprehensive mechanism to assess students' performance at different learning stages, and improve the modes of teaching and learning accordingly?" The short answer is a resounding YES.

The simple answer is that for preschoolers, there should be elements which tap the preschoolers' sensitivity to (not the actual learning of) symbol-sound correspondence or what is known as metalinguistic awareness in learning English. This awareness has been shown to be important precursors in learning to read and spell alphabetic languages. Young children can be prepared and need to be prepared systematically from an early age on to make the link from spoken to written language. And this preparation can take the form of games, songs, dances and other playful activities to make learning fun. The efficacy of such kind of sensitivity to language preparation at a young age has been shown in a prototypic, and now classic, longitudinal study by Lundberg, Frost, and Petersen³⁰ from Scandinavia. For Chinese, phonological processing of a different kind, namely, emphasis on onsets (initials) and rimes (finals) at the character level IS important; and there is also the awareness of the internal structure of characters or morphological decomposition (see Leong, 1997, 1999 for representative work).^{31,40}

At the school age level a diagnostic framework should include sampling of characters, words, sentences in terms of reading, spelling and writing (composing). Working memory, listening to text (auditing) and related tasks should also be included. I will not go into specifics here as they are provided in a detailed chapter on a diagnostic framework.³² For the second part of this paper I want to emphasize some fundamental issues pertaining to the learning of Chinese, which has clear implications for our work as clinicians. In essence, I want to dispel the persistent and mistaken notion that learning Chinese characters is more of a "right hemisphere" activity and is "visual". There is nothing further from the truth. Second, I want to emphasise the importance of character configuration, speech-sound connection and meaning as integrative activities in learning Chinese.

Processing Chinese Characters Subservied by the Left Hemisphere in the Conjoint Working of the Two Hemispheres

Until more recently, there has been the mistaken notion that Chinese characters, being visually complex, are processed by the right hemisphere. The unfortunate consequence of this line of misguided and unfounded thinking is that diagnosis of reading/spelling difficulties in Chinese and for Chinese children in Hong Kong has, as its focus, so-called visual perceptual tasks such as the Bender Gestalt test and some such instruments. There are also colleagues who will latch onto the basic research into fine-grained rapid processing of the magno- and parvo cells in the visual system. Worse, there are also advocates of the Irlen Colour lenses as a "cure" for dyslexia. I have long argued against one-sided notions of the role of so-called visual perception in processing Chinese, which must have affected educational and clinical psychological work in Hong Kong for some time.^{6,31-33} For our purpose, I want to reinforce the notion that processing Chinese is NOT just a visual, perceptual activity; it is a language activity similar to, though not the same as, the processing of an alphabetic language system such as English. I will advance two lines of argument: One neurolinguistic and the other psychological and psycholinguistic.

Studies of Patients with Alexia and Agraphia

Li, Hu, Zhu and Sun³⁴ from Academia Sinica in Beijing provided an insightful analysis of a 56-year old Chinese patient diagnosed with temporo-parietal cortical and subcortical intracerebral haemorrhage. Li et al. found that the written language impairment of this patient with alexia and agraphic was at the lexical level. This impairment was

due to deficiency in linking the configuration, speech-sound and meaning of the characters and words. They further stated that it is clearly the left temporo-parietal area that is involved in the reception and expression of Chinese character shape, sound and meaning and the integrative process. The results of the breakdown of this inter-connections is shown in Figures 3a and 3b. (original Figures 13 & 14 from Li et al.) Figures 3a and 3b show spontaneous writing and there was a 20% errors, while the oral rendition was error-free. It should be noted that the patient's copying (of characters) ability was good and he was able to write correctly Arabic numbers in the correct sequence as heard.

A more recent study with both experimental and controls comes from the work of Professor Ovid Tzeng (personal communication, June, 1998 & May, 1999), who is one of the pioneer cognitive psychologists in bringing to our attention the importance of cognitive processing of Chinese from both the psychological and neurolinguistic perspectives. In his recent study in Taiwan he had six left hemisphere patients with alexia or agraphia, compared with six right hemisphere patients, carefully matched on educational level and socio-economic status. In drawing and figure copying the right hemisphere patients, but not their left hemisphere control patients, all show the well-known left visual field neglect effect. The important finding is that in writing from pictures the left hemisphere patients fail to write the characters, while their right hemisphere controls were able to do so correctly, even though the latter showed the left-field neglect phenomenon.

What is even more significant is the finding that in copying pseudo Chinese characters (those formed according to linguistic principles) and non Chinese characters (those formed against linguistic principles) from the left top-hand corner down, one character and one square at a time, there are some striking results. The right hemisphere patients still show the left visual field neglect in copying the non characters, but they could grasp the internal configuration or the glueing together of the constituent parts of the characters to form a whole. The left hemisphere patients were able to copy the non-characters one at a time from top left to the bottom.

Over-simplifying, the results of Tzeng clearly show that Chinese, like any other language system, is processed in the main in the left hemisphere. In particular, he has also demonstrated the **double dissociation** principle in processing scripts. This phenomenon has been shown in a series of elegant clinical studies by the Japanese neurolinguist Sumiko Sasanuma³⁵ with Japanese patients with acquired dyslexia. Sasanuma clearly demonstrates that there are Japanese brain-damaged patients who show a selective impairment of kana (phonetic scripts) processing, while their kanji (Chinese characters)

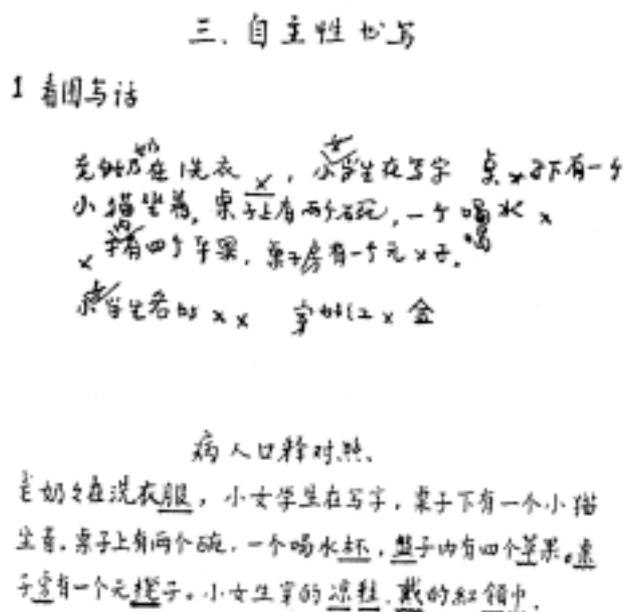


Figure 3a & 3b Written and oral description of picture of a Chinese patient with alexia and agraphia (From Li et al., 1984).

processing is relatively well preserved. She has also found that there are rare Japanese patients who show a selective impairment of kanji processing but with remarkable preservation of kana processing.^{2,35}

Having said the above, I would want to emphasise the different contribution of the right hemisphere in language functions. This is particularly so in the studies of adult illiterates. The weight of evidence for adult illiterates seems to be: "less mature [left hemisphere] dominance, calling for particular perceptual strategies in special circumstances".³⁶ The adult illiterates may be ambilateral with different strategies, but language is still mostly subserved in the left hemisphere. Further, the illiterates may have a lower threshold on the left side and would need to use right hemisphere strategies to access tasks that literates can do using mainly left hemisphere functions.

To summarise this section, I want to lay to rest that Chinese characters are processed by the right hemisphere and that diagnosis of reading disabilities should involve so-called visual perceptual tasks. Neurolinguistic and psychological findings dispel these mistaken notions. Chinese is processed in the left hemisphere in the main like any other language system and neuropsychological and psychological assessment and diagnosis should be grounded on theories linked to this substrate. Some very recent functional magnetic resonance imaging (fMRI) results by Chee, Tan and Thief³⁷ also clarify this notion by showing the activation of common cortical areas in the processing of single words in Chinese and English by fluent bilinguals in these languages.

Principles in Diagnosing Reading/Spelling Disorders in Chinese

Geometric Configuration or GEON of Chinese Characters

Given the neuropsychological underpinning in processing Chinese characters, we should take a componential approach to reading and its disorders in analysing the learning and teaching processes. The components in diagnosis include: the role of the constituent semantic and phonetic radicals in perceiving, pronouncing, and deriving meaning of the characters as a whole, the complexity of the strokes, the comparative influence of radicals and strokes. In short, the salience of different parts of the geometric or "geon" configuration of the characters needs to be analysed and synthesised. This geometric decomposition is shown in Figure 4.

* GEONS * (Geometrical Ions) of Chinese Characters

A	日 (sun) 月 (moon) 雨 (rain)
AB	休 (rest) 好 (good) 暗 (dark)
A, B = A	國 (country) 園 (park)
A B	早 (early) 否 (no) 音 (sound)
ABC	淋 (sprinkle) 謝 (thank) 假 (false)
A BC or AB C	森 (forest) 箱 (box) 染 (dye) 雙 (double)
A ₁ B ₁ or A ₂ B ₂	新 (new) 船 (boat)
A ₁ A ₂ D	慢 (slow)
ABC D	雙 (change)

Figure 4 "Geons" (geometric ions) of Chinese characters (From Leong, 1999).⁴⁰

Tones in Chinese

What the geometric configuration of Chinese characters does not convey are the important autosegmental elements of tones. Tones in Chinese are defined in terms of the rhythmic rise and fall of pitch, or the pitch contour of the voiced part of the character. As examples, the tone for /NIAN/ begins with the voiced /n/, but for the voiceless /p/ in /PIAN/ the tone begins with /i/ or strictly with /ia/. The tones in Chinese convey meaning and should be distinguished from the prosodic elements of stress in English, which add to the emotive aspects of utterances. While tones may pose difficulties to non-Chinese learners of the language, they seem to be acquired fairly early by Chinese children.³⁸ Moreover, there is a universal order of tone acquisition. Tones 1 and 4 seem to be acquired earlier and more easily than the rising and going tones of 2 and 3.³⁹ The other reason for the importance of tones is

that tonal similarity affects short-term memory and reading. From this succinct discussion, it should be clear that any diagnostic aspects of reading and spelling in Chinese should incorporate tonal elements.

Phonological and Orthographic Involvement in Reading Chinese

Contrary to popular wisdom and as discussed earlier, reading Chinese characters is not just a visual process; it involves phonological processes even before meaning is accessed. Elsewhere, I have amassed evidence from linguistics, experimental psychology and Chinese speech errors to show that the phonology is syllabic in nature, is paradigmatic and not segmental, and is analysable into initials (onsets) and finals (rimes).^{31, 40} I will not go into details here except to mention an interesting phenomenon from some very recent studies of "slips of the tongue"⁴¹ phenomenon. From his corpus of 561 Chinese utterances collected from Putonghua speaking normal Chinese adults, using a speech production model of Levelt⁴², Yang⁴³ found a considerable number of errors of anticipation of Chinese syllable onsets and rimes. An example is "kafeihui" (coffee pot) transformed into "kahueihu". The main point is that these slips of the tongue errors are much more phonological than semantic in nature. This line of investigation reinforces the findings of [character] "identification with phonology" by Perfetti and his Pittsburgh colleagues.²

Compositionality of Chinese Characters

With the explanation of the configuration and tone as the background, Figure 5 explains the compositionality of real Chinese characters, pseudo characters and non-characters.⁴⁰ Clarification of these concepts is important in that the small number of studies available on Chinese character processing and diagnosis often makes this distinction, although the precise meaning of these terms is not always clear. Real characters are those found in modern-day Chinese dictionaries and can be differentiated on the basis of sound and tones into regular consistent and regular inconsistent and exception characters. Regular consistent characters are those pronounced the same way as the phonetic radicals and with the same tones. Regular inconsistent characters are those pronounced with the same sound as the phonetic radicals but with different tones. Exception characters are those pronounced with sounds and tones different from the phonetic radicals. Pseudo characters are those with radicals in legal orthographic positions and non-characters are those which violate orthographic and linguistic rules. The characters in the different compositional forms are shown in Figure 5. In

Classification of Chinese Characters	
A. Real Characters 正字	
1) Regular Consistent : Characters pronounced the same way as the phonetic radicals and with the same tones	e.g. 朱 (red) 珠 (pearl) 蛛 (spider) (zhū)
2) Regular Inconsistent : Same sound as the phonetic radicals but with different tones	e.g. 馬 (horse) (mǎ) 罵 (scold) (mà)
3) Exception Characters : Different sound and tone from the phonetic radicals	e.g. 里 (lane) (lǐ) 埋 (bury) (má)
B. Pseudo Characters 假字	Radicals in legal positions; not strictly pronounceable
	e.g. 披 伙
C. Non Characters 非字	Radicals in illegal positions; not strictly pronounceable
	e.g. 台 汗

Figure 5 Classification Chinese characters (From Leong, 1999).⁴⁰

making clear and unambiguous differentiations, items for diagnosis can be designed accordingly.

To summarise this section, researchers and clinicians in designing diagnostic instruments to delineate the processes of reading, spelling and writing in Chinese and their breakdown should base their work on well founded psycholinguistic theories and research findings. These instruments should include tasks that sample phonological components such as paradigmatic syllabic differentiation, tonal differences; morphological components such as stroke and radical awareness and sensitivity; and syntactic aspects such as sentence repetition, sentence coherence and cohesion. In designing character tests aimed at testing reading models, care must be taken to ensure the nature of the different kinds of characters, pseudo and non-characters. Above all, the diagnostic process must be based on a solid framework, which should take into account the developmental stages of the learning process and the level of the learner.

Coda

It is obvious that there are many aspects I have not discussed. Diagnosis is evolving, is dynamic and should focus on this ongoing process rather than just mere scores. Above all, clinicians should always remember that we are working with individuals within a certain socio-cultural milieu. The words of the Scottish poet Robert Burns come to mind: "Whatever mitigates the woes and increases the happiness of others, this is my criterion of goodness; and whatever injures society at large, or any individual in it, this is my measure of iniquity." Many more years earlier, Confucius reminded us that we should teach all individuals

irrespective of their levels or social classes. In this enterprise, we are all one: child neurologists, developmental paediatricians, psychologists, educators, and parents.

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