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Childhood dysgraphia. Part 1. An illustrated clinical classification

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Summary In this paper we propose a clinical neurological classification of childhood dysgraphia (medical model). The subject is introduced by briefly considering the childhood learning disorders as a whole, and subsequently dysgraphia will be considered in particular with description and illustration of the different types. In our second paper we report a detailed neuropsychological study which we made of 66 children with dysgraphia. In view of the differing definitions used between professionals, this first paper is an attempt to define the terms used in our classification so that subsequent statistical analysis of individual factors in aetiology and neurology can be interpreted.

The brain is the organ of learning and it is a developing organ throughout childhood. It can be considered as being made up of modules (Eccles 1979) which contain a preprogrammed strategy for learning particular skills. Many factors influence the speed at which the child progresses through these strategies, e.g. sex of the child, percentile rank, genetic/familial disorders, acquired brain damage, and environmental factors (Brown 1981). Therefore, a behaviour is the final common pathway by which the learning is expressed and depends upon an intact learning strategy in the brain along with adequate environmental experience and practice. Studying the behaviour alone allows one to determine if the child has significant delay in a particular area of learning but it does not necessarily determine the aetiology; i.e. the child's actual difficulties in speech, reading, writing or drawing are not in any way specific to the cause or prognosis.

'Significant' delay leading to a diagnosis of a learning disorder is arbitrarily designated as being when the child performs two standard deviations below the mean for his age, or alternatively shows a 2-year

delay in the acquisition of a skill compared to standardized tests. If the learning disorder is specific (Table 1) then the child must have preservation of normal development in other brain modalities (Brown 1981). A specific disorder may be isolated or multiple. Alternatively, if cognitive development is delayed overall, the child will have a global learning disorder, i.e. mental handicap.

TABLE 1. Specific learning disorders

1.	Central deafness
2.	Receptive aphasia
3.	Expressive aphasia
4.	Articulatory dyspraxia
5.	Dyslexia
6.	Dysgraphia
7.	Dyscalculia
8.	Dysmusia
9.	Dysprosodia
10.	Manual dyspraxia
11.	Postural dyspraxia
12.	Visual agnosia

Dysgraphia is retarded development or an acquired loss in the skill of writing. This difficulty may be subdivided into three groups: (1) abnormalities in motor learning and execution, i.e. penmanship; (2) difficulties with the syntactical aspects of written language, i.e. spelling, sentence construction (grammar) and punctuation; and (3) abnormal content of what is written, i.e. semantic aspects of dysgraphia. The latter is often not specific as the dysgraphia is then secondary to a disorder of inner language. This may itself be specific, i.e. a dysphasia, or be part of a more global cognitive learning disorder, i.e. mental handicap (Figure 1). Thus the time-honoured division of writing skills into penmanship, spelling and composition still holds good.

Ontogenically, writing is the last language skill to develop in the child (comprehension, speech, reading and writing) and is, therefore, the abnormality which is likely to persist the longest in disorders of language development, or be lost most easily in acquired brain disease (Mykelburst 1973). The child who has brain damage acquired after the development of speech, reading and writing may show a

persisting disorder of writing even after there has been an otherwise good recovery (Haecen 1976). A dysgraphia is also the disability most likely to persist into secondary school in the child with developmental slow speech followed by dyslexia and dysgraphia, defined as the 'word blind aphasia syndrome' by Machmechen (1942), or 'specific developmental speech retardation syndrome' by Ingram (1963).

Although dysgraphia is a common problem, the incidence is difficult to establish. The definition and detection presents the same difficulties as those which have occurred when agreeing to a definition of dyslexia. Since the two often co-exist (multiple specific learning difficulty) there is a tendency still to call a child dyslexic when his speech and reading skills have improved and he remains with a dysgraphia as his main disability. Benton (1975) has estimated 3–4% of the childhood population as suffering from dyslexia/dysgraphia, i.e. one child in every class of 30 children. Any developmental milestone or skill will show a normal population distribution so that 3% of children will be very slow, i.e. below the third centile, and 10% slow, so figures for the number of slow learning children in either speech, reading or writing must be examined against this background. Three per cent of the population will be mentally retarded (subcultural mental retardation) and will be slow in language skills as part of a global cognitive delay. There will in addition be a group of children who suffer from a developmental 'disease' rather than a slowing up of normal development. In these children there is no catch up before full brain maturity and cessation of brain development and they are left with disabilities continuing into adult life. This latter group are often genetically determined or are related to disorders of the sex chromosomes (Ratcliffe 1982).

The diagnosis may also be masked by the secondary behavioural abnormalities due to the frustration and anxiety of chronic failure. A short attention span, distractibility, poor concentration on teaching materials, migraine, school phobia, and acting out behaviour may all mask the true diagnosis (McKinlay 1978). The loss of attention is selective and the child will concentrate during testing conditions for long periods of time whilst succeeding, and for seconds when material is presented which the child knows will cause failure.

Although dysgraphia has not commanded the same attention in the literature as dyslexia, there have been previous suggested classifications (Gaddes 1985), in which writing disorders have been separated from those with an aphasic basis, auditory or visual perceptual basis or

a motor disability. Within the dysphasic category it has been spelling which has attracted most interest (Nelson & Warrington 1976, Lansdown 1976, Kinsbourne & Warrington 1964, Frith 1978).

In this study we propose a clinical approach (medical model) for the diagnosis of childhood dysgraphia and illustrate the different types of disorder.

DEFINITION OF GROUPS

Figure 1 shows a flow diagram of the three main categories of dysgraphia. Motor disorders affecting writing (penmanship) are further divided into several subgroups: (1) anatomical, (2) visual-spatial, (3) co-ordination (executive) and (4) dyspraxic (motor planning). The criteria for these different groupings will now be defined.

Motor dysgraphia: (a) anatomical

Children who have an anatomical defect of the upper limb such as phocomelia, will often devise alternative ways of bypassing the difficulty, e.g. by using the feet. A pincer grip with very accurate praxic skills, e.g. writing, or threading a needle, is perfectly possible using the feet provided that there is no brain damage. This was seen at its most impressive in children with phocomelia from thalidomide

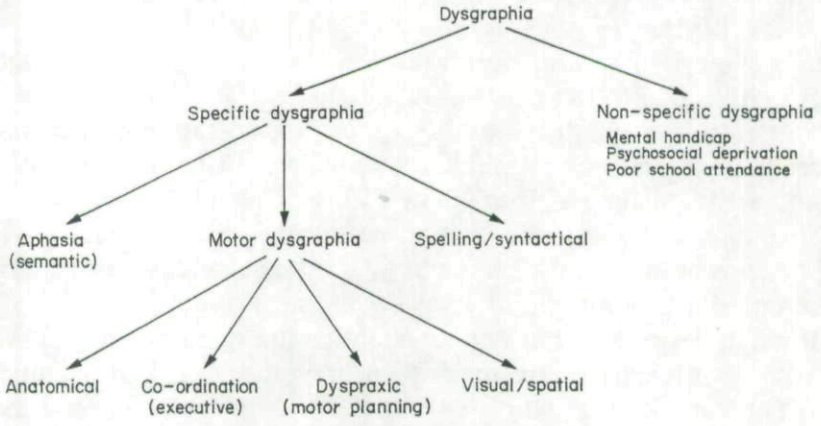


FIGURE 1. Classification of dysgraphia.

embryopathy when the toes were far more efficient than the most sophisticated arm prosthesis (Figure 2). Trick movements can be used so children with lower motor neurone lesions such as brachial plexis palsies, or neurogenic arthrygryposis can develop impressive skills provided that the motor engram (praxis) in the brain, i.e. the ability to plan and remember the movement, is intact. Any trick movement which allows the child to hold a pen will often demonstrate surprisingly little impairment of spelling or syntax although writing may be large and untidy depending upon the mechanical disadvantage in getting positioned over the paper.

Motor dysgraphia: (b) visual-perceptual/visuospatial

Perception is the conscious awareness of input to the brain from the five senses (smell, touch, taste, vision and hearing) and also the appreciation of limb position through proprioception, movement through kinaesthetic sense and the awareness of pain and temperature. Several of these perceptual inputs are vital to writing compe-

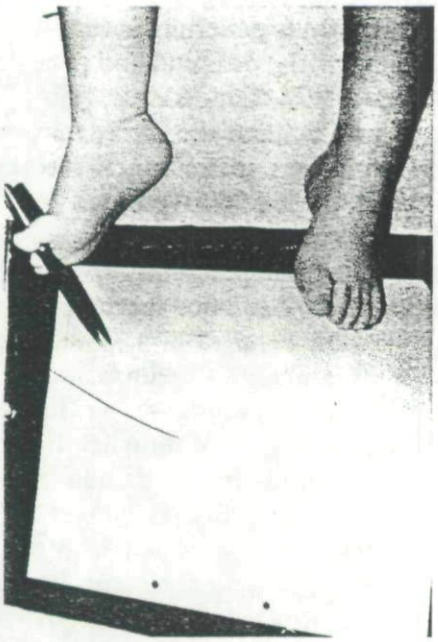


FIGURE 2. Executive dysgraphia: anatomical.

tence, such as hearing for the development of inner language and comprehension as well as establishing a word store or lexicon. Vision is necessary to see the letters and words in order to read and copy as well as orientation upon the page. The motor skill at first depends upon visual monitoring but once the task is learned the movement is stored as a movement memory, i.e. kinaesthetic memory. This is then very dependent on proprioceptive feedback, not from position and vibration sense as usually measured but from muscle spindles and tendon organs which do not normally reach conscious awareness.

Although visual perceptual difficulties are an uncommon cause of childhood dysgraphia, visual acuity should always be tested. Although gross refractive errors are often manifested by a squint this is not always the case and severe myopia can be missed up until school age (Stewart-Brown *et al.* 1985). Onset of visual impairment may present as school failure and Figure 3 illustrates the effects on writing of the inability to focus as a result of intraocular myasthenia.

There are several types of visual agnosia, e.g. the inability to recognize shapes, objects, faces, places, geometrical shapes, musical notation and letters. These can be lost in isolation or in different combinations. (Foley 1987). The ability to recognize faces, shapes, objects, places and direction is generally accepted as being dependent upon normal functioning of the occipital and parietal lobe on the non-dominant side (Meadows 1974, Landis *et al.* 1986). The recognition of graphemes as shapes with a linguistic (word) and sound (phonemic) association indicates a linguistic spatial function of the left or dominant hemisphere. Lesions of the occipito–parietal area (left occipital in right handed and right occipital in left handed people) show that reading (alexia) can be lost independently of writing (agraphia). One is not dependent upon the other once learning has occurred, i.e. the Dejerine syndrome (Pillon *et al.* 1987). Visual agnosia limited to graphic symbols was described by Alajouanine *et al.* (1960) and aphasia limited to the understanding of written language and not auditory can occur (British Medical Journal Editorial 1979).

In most cases of acquired brain damage loss of reading is accompanied by loss of writing ability (Levine *et al.* 1981). The ability to lose one skill in isolation as described in individual cases in the neurological literature does, however, suggest that the brain circuitry for these skills is specific (Regard *et al.* 1985, Kirschner *et al.* 1982, Rothi *et al.* 1982) and so can be damaged or fail to develop in a specific manner.

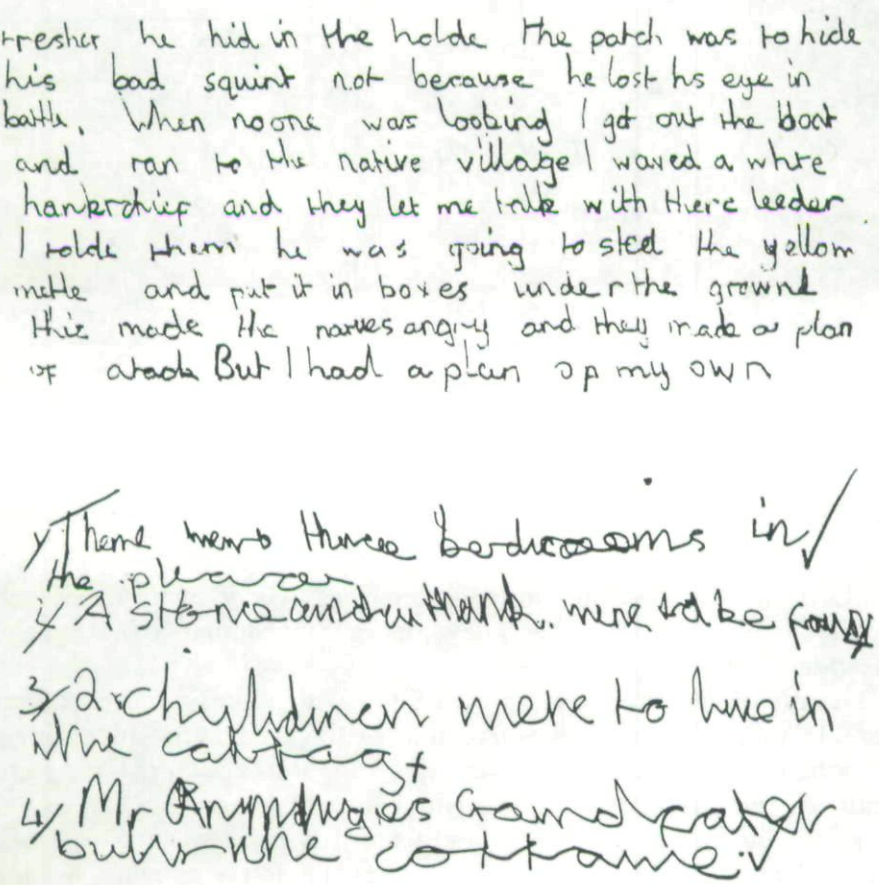


FIGURE 3. Visual-perceptual dysgraphia.

Lesions which damage the angular gyrus, which has been described as the centre for the optical image of letters, will usually affect reading and writing. A child with a severe visuospatial difficulty may be unable to organize himself on the page yet writes and spells acceptably. The converse is also true, children with severe reading and writing problems may have normal or superior spatial skills (Figure 4).

Visual copying of letters is a primary skill in learning to write but as the motor engram becomes established it becomes less important, i.e. one can write and spell with the eyes closed with poor spatial arrangement on the page. Alternatively one can execute the motor skill with a toe in the sand, a pen in the mouth or the opposite limb (in mirror fashion). As the motor skill is learned it becomes subconscious

Wans apne atim I went to
the beesh andmi littll Sisti
cam to the deeish.

Wus a Pan ~~of~~ Tim I wint
to the Srcis ond I Saw sum
cldons doing sum funee trics.

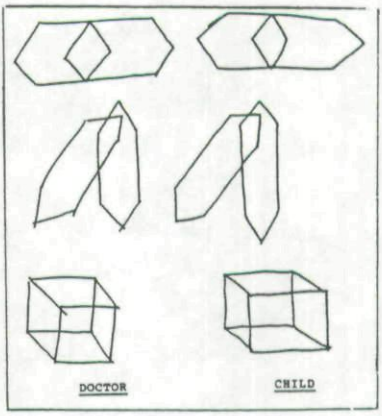


FIGURE 4. 15-year-old boy: normal visual-spatial skills, spelling dysgraphia.

(*vide infra*) and becomes more strongly associated with visual and auditory imagery and the developing knowledge of language (Gaddes 1985).

Examination of the writing of a child with visuospatial problems reveals that: the margins vary, the writing tends to slope down diagonally from left to write, one line runs into another, letters are omitted, the end of the line is misjudged so that one runs out of the page in the middle of a word, and there is poor spacing between words. The difficulties occur with equal expression in copying, writing to dictation and original composition, although greatest difficulty may be observed in the copying exercise (Figures 5, 6). The term visuomotor difficulty is vague and may refer to a child with blindness, cerebral palsy, spatial difficulty or dyspraxia, and is often all embracing for hand skills in dressing, drawing, writing, construction, block designs and the ability to perform well with jigsaws (Brenner *et al.* 1967).

Motor dysgraphia: (c) executive/co-ordination

The movement is planned by the cerebral cortex dependent upon motormemories (engram) from past experience and practice. The execution of this planned movement in a smooth co-ordinated way is dependent upon the precentral motor cortex, pyramidal tract, extra-pyramidal and cerebellar systems. In pyramidal lesions the child can plan but not execute the movement. The degree of distal weakness

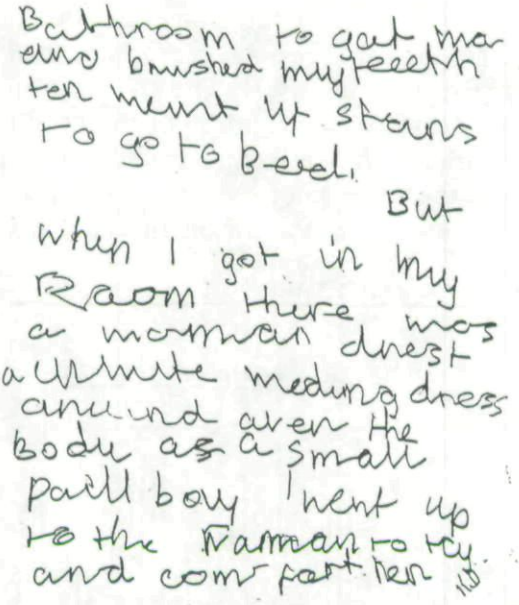


FIGURE 5. Visual-perceptual dysgraphia: composition.

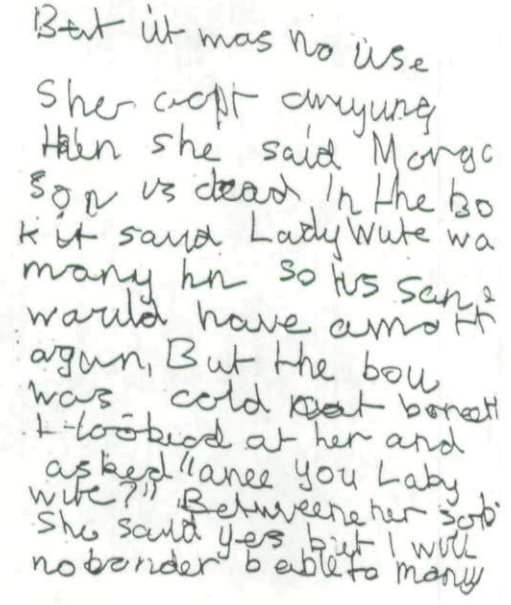


FIGURE 6. Visual-perceptual dysgraphia: copying.

correlates well with the loss of function. The speed of movements is decreased and this loss of speed also correlates well with the loss of skill (Figure 7) (Brown *et al.* 1987). The child has an immature grasp and may in severe cases have retention of the primitive grasp reflex.

The extrapyramidal system regulates the natural speed of a movement and so the cadence of speech, gait and writing. In cases of hypokinetic dyskinesia (e.g. Parkinsonian complex) writing is small

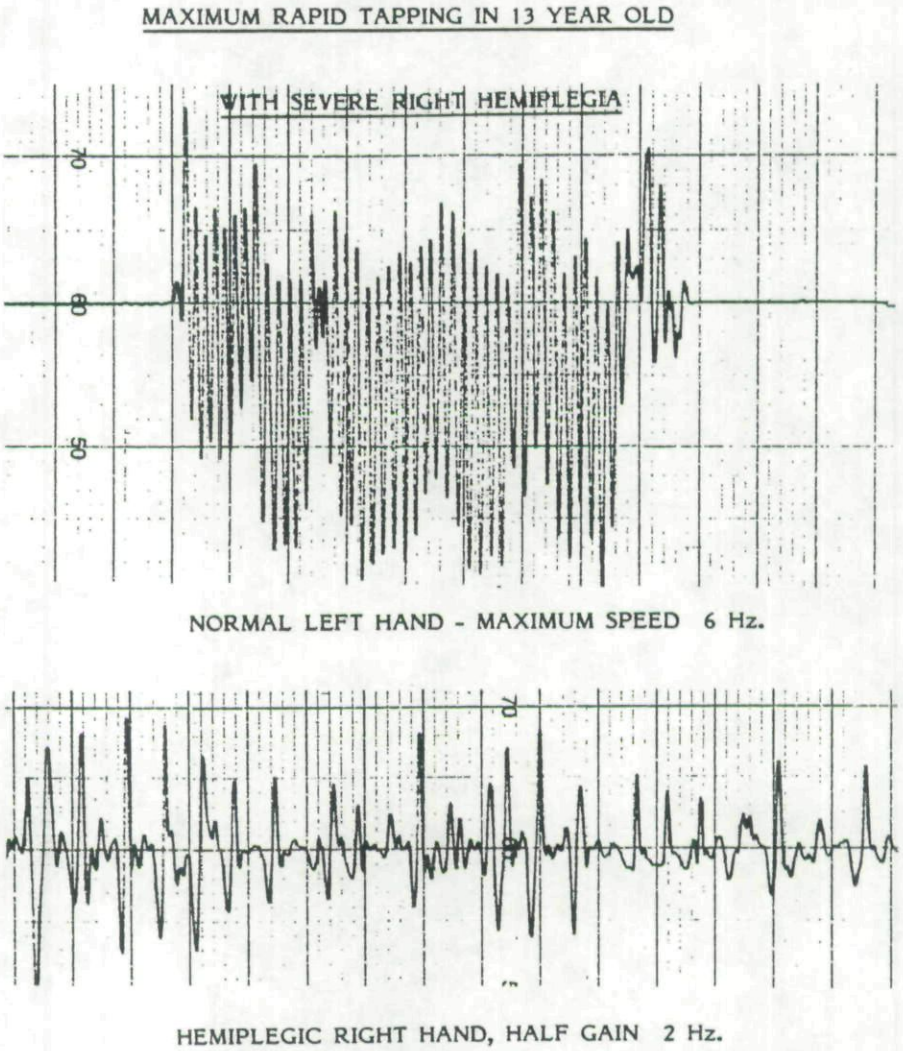
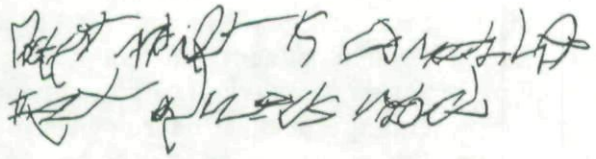


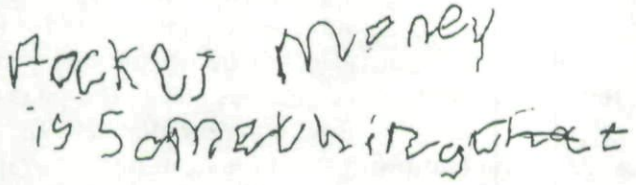
FIGURE 7. Neurophysiological measurement of reduced speed of function in a pyramidal lesion (fast finger tapping/accelerometer).

(micrographia) and slow (bradygraphia) whilst the converse is the case in hyperkinetic dyskinesias (Figure 8). Involuntary movements may cause sudden unexpected jerks, sudden angulation of letters, blotching or drawing of the pen across existing script. This is seen best in choreoathetosis. A typewriter will immediately overcome this problem (Figure 9). Co-ordination is a measure of the accuracy of judging the distance, force, speed and direction of muscle movement required to execute the planned movement. Abnormalities produce clumsiness, with dropping and breaking of objects and loss of fine neat adjustment producing clumsy untidy writing (Figure 10).



"POCKET MONEY IS SOMETHING THAT ALWAYS INTERESTS..."

FIGURE 8. Incoordination dysgraphia/hyperkinetic dyskinesia.



Pocket money is something that always interest little boys, and Barney was nd exeeption.. He thought of many ways in which he could earn some pennies to spend in the nearby toyshop. How he laved to g go and look at the window add see all

FIGURE 9. Executive dysgraphia: typing.

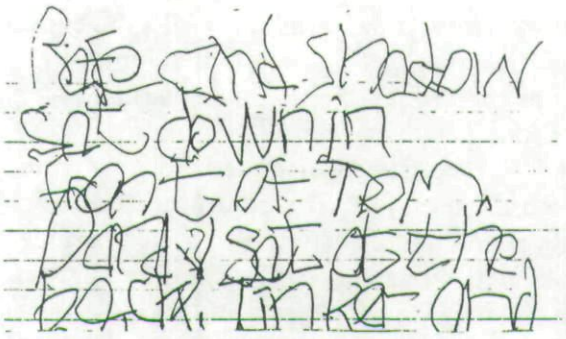


FIGURE 10. Incoordination dysgraphia.

It is in this group of disorders that simple physiological tests can be most helpful. Many of the children will already be known to suffer from cerebral palsy. Fine independent movements of the fingers without associated or mirror movement and with speedy opposition of fingers to thumb, represents the peak of neurological maturation in the upper limb and would therefore be expected to be a useful clinical test of pyramidal maturation. It is not surprising that this is often poorly performed by these dysgraphic children.

Analysis of the child's writing reveals a wide range of abnormalities which affect copying, writing to dictation and spontaneous composition equally severely. The pen is held insecurely with a dagger or abnormal tripod grip (Rosenbloom & Horton 1971) and it may slip through the fingers. Writing is untidy, shaky and blotched and there is varying pen pressure. There may be angulations and different sized letters in the word, the words do not lie on the lines on the paper, margins are irregular and the text slopes across the page. There may be macrographia, micrographia with a very slow speed, or a dashing 'careless' speed. The child with this type of motor dysgraphia may be able to spell correctly orally and his executive problems can be overcome by a typewriter or word processor.

Motor dysgraphia: (d) dyspraxia

Motor learning, like cognitive learning, increases with age as brain development proceeds and environmental experience and practice allows the 'learning' of skills. Learning to speak, read and write are skills which we spend more time practising than other skills such as typing, dancing, gymnastics, or using tools. Motor development is independent of cognitive development. A skill may be prevented from

being acquired either due to lack of experience and practice or because the brain mechanism underlying its learning is not developed. The ability to use one hand completely independently of the other or of the position of the feet (Fog test) and to use the fingers rapidly independently of each other is only acquired by 12 years (Wolff *et al.* 1983, Connolly & Stratton 1968). Recent studies of pyramidal tract conduction times utilizing magnetic induction techniques have confirmed this slow maturation (Koh & Eyre 1988).

The ability to cut with scissors, use a knife and fork, tie shoe laces, catch a ball in one hand, etc., are developed in a sequence. A child can have a normal IQ and yet have the hand skills of a much younger child, i.e. manipulative retardation (developmental dyspraxia) (Walton *et al.* 1962). Minns & Sobkowiak (1977) showed that children with hydrocephalus could have severe retardation in hand skills in the presence of normal IQ and good cognitive development.

A dyspraxia relates to the inability to learn how to perform a motor skill which is commensurate with the child's age. Fine motor skills are learned according to a strategy in that the individual component movements are learned in isolation; they are then sequenced into a skill which is slow, clumsy and requires attention, i.e. it occupies a conspicuous part of consciousness. With practice there is a gradual increase in speed and in the neatness of the skill until the skill becomes automatic or subconscious (over learned). A skill, be it speaking, writing, typing, playing the piano, dancing, driving a car or using tools, is only fully learned when it no longer requires conscious effort.

The learnt skill produces an engram or motor memory (kinaesthetic memory). This depends upon the motor association area, e.g. Broca's area for speech and the graphmotor area for writing. Eccles (1979) has been a proponent of the importance of the cerebellum in motor learning in the child as well as the cerebral cortex. Children with congenital ataxia often have slow development of hand skills and speech, which resembles a dyspraxia rather than a co-ordination defect. Motor planning depends upon these past memories and experiences but not on the ability to execute that movement, which requires an intact peripheral motor system.

This learning of motor skills is also dependent upon a normal sensory system. However, development and maturation of the cortical sensory system, e.g. two point discrimination, graphasthesia and finger gnosis, is very difficult to evaluate in the individual child. Finger agnosia occurs in 29% of normal 7–8-year-olds and inaccurate

graphasthesia in 45% (Minns & Sobkowiak 1977). Measurement of kinaesthetic acuity and memory has also proved difficult to evaluate in young children and the results are controversial (Bairstow & Laszlo 1986, Doyle *et al.* 1986, Lord 1987). The child with a dyspraxia has difficulty in putting several movements together, e.g. sequencing the fingers, repeated tongue movements, postural sequences as in dancing or gymnastics or phonemes into a spoken word or graphemes into a written word. He will be able to make the sound or copy the letter in isolation in all but the most severe cases. He may not be able to carry out a constructional task after demonstration even though he has no weakness, spasticity, incoordination or involuntary movement (constructional dyspraxia). The child with isolated articulatory dyspraxia will always be able to bite, chew and swallow. The child with a manual dyspraxia will have good strong hands with no shaking and can pour juice out of a jug without spilling any.

The dyspraxia may be isolated for writing or involve all hand skills, such as cutting with scissors, colouring between the lines, using feeding utensils, tying shoe laces and using tools (Walton *et al.* 1962). Speech may also be affected, with slow development of articulation (developmental articulatory dyspraxia). These dyspraxic children are often included in the broad category of 'clumsy' children and various tests have been developed to detect these children in the school-age population (Stott 1984, Gubbay 1978). However, many of these tests determine whether a child lies below the third centile for a cumulative score. These incorporate many different modalities of learning, e.g. posture and mobility, visuospatial skills, motor planning. Therefore, although the score tells you if the child is retarded in development, the exact nature of the difficulty is often unclear. Refinements of these approaches have led to the publication of centile charts for the different skills tested and these may enable the examiner to be more specific about the child's problem (McKinlay *et al.* 1987).

Examination of the writing of a dyspraxic child demonstrates that he can copy letters and words, he may be able to write all the common letters but not the complex graphemes to dictation, but he has difficulty in word synthesis from the letters (writing word blind). Writing is slow and laborious, and the child rapidly loses concentration. He writes something down and then monitors it by vision not kinaesthetic memory. When he sees that it is wrong he crosses it out so that frequent corrections and crossings out are usual. Copying can be very neat but he often makes 'careless'(!) mistakes even when copying.

Nevertheless, spontaneous script will always be much worse. The child appears to be inconsistent, making mistakes in words that he has just copied accurately and which he can read correctly. The child may make frequent static and kinetic reversals; also, mirror and associated movements of the face, tongue and opposite limb may be marked. Failure to establish dominance will add reversals and mirror writing to the basic motor learning problem (was/saw, dog/god, b/d, n/u,) (Figure 11). In cases of pure motor dyspraxia typing will circumvent the disability but this presupposes that the child can spell (if he can't it is not pure motor dysgraphia).

FIGURE 11. Dyspraxic dysgraphia.

DYSGRAPHIA: SPELLING/SYNTACTICAL

We can compare the expression of inner language by writing with that by speech. Speech can show a motor dysarthria (i.e. co-ordination and expressive dysgraphia), an anatomical dysarthria (i.e. anatomical motor dysgraphia), an articulation dyspraxia (i.e. dyspraxic motor dysgraphia), or there may be an expressive, i.e. motor, dysphasia which in the acquired as opposed to congenital form constitutes Broca's aphasia. The problems experienced in spelling/syntactical dysgraphia should be likened to those in speech in expressive aphasia.

Spelling can be defined as the production of a correct sequence of graphemes to correspond to a word of spoken speech as dictated by the rules of the particular language. Speech is the same, substituting phoneme for grapheme. It should not, therefore, surprise us that syntactical and spelling dysgraphia should so often follow a developmental speech retardation syndrome (Figure 12). Mastery of spelling requires a high degree of linguistic competence (Frith 1978) and is the last language skill to develop. There are cases of isolated familial spelling dysgraphia without any preceding abnormality in speech development, again suggesting that there must be genes acting during childhood governing the maturation of individual systems within the brain.

In expressive speech asphasia there are word finding difficulties, often combined with pronunciation problems, i.e. an articulatory dyspraxia often coexists. There is also a general reduction in output, short sentences with hesitancy, dysfluency, difficulty with the 'little words' (on, at, me, it, so, but, and) and difficulty with tenses, plurals and pronouns.

The same applies to writing. In the congenital form there is a reduced output with a lot of effort. Writing speed is slow and there is difficulty retrieving words from spelling vocabulary. Words are written in a slavishly phonetic way (sodeam/sodium, matilic/metallic, di-

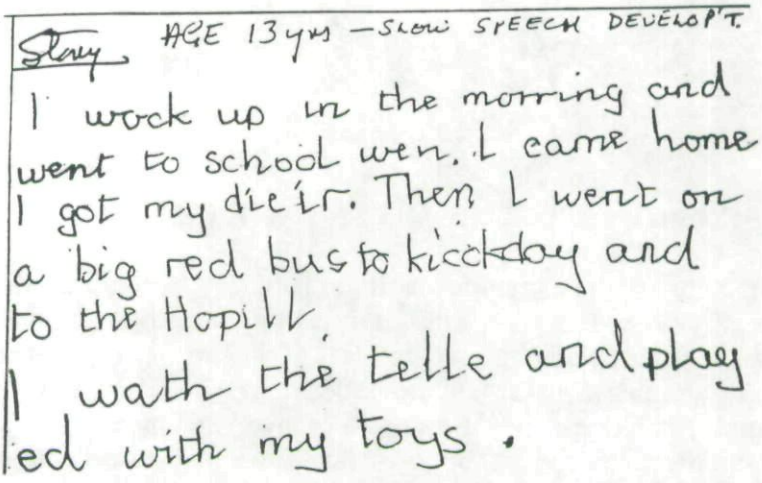


FIGURE 12. Spelling dysgraphia/slow speech development.

monds/diamonds, pepol/people) or according to dialect (reet doun for right down), and very occasionally as the child speaks them with immature speech (led lolly, red lorry, doddy/doggy). Complex graphemes such as ph, ch, sh, th, ough, cause particular difficulties. Spelling age is retarded on standardized tests and mirror writing, with god/dog, was/saw b/d, adds confusion to what at first may appear an unintelligible muddle. The child has no idea of punctuation, a phrase or sentence and spacing may be absent between words. They cannot read what they have written even though they can read the same passage from a book. They can copy well and neatly but writing to dictation and spontaneous composition is very poor, with short, poorly constructed, simple sentences (Figure 13). The child will deliberately search out words he can spell in order to try to get his ideas down on paper. This is slow and very frustrating (Millar & Klein 1986).

The learning of syntax in speech follows the development of the phonetic system and that in the writing system follows graphemic skills, so sentence construction is more related to motor than cognitive learning. The child may have an IQ over 130, i.e. excellent cognitive development, and yet have very severe syntactical dysgraphic diffi-

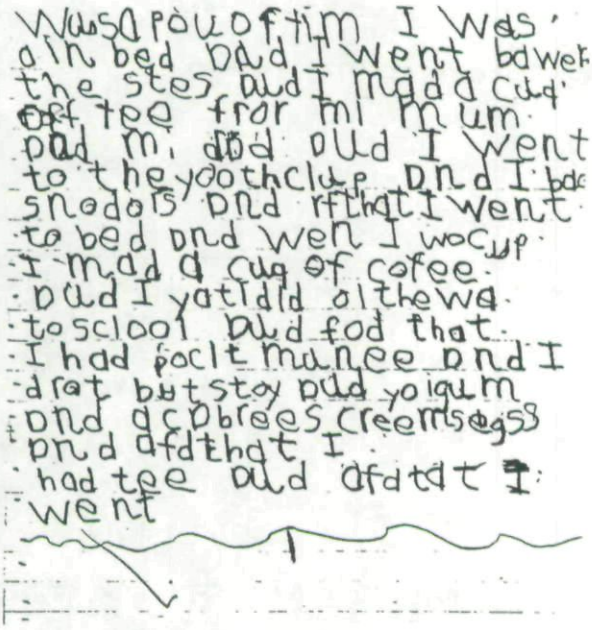


FIGURE 13. Spelling dysgraphia: boy aged 12 years.

culty (Figure 14). Acquired brain damage which causes a Brocas aphasia will in most cases also cause a dysgraphia since the motor association area of Broca, controlling motor learning in lips, tongue and palate, is adjacent to the graphomotor area on the left which controls motor learning, of the right hand required for writing. In children, head injury (Figure 15), encephalitis, (Figure 16), tumour, epilepsy or stroke can all cause an acquired dysgraphia. The spelling dysgraphia may remain when the motor aphasia of speech has cleared (Figure 17) (Woods & Carey 1979).

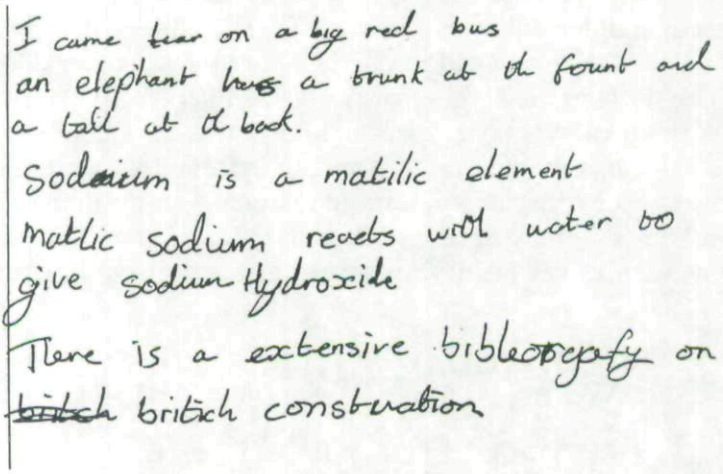


FIGURE 14. Spelling dysgraphia: boy aged 15 years. IQ 130.

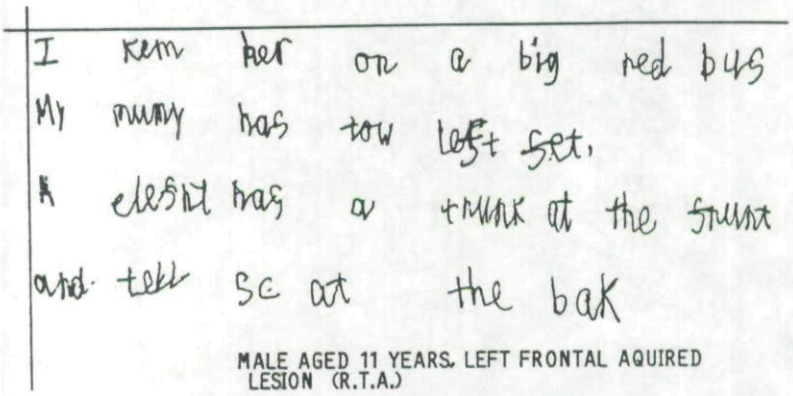


FIGURE 15. Acquired spelling dysgraphia: head injury.

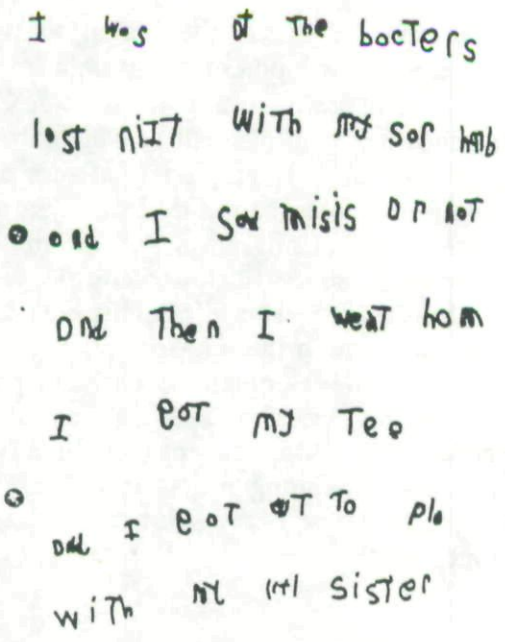
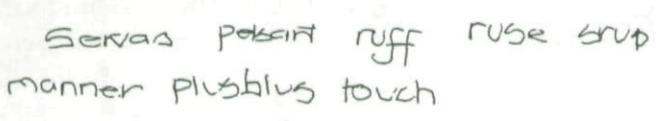


FIGURE 16. Acquired spelling dysgraphia: post-encephalitic.

1 year after aquired R. hemiplegia and aphasia.

(Fiona aged 14 years)

Written spelling:



surface pleasant rough raise scrape

manner publish touch

Oral spelling:

feel - fleu

answer - ansear

several - serval

FIGURE 17. Spelling dysgraphia/post-expressive dysgraphia.

There is nothing specific about the actual writing, which will differentiate a congenital development dysgraphia from one resulting from post-natal brain damage. Children with the XXY chromosome configuration may show congenital features which are identical to an acquired Brocas aphasia and dysgraphia (Ratcliffe 1982).

Some children with a developmental dyslexia/dysgraphia may have abnormalities of the neuronal migration and assembly in the cortex and connectively-related subcortical structures as proposed by Geschwind & Galaburda 1985. The left hemisphere is also preferentially developed for language in the majority of individuals. A theory was proposed that delayed development of this hemisphere dominance could be incriminated in dyslexics, although the theory remained controversial (Benton 1975). More recent techniques in brain electrical activity by topographic mapping in dyslexics (Duffy *et al.* 1980) and studies of regional cerebral blood flow (Rumsey *et al.* 1987) have given added support to these theories.

DYSGRAPHIA: SEMANTIC (COMPOSITION)

Speech and writing are the usual means by which we express inner language and if they are faulty then some alternative communication system is needed. The word language has many meanings: (a) the language system or morphology, i.e. English, French; (b) the syntax and rules of the language/its phonemic and graphemic structure; and (c) in computer sense as a coded system of symbols which allow groups of memories to be stored together even though at different 'addresses' in memory. This allows us to develop concepts, understand and compare these concepts and reason. Language in this sense is not localized within the brain even though the lexicon is localized. Equally language is basic to understanding, thought and reasoning and so intelligence (Mykelburst 1973). Words are not the only symbol system that can be used. Cognition depends upon the use of different types of symbol system to give meaning. To speak or write a word is perfectly possible without any understanding, as is seen in the reciting of nursery rhymes, echolalia and barking at print in the mentally handicapped child or the so-called cocktail party personality of children with hydrocephalus.

Equally, one can copy a word neatly from a foreign language and not understand its meaning. Any child with a severe language disorder

will have impaired cognition, poor understanding, limited concept formation, poor reasoning ability and so slow speech development and slow writing ability. He can be taught exercises in penmanship in the same way as teaching the recitation of nursery rhymes as a memory feat without meaning. Children who show a semantic or linguistic dysgraphia do not usually have a specific disorder as their problem is part of a more global cognitive learning disorder, i.e. mental handicap.

There are, however, children with a specific receptive aphasia who have severe language difficulty with little understanding of speech and with severe reading and writing problems. Semantic dysgraphia is, therefore, not an isolated or single specific disorder but part of a wider language disorder which dominates the picture more than the writing defect. Ingram (1963), in classifying speech disorders, spoke of primary disorders of speech and secondary speech disorders when the latter were due to mental handicap, autism, psychosis, aphasia, deafness, etc.; the same classification is useful in dysgraphia with primary and secondary writing disorders.

REMEDIAL TREATMENT

Although this is the province of the educational system, there are several principles which the school doctor or paediatrician must bear in mind. The first aim must be to reduce anxiety, the second to circumvent the handicap, the third to practise areas with no disability and the final aim to prepare a remedial program for the disability itself.

Reduce anxiety

The child often has a low self-esteem, low morale, and may be teased at school if he is not good at physical activities due to his clumsiness, as well as being poor at academic subjects. He may show acting-out behaviour, buy favours, become the class buffoon, develop school phobia or other anxiety states. The anxiety may manifest as migraine, punishment behaviour at home with the parents (he goes berserk when released from school), enuresis or deliberate provocative behaviour. Anxiety may be obvious with fear, pallor, tachycardia and panic in relation to certain lessons. During testing the child will co-operate whilst succeeding but will fidget and become restless and say he wants

to go home as soon as an area of difficulty is tested in which he knows he is going to fail.

It is easy then to blame the learning difficulty upon poor concentration and restless overactivity, i.e. blaming the effect as the cause. The anxiety engendered will block further learning and the teacher must allay this and not simply present the child with a programme to practice all the things he knows he cannot do. The outstanding remedial teachers are successful not because of the methods that they use, which are often no different from those used by unsuccessful teachers, but in that they have the right personality and approach to the child to allay his anxiety and motivate him to want to learn.

Circumvent the handicap

There is a tendency to diagnose a condition in order to practise it, and further destroy the child's confidence, so if he cannot walk we practise very inefficient walking and deny the electric chair which will give him independent mobility, if he cannot talk we practise speech rather than understanding him at all costs by whatever means so that he can communicate. In the same way a child who cannot read is missing out on information and the way around this is to read to him and buy taped stories and not practise reading material which is emotionally much too young for him. The child with a dysgraphia needs to be given some way of putting his ideas down in some form of retrievable store. This can be by photostatting the work of another child in the class, using a typewriter or word processor, using plastic magnetic letters, or by using another child to scribe (Goad 1979). Oral answers should be accepted whenever possible. In severe cases, with a combined executive motor and syntactical dysgraphia so that the child's spelling precludes use of a word processor, the decision may have to be made to allow a totally oral method with the use of a hand-sized tape recorder with notes being kept on tape and not in a book.

Handicap may be bypassed where appropriate with facilities for scribing, typing, oral answering and tape recording, with an emphasis on communication (Millar & Klein 1986).

Practice areas without disability

The child's morale as well as his continuing education depends upon stimulation of learning in areas where the child has no disability. He should not be punished in subjects such as history, geography, physics

or chemistry for his poor graphic skills. 'Untidy, careless, could do better' — when referring to his writing — make things worse and criticism should be levelled at the subject being taught when the teacher knows that the child can do better. The child should be encouraged to take up swimming, golf, horse-riding, ski-ing or some physical activity where he can succeed and if possible outstrip some of his class mates to restore self-esteem. Computer work appears to be particularly appealing to children and apart from circumventing the handicap may allow them to develop skills above the level of their classmates.

Prepare a remedial programme

The prognosis for acquiring useful writing skills may be very poor, especially in children with dyspraxias (Walton *et al.* 1962). Children who are simply below the third centile for the development of the particular skill will show steady improvement with remedial help. Those following head injury, encephalitis or focal infarcts, if persisting for more than 18 months after the acute insult, are usually permanent. The familial dyspraxias and those associated with chromosome disorders are also usually persistent. The child with slow speech will usually be speaking well by 7 years but be dyslexic; this will improve by 11 or 12 years but the dysgraphia will often persist into secondary school and into professional exam time.

It is because the disorder is long-standing with often very slow improvement or slow response to remedial education, that we place the remedial programme as number four and not the first stage of management. It is not that it is not important, nor that any child will learn to write and spell without continued practice, but that we cannot have an emotionally disturbed child who then fails in subjects in which he does not have a disability, because his whole world has revolved around his disability.

A programme aimed at the child's motor proficiency should be developed independently of a spelling programme. It is not, however, clear to what extent children transfer remedial pencil skills into their everyday writing. There are a number of papers in the literature which report on individual cases which appear to support the value of practising writing, e.g. repeated pencil strokes, circles progressing to individual letters in isolation and then onto words (Anderson & Cambridge 1979, Freischlag 1979). Such authors emphasize the need for encouragement and maintenance of the child's motivation and self-

esteem with praise and positive rewards, and the importance of these factors makes the effect of practising the motor skills difficult to evaluate. Nevertheless, some children with executive writing difficulties may benefit from attention to pencil skills, with, e.g., modification of pencil design to improve grip and the use of non-slip material on the desk, or taping the paper to the desk.

Children with spelling problems may restrict their spontaneous output and decreasing the emphasis on spelling may allow them to express themselves and communicate their ideas. The spelling difficulties themselves can then be addressed. Affirming motor patterns with oral spelling may help (Bradley 1981). The types of spelling errors can be delineated and a programme of remediation planned to practise the types of spelling giving problems (Lansdown 1976, Millar & Klein 1986).

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