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Improving the fluidity of whole word reading with a dynamic co-ordinated movement approach

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Abstract

In this article we present an intervention approach geared towards improving the fluency of reading and processing in children with dyslexia and dyspraxia. This is an important topic, identified by the National Reading Panel 2000 as key to improving reading comprehension. The approach, the Crispiani method developed in Italy is derived from theories of cerebellar deficit and procedural learning, and adopts a dynamic approach based on a combination of whole word reading with rapid co-ordinated movement. Following a literature review, an intensive case study of clinical practice with a 10-year old girl with dyspraxia and dyslexia shows marked improvement in initiating and completing tasks. Finally, an experimental study with 33 children show an average improvement of 30% in reading fluidity following a 3 months intervention designed to improve processing speed and confidence in a clinical setting. This improvement was highly statistically significant. The implications for a whole child approach to intervention are discussed.

Introduction

The article starts with a review of phases in theoretical understanding of dyslexia,

moving from phonologically based to a recent emphasis on cerebellar deficit and procedural learning, which provide a rationale for the Italian Crispiani method

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of intervention. This method emphasises the fluidity of reading in conjunction with sequences of movement in order to improve fluency. In 2000, this was identified by the National Reading panel in the USA as the key missing component in fluent reading and comprehension, advocating the inclusion of fluency training in programs for children with dyslexia.

We present an in depth analysis of the Crispiani method and the approach adopted as a whole child intervention involving the family and school. The case study provides a moving example of a child with complex impairments who has benefitted from an intensive 3 day course. The final study is an experimental analysis of a group of dyslexic children and the impact on their fluidity of this intervention over a three-month period. The article moves from theory to practice to illustrate the approach in action.

Definitions and diachrony

The complex phenomenon defined as *Specific Learning Disorder* has found a plurality of intense theoretical interpretations, and different experiences of research and professional practice in diagnosis, functional assessment, prevention practices and treatments, advice for school, and orientation. The Diagnostic Manuals such as ICF and DSM-5 have introduced multiple and important theories, only partially reported and supported in the literature. Adopting a diachronic perspective, on the development of these theories over time, it is possible to make a brief summary of the multitude of theoretical visions in a series of historical phases.

First Period

From the 1930's to the 1960's, a variety of approaches and theoretical models follow one another: These include theories of motor and cortical differences. Theories founded on neuro-psycho-motor functions such as motor organization and space-time and the assertion of lateral dominance, for example Orton (1937) Theories of neuro-cortical differences, with Critchley and Critchley (1970).

Second period

From the 1970's to 2000's, comes a period of enhanced linguistic theories. In Italy, in this period, there were a substantial number of theories, dominated by a strong phonological approach referring reductively to sign-sound connections.

Third period

Since the 2000's, there has been a change of paradigm in terms of complexity. By the end of the '90's, recent theoretical conceptions on dyslexia are oriented towards a more neurobiological foundation. In this period a dynamic and complex vision of cognitive processes in general moves towards an important global *breakthrough paradigm*. The functional performance of reading, writing and math skills, as well as disorder in many areas, confirm previous multifactorial theories, from neurological dynamics interpretations, today expressed in the conception of multi-components which impact on the course of development over time (Karmiloff-Smith, 1993).

Table 1 Language theories, including many options

LANGUAGE THEORIES
Phonological Deficit Theory, based on a problem in breaking down the sounds: e.g. Bradley and Bryant (1983), Stanovich (1980, 2000), Ramus et al. (2003), Snowling (1981, 2001).
Dyslexia as a deficit of phonological recoding, e.g. Lovett (1992), Tressoldi, Stella and Fagella, 2001 etc.
<i>Theories of language processing</i> - a visual and auditory processing disorder, based on organization of sequences, especially in terms of speed, by Livingstone et al. (1991), Tallal et al. (1995), Galaburda, and Livingstone(1993)
<i>Theories of visual-motor deficit</i> - related to the disorder of visual and/or auditory information processing (Wolff et al., 1984)
Disorders of visual processing, visual-spatial or with involvement of "magnocellular system", Livingstone et al. (1991), Tallal (1995),
Failure of the rapid processing of visual stimuli Slaghuis et al. (1993) and acoustic stimuli: Merzenich et al. (1996).
Difficulty in managing the assembly of words and letters mostly on the right side of the visual field, the effect of crowding (crowding) asymmetric: Geiger and Lettvin (1987).
<i>Neuro-Cortical Theories.</i> Neurological disorder related to the cortex or of higher functions, mainly in the left hemisphere and with involvement of Broca's area brain asymmetries, or variations of symmetries, asymmetry reversed (Geschwind and Galaburda 1985)
<i>Theory of the disorder of working memory (Baddeley, 2000; 2003).</i>
Deficits in executive or procedural order, based on memory retrieval
<i>Theory of the disorder of management attention or attentional orientation:</i> Plaza and Cohen, 2006
<i>Neuro-Psycho-Motor Theories.</i>
In a second phase, still on the neuro-psycho-motor conception, dyslexia has been discussed as a disorder of motor coordination and involvement of lateral dominance, by: Geschwind and Galaburda (1986),
<i>Theory of deficit magno-cellular.</i>
Sensory deficits Theory, related to dysfunctions or migration of magnocells delegated to the optimization of behaviors, in Tallal, (1984) Stein and Fowler (1993).

There is a trend to dismiss simple interpretations and to consider instead the diversity of the phenomenon, taking into consideration its roots (both structural and functional), and manifestations of syndromes, approaches to the prevention and rehabilitative treatment. Numerous considerations are central when theorizing dyslexia:

- The sense of the complexity of the phenomenon.
- The nature of human functions multi-components.
- The componential analysis, structural and functional, cognitive function.
- The reference to the executive functions and the related cortical system.
- The reference to automatic neuro-psychic functions.
- The partial pervasiveness of the disorder.

A multiplicity of paths of inquiry and theoretical constructs have been undertaken, whose mapping is not always easy, even for the partial overlap that the phenomenon manifests from conceptual viewpoint. These multiple interests in dyslexia, give a sense of a more homogeneous scientific platform, more oriented to neuro-cortical systems related to executive functions, which can be traced back to reading and writing and math performance.

Theories of attention deficit or executive functions.

Multiple authors explain dyslexia as a condition of attention deficit disorder in terms of the constancy of action,

associated with a disorder of executive functions (Stein and Walsh, 1997; Facoetti and Turatto, 2000; Facoetti et al., 2010).

Anthropological-Evolutionary Theories

Authors mainly engaged in the history of writing such Dehaene, and Carr, are interested in the structural and functional changes in the brain produced to fit the task, also denoting sensitive ethnic and cultural diversity, the process of adaptation of brain structures to the written language.

In Dehaene's 2009 study the functions of reading and writing are seen as a recent evolutionary conquest. Developing the necessary neural circuits in the brain still involves a process of adaptation, so this is based on some sort of modification of functions by means of a neuronal recycling in conjunction with the decline of orality, the preference for spoken language. The process develops on the basis of converting existing neural circuits to reading. This is a function that, in dyslexics, is expressed differently and makes the recognition of phonemes within words difficult. The authors then consider reading as a visuo-motor disorder with reference to the decoding of letters, tending to believe that a transparent or regular script (such as Italian) allows for faster learning of written language.

Similar evolutionary positions are expressed by Wolff (2009) which indicate that the origin of automatic reading is the generation of symbolization, when certain linguistic codes come to an alphabetical scheme for which each word is divided into individual sounds, phonemes represented in graphic signs. So this is a

story based on semantics, the ability to analyze the meaning of sounds and words, which fully engages the brain in visual areas, in occipital-temporal pattern recognition, and in parts of the frontal lobes.

The evolutionary perspective can be linked to the conceptual work of Carr, (2011) who considers how new technologies have changed the way we work and the perceptions of the human mind, and therefore how we direct our attention. Reading involves in fact a synergy of actions that, in practice brings together fragments of learning.

Theory of cerebellar disorder and "procedural dyslexia"

Of increasing importance is the "Cerebellar Deficit Theory" of Nicolson (1990, 1996), that identifies the cause of dyslexia in the dysfunction of the cerebellum and the subsequent ineffectiveness of the procedural processes, in particular the sequential, with effects in disorders of motor skills and automatic transmission in motor areas of the cortex, including Broca's area.

The analysis starts from the consideration of the multiplicity of brain structures involved in skill proceduralization through the Doyon and Ungerleider (2002) model. This model refers to two separate circuits responsible for learning: the Corticostriatal system particularly involved in learning motor sequences and the Corticocerebellar system particularly involved in adapting to environmental perturbations. Nicolson and Fawcett (2010) analyse the role of the cerebellum,

together with the motor cortex and the basal ganglia in the acquisition of motor skills, integrated systems and the corticocerebellar phase of automation. It is the declarative-procedural circuits that can compromise the initial acquisition of motor skills, in particular in the fast phase (*fast learning stage*), in the presence of inefficiency of a single part of the system. The Corticostriatal system regulates the motor sequential activities, and the Corticocerebellar system regulates *balance* and *adaptive timing*. Nicolson and Fawcett (2010) place great importance on the secondary symptoms, with particular reference to impaired balance and motor skills that do not constitute the primary cause of reading disorder, however, contribute to the phonological processing and the *verbal working memory involved in reading*.

Turning to the neurophysiology of cognitive-motor skills, the research of Bullock (2004), underlines the complexity of the skills involved in reading and writing, where a loss of performance may be due to impairments in any brain region such as the parietal cortex, motor cortex, frontal cortex, basal ganglia, cerebellum. Evidence from cerebellar patients provides support for the importance of this structure in language and literacy (Fabbro et al., 2000).

In any case, the difficulty is related to activation time and execution, in other words the temporal dimensions of fluent action. The execution of accurate and speeded actions, such as how to take the ball at a glance, depends on the coordination of speed (*velocity scaling*), the speed of perception, or contact time (*time to contact*) and the speed of the

muscles (*muscle force*), based on the activation of timed patterns of action. Further evidence for disorders in reaction time in all tasks apart from a simple reaction time, even where language is not involved, comes from Nicolson and Fawcett, (1994).

This condition inevitably disturbs language as it involves both time and fluency, then the automatic and fast processing of information, from which connections with reading and writing and dyslexia may be seen. These apparently heterogeneous disturbances are the cause of cerebellar dysfunction, related to discrepancies between actions and the time of their execution, and generate a procedural learning deficit.

Links to theories of magnocellular deficit.

This is a theoretical solution expressed mainly by Stein 2001 that signals the impairment of the magnocellular layers, with negative effects for binocular stability, then for visual localization mainly on the left side. The author indicates ganglions in the cerebellum crucial for establishing binocular stability and selecting lexical functions that are disturbed in dyslexics, therefore, a neurological syndrome affected by in-coordination, difficulty in working from left to right and poor "sequencing".

Other authors back the theory of magnocellular dysfunction as a decisive factor for the onset of the dyslexic disorder. On the basis of genetic and neurophysiological research, mainly attentive to visual disturbances such as processing deficits, with effects on the

analysis of spatial relationships and movement, dyslexia appears as a functional disorder, (Ruffino et al., 2014) linking potential loss of spatial and temporal co-ordination, and dyslexia.

Links to theory of programming and sensory integration

Chiarenza and colleagues (2014) propose a neurophysiological disorder in terms of integration of sensory information, with involvement of the cerebellum and motor functions and attention to reaction time and self-regulation of behaviour

Neuromotor and co-ordinative theories. With reference to the neuromotor field, anchored to the scientific tradition, there are important theories that indicate the nature of the motor and coordinative dyslexic disorder, based on the work of Crispiani (2006, 2011), Massenz (2013), etc.

The Praxic-Motor Theory and The Crispiani Method

The theory

In a series of neurobiological and functional studies, we undertook our Praxic Motor Theory (TPM), with reference to the investigation of cognitive processes and motor coordination.

We provide a developmental account of dyslexia in terms of a disorder of praxia with particular reference to the sequential functions/procedures and the fluidity of executive functions and involvement with the organization of space and time and lateral dominance.

The cognitive, visual-motor and semantics actions related to reading and writing, appear dysfunctional in the organizational sense, in the sequential processing of the stimuli. It is not in our view a disorder of discrimination, nor phonological conversion, but it involves difficulties in organizing perception in terms of speed, alternating rhythms or overlapping sequences or responding to prolonged visual or auditory stimuli. For this reason it is in our view, a qualitative disorder.

Executive disorders related to reading, writing and math skills are based on phonological problems (sound-symbol relationship, semantic, symbolic), but sequentially proceeding from left to right, the automaticity and the fluidity of the action, the organization in space and time, the rhythms and the relationship between part and whole.

Slowness in the precipitation of actions, in particular in the incipit - initialization, can be easily recognized in all the actions of the person, from the motor to the mental, compared with a lack of lateral dominance and dyspraxia in general, leading back to neuronal cortical disorder.

Critical aspects concerning functional performance are related to neuronal cortical circuits, in particular in the bidirectional exchange between brain areas and in inter-hemispheric reciprocity. In this complex system, both the cerebellum (cerebellar function as sequential projection in motor areas) and lateral dominance are important. Both generate effects of slowness or randomization of the electrical flow of the

brain. Randomization and slowness in the executive phase seem to be the most significant indicators.

We support a complex consideration of the phenomenon in the sense of a multi-factorial and multi-componential disorder as reading and writing are executive functions.

For this reason, they are not reducible to a "mere" symbolic process (sign-sound association, phonology, and meta-phonology). They are dynamic functions, motor and cognitive ones, self-regulated with feedback processes and anticipation.

Under normal conditions, reading-writing is not a fragmented nor cumulative phase (adding elements to one another such as graphemes, phoneme, other symbols), but it may become a fragmented process in the presence of obstacles, as in the case of procedural disorder, sequential disorder, space-time disorganization or difficulty in left-right directionality.

It is a process of solidarity of motor coordination, perception and movement, along physiological coherence that normally regulate the higher human functions (Maturana et al., 1995). Dyslexia is often an integrated condition, inclusive of dyslexia, dysgraphia and disorders of mathematical skills, with extension to the overall praxis in the sense of a qualitative disorder, (partially pervasive disorder). Dyslexia is revealed as a sequential dyspraxia related to sequences founded on a matrix of bio-psychic functions .

Our research and theory define the Dyslexia Condition in Paradigm D:

Dyslexia, Dysgraphia, Dyscalculia, disfluency, Dis-laterality, Dyspraxia, Disorder. We are therefore working with children with complex needs.

Treatment- Intervention Programme

Starting from praxic-motor nature, Dyslexia, dysgraphia and dyscalculia are treated according to the scientific-professional procedures based on prevention, early functional assessment, recommendations for school and families, educational and professional guidance, cognitive enhancement and study methods and cognitive development activities to improve sequences

The Treatment (intervention programme) is ecological and dynamic, in the sense that it takes care of the entirety of the person in all its functional areas (motor, perceptual, emotional, affective, thought, communication, social performance and school) and promotes mental and motor reaction. Moreover, it promotes the dynamic of all functions, making them fluid and automatic, through a training aimed at soliciting a continued coordination, under the automatic and intense cognitive presence, in all functional areas.

The activation training is conducted on motor skills, perception, memory, grapho-motor, language, thought, storytelling, reading, writing and mathematics. All actions are in a professional kit of 12 cognitive training modules which combine practices of Motor Training.

Our therapies insist on the dynamics of Succession, Automation and Fluidity (Polo SAF).

The training tends to generate neurophysiological automaticity, fluid and oriented in the sense of space and time. It is indicated for dyslexics because they always prefer to isolate gestures, phonemes or graphemes.

The active and fluid execution of motor automatic sequences, including exercises about grapho-motor skills, mnemonic procedures, language fluency (reading, writing, calculating) improve not only the function but the co-ordination of the brain itself. While inertia is the cause of decay and progressive dysfunction, the simultaneous activation of coordinated and constant functions is the strength to reorganize the **inter-hemispheric cortical flows**, working in reciprocity and parallelism, developing their effectiveness. In particular, the increased fluidity (readiness incipit - to initiate action, the right speed, agile self-correction, perseverance, etc.), together with the global approach to real learning (words, sentences, strings of signs, numbers, figures) allows the dynamization of slow and messy executive processes. An entire approach and fluidity guide the action of all people in conditions of normal-functionality and they are therefore taken as skills on which to build and establish correctness.

The most important qualitative indicator is the **executive fluidity**, not speed.

We define a **Neuromotor Storm** a global activation with intense involvement of all kind of functions, linguistic and perceptual, and their coordination (synesthetics). Through our treatment we obtain improved fluidity of executive functions, enhancing the capabilities of electrophysiological braking, self-

regulation, self-inhibition and self-control allowing the adjustment of dynamics from slow and precipitous to smooth and consistent. This strengthening function assumes four major vectors, named Physio Praxis Vector (VFP) that constitute the **energizing platform**: 1. Incipit - 2. Fluidity - 3. Cross lateral pattern - 4. Rotary pattern. The treatment usually takes three months for three sessions a week.

There is a **Common Training**, based on the 12 cognitive training modules that make up the system, working in an intensive and consistent way, towards fluidity and the strengthening of sequences.

This training may be complemented by a **Special Training of functional activation**, that may be used in more severe cases or for subjects who are not able to follow an ordinary course. It is very intensive and concentrated on consecutive days and in conjunction with neuro-motor activation, and with fast reading (Champion LIRM: Intensive Reading Speed Motor).

The aim of the treatment is not to use tools to bypass the problem, depriving children of the necessary functional exercises, but to solicit, track and push fluidity both in basic skills (motor, perceptual, memory, language, thought, grapho motor) and the primary ones of reading, writing, and maths.

The treatment can be followed in various disciplines (mathematics, Latin and Greek, foreign languages), or exercise performance as the report, the synthesis, the interview, interrogation, and note taking always including speech training. It also deals with training to support study methods.

The specialist *takes charge* of the student and his personal situation. He is systematically evaluated by comparing questionnaires from family members, teachers and the therapist.

Assessment of Treatment

Critical aspects

Assessment of Treatments (VTA) of the dyslexic condition, constitutes a widespread critique of many aspects and it reveals, at the same time, recognition of the complexity of the phenomenon as defined by Italian researchers, who emphasise the importance of attention, fluency and learning. The treatment can be distinguished from a mere collection of recommendations or the use of tools/technologies that allow the child to avoid reading and writing exercise. Another critical aspect is what is under assessment during the treatment, which is the target and criteria used. In our training the indicators are Fluidity, (rather than speed itself, which maybe incorrectly used in Italy), Accuracy and understanding of the text, complex skills that lead the analysis to a number of theoretical explanations and interpretations.

In terms of the DSM.5, there is also a focus on the observation of everyday conduct and evaluation of school performance in all areas, not only the association of reading performance from a psychometric point of view. The concept of *speed* is another key point because it is opposite to that of *fluency*, so it is important to include the *incipit* - start in the measurement of time, the possibility of reverse dynamics between speed and accuracy and the consequent limits of the calculation of the direct

correlation. This refers to a trade off between speed and accuracy that is frequently noted in readers with dyslexia

Assessment and speed

The Crispiani method sustains a qualitative culture of Assessment treatment, according to the VES strategy (Empirical Semiotics Approach - Crispiani, 2011) oriented to the description of dyslexia-dyspraxia in terms of "low qualitative measurement". In this context and in recognition of the need to integrate qualitative and quantitative assessment, we have applied a process of measuring the absolute speed, which refers to the time it takes to read selected and standardized passages.

Reading tests and Index of Difficulty of Text (IDT)

The test consists of reading a narrative passage and measuring the time taken.

Characteristics of the passage.

The text reading is part of a set of narrative passages validated by the Itard Staff with reference to: n. 12 complete lines, Times New Roman, 100%, size 12, n. 83/85 beats per line (average and including spaces and punctuation) absence of paragraphs or other interruptions, absence of unusual graphemes (K, J, W, Y, X, etc.), The absence of distractors and foreign words, no repetition of long words (four syllable), very low repetition of general words, absence of the title and any illustrations.

Index of difficulty of the text (IDT) = 0.05. The Index is the ratio between the number

of long words (four syllable or more) and the total number of words.

Modality

Activate the normal form of reception. Perform the test before starting other assessments or treatments. Invite the student to sit inform him that he has to read, avoid any other pronunciation. Show passages with the sheet covered. Simultaneously uncover the text, and start the stopwatch. Stop the clock on the pronunciation of the last word of the text. In each case note:

Date, age (in years and months), class and school attended, number of the text read, time taken (in minutes and seconds).

Type of reading: phonic-fragmented, sibilant, Periodicals sibilant, radical sibilant, sub-voice, predictive (global, intuitive and with errors), refusal of reading, reading correct.

Main distinctive features: slow/fast, fluency/disfluency, opening words, errors, constancy of the disorder or initial reading correct and fluid.

Index Fluidity Individual (IFI). The Index of Individual Fluidity is the ratio between the number of lines/spaces and number of seconds used, (Space Time).

Conclusions

Our Practices defined as Ecological-Dynamic encourage neuromotor and neurocognitive activity with particular reference to the fluidity and efficiency of inter-hemispheric exchange and it also gives a general rapid warning of executive disfunction.

Our treatment improves the following, with great appreciation from parents and teachers, obtainable from reporting and direct observations:

- General executive functions
- Readiness
- executive fluidity
- grapho-motor skills
- reading and understanding of texts
- processes of self-regulation
- Cognitive processes
- An understanding of their practices
- Improvement in school commitment

The experiences reported here consider briefly reading speed after an Intensive Treatment (Champion LIRM), revealing sensitive increases, even within the limits of a brief therapeutic intervention conducted by specialized therapists.

The case study analysed, presents the severity of the dyspraxic disorder and included performance of reading and writing and math skills. After an initial process of Motor Intensive Training (Champion LIRM) and treatment based on Ecological-Dynamic Practices, it shows a progressive and significant functional improvement and active participation.

Informal observations of the approach in practice

On entering the child is put at ease by the therapist, and asked to join in by imitating a series of movements that the therapist executes. Errors in copying the sequence are not corrected, but correct copying is verbally reinforced with praise. There is a clear rapport between the child and the

therapist and even the complex movements are designed to be challenging but fun. These may include walking backwards while juggling. The approach moves on from more complex sequences, to following a pattern of movements recorded in a book held by the therapist - thus translating symbols rather than repeating concrete actions. Finally, the reading or maths is added, once the fluidity and rhythm of the movements has been successfully established.

CASE STUDY – Dyslexia and Dyspraxia

Presentation

Valentina is 10 years old and attends the fifth class of Primary School in Italy. She came to our centre because of learning difficulties, in particular, in the performance of reading, writing and in completing tasks. At school she is disorganized and she often loses attention, looking away, almost enchanted.

She tends to isolate herself from the group and she used to be on friendly terms with only a few of her class-mates. The organization of her homework is stressful because of her slowness in reading and writing. For this reason Valentine often becomes nervous and hesitant in carrying out tasks. Her mother reports that they often spend whole afternoons in the organization of homework because her daughter is slow to start working and to do tasks. When she is left to herself, she often remains motionless or she gradually becomes distracted, looking around or fiddling with objects.

The context

Valentina belongs to a high socio-cultural group, her parents provide a stimulating environment, showing a high sensitivity to the learning process and the value of school and education. The climate, the values and interest in school activities and the daily attention to what happened at school everyday, are important factors that allow a serene educational continuity. It is clear that her parents have done their best to help and support her.

The diagnostic process

After the first interview with Valentina's parents, we proceeded to the functional evaluation according to the guidelines and procedures specific to the "Crispiani Method", with an ecological and qualitative approach, founded on "Bio-Psycho-Active Structure"

Functional assessment

Motor area: Parents referred to delays in motor-coordination but after a long period of difficulties, there have been significant improvements. Today she expresses hesitation in initiating actions, slowness in motor coordination and in the execution of a task, hesitation in walking down stairs and crossing the road. On closer examination, this may be due to her lack of lateral dominance, she is partly left handed and partly right handed with interference and orientation to the left (Hourly closures, mirror writing numbers and graphemes p, b, d, q). Time-space disorder. Awkwardness, clumsiness and general disorientation in team games, especially when they are fast and require coordination with other people (such as volleyball). In terms of

eye movements, previous assessments from other specialists are referred to, as she has difficulty in perceptual tracking and in cross lateral patterns, rotary patterns and speed.

Emotional area: Valentina shows emotional sensitivity with uncertain self-esteem. She has poor and discontinuous attention. Her personal strategy is a tendency to isolate herself, whenever there is too much noise or confusion. She is impulsive but has a strong relationship with her family.

Affective Area: She shows a normal availability and interest in human relations accompanied by discontinuous availability for the task.

Perceptive Area: Her perceptual and visual discrimination are normal in conditions of stillness and calm. However, she has a disorder in perceptual pursuit and synthesis, suffering from an overload of stimuli, reaction to unusual sounds and strong light stimulation. She shows a tendency to repeat to herself what she heard or saw (difficulty in auditory and visual procedural) to reinforce the sequential order.

Area of thought: Valentina shows hesitations and delays in the coordination and sequencing of concepts, thoughts and ideas. She shows poor cognitive organization, indicative of ideational dyspraxia, accompanied by difficulties in temporal and sequential structure. Her poor school performance is due to her learning disorder, exclusively in the executive phase, not in the intellectual one (in terms of dyspraxia, and disorder in sequencing), with difficulty following

sequences of thought and language, above all when they are too long and complex. She demonstrates slowness of activation in cognitive processes (a phenomenon of Mind-Out).

Area of communication and language: Parents referred to delay in development of speech with a global improvement in communication and eye contact over the years. Valentina shows slowness of speech and difficulty in the initiation of speech. She has difficulty with long and fast verbal messages, with a tendency to cognitive loss in multiple explanations, reflecting a disorder of "succession or sequence". In learning, she often requires dual explanations, verbal and written short deliveries.

Social Skills: She expresses a positive attitude even if she tends to self-select interests, hobbies and places or contexts. Reading - Dyslexia in terms of lack of fluency, hesitation, interruptions and losses. She reads better in an oblique direction with small fonts (improving the visual span and movement to the right). She show an uncertain understanding of the text, accompanied by tiredness when reading.

Writing: Dysgraphia in terms of a functional disorder in grapho-motor skill (irregularities generally, untied letters, interruptions), alternating slowness and precipitation. Syntactic structures are often contracted. Uncertainties in proceeding from left to right.

Calculation and math skills: Uncertainties in the time line and in the line of numbers, writing numbers.

Foreign language: Difficulties in written language, better in oral performance.

History: Cognitive loss in timelines. Difficulty in sequencing of events.

Stories: Difficulty with the timeline. Difficulty with the sequence of events.

School situation: Progress at school is compromised because of the disorders of executive functions and the discontinuity of Valentina's attention - concentration.

Consequently to summarize or paraphrase, remember and express properly the contents of the texts, understand mathematical problems, organize verbal exposition, are disordered and confused.

In other words Valentina's performance is often discontinuous, involving procedural - sequential processes, characterized by lack of coordination. She tends to lose attention with frequent cognitive losses, and she often exits from situations (especially when someone talks to her for a long time or when she talks by herself for long). Concerning temporal organization Valentina appears hesitant in telling the facts in the right sequence and she often makes mistakes in the memory of order or procedural memory, rather than in the memory of the individual events.

When she has to do a simultaneous and coordinated action for example two motor activities (clap hands while jumping) or motor and linguistic together (jump and say a rhyme), she is not fluid as a result of a lack of general coordination problems (involving both cognitive and praxic disorder).

Assessment

Valentina has a dyspraxic condition involving severe disorders of reading, writing and math skills based on disorganization in time and space with a poorly defined lateral dominance (dis-laterality).

Symptoms are observed in:

- **The subject:** She demonstrates alternating slowness and precipitation in school performance with a tendency to "cognitive loss" and to escape from the task.
- **Parents:** Valentina's mother, helping her daughter every day with her homework, is especially subjected to a state of strong emotional distress.

Treatment (Intervention programmes)

a. Welcome to the family

In the Crispiani Method, great importance is placed on the relationships with parents.

Referring to the case presented, the interview before the intervention programmes was conducted with efficiency, thanks to Valentina's collaboration and the careful analysis presented by the parents (in this case they are two doctors and inform us in details about some critical aspects). The diagnostic process was followed by the provision of information on the nature of the syndrome, subjective manifestations, trends, intervention

programmes and strategies applied. Parents were informed of the nature of the disorder in terms of dyspraxia, involving difficulty in motor coordination in different functional areas.

b. Treatment

Concerning Valentina's disorder, it activated an intervention programme based on procedures and strategies, that belong to the CO.CLI.TE System (Cognitive Treatment Clinical Education - Crispiani, 2011).

This consists of a series of cognitive and dynamic programmes (12 cognitive training modules) that work to improve automaticity, cognition, coordination of thought and concepts. The dominant trait is a dynamic and qualitative conception of dyslexia/dyspraxia, partially considered as a pervasive disorder that manifests dyspraxia in many other functional areas.

As Valentina lives in an another town, far from our center, a special training has been activated in the form of the Champion LIRM (Intensive Reading and Speed Motor), a very intensive therapeutic intervention with total monitoring of the subject, with a short duration (3 days and for 5/6 hours a day in two stages). The aim of this special training is to improve fluency from a neurological point of view, (Storm Neuromotor) alternating an intensive physical activity (sequential praxic processes) and, after this, exercise of reading in

terms of fluency. This constitutes the programme of Intensive Reading and Speed Motor (Crispiani and Palmieri, 2012).

c. **Assessment of reading speed before treatment**

After the functional assessment of the child, before starting the Intensive Training Programme, a component of reading function, Speed, was also assessed. This was obtained from the time taken to read a narrative passage, with an Index of Difficulty (IDT) 0.05. Valentina's reading performance at the beginning was 3 minutes and 15 seconds, with an index of Individual Fluidity (IFI) of 2.32.

Her performance also showed some important aspects:

- hesitation in reading
- slowness in the initiation (*incipit*)
- Hyphenation at the beginning of the word, prolonged in long words (Pa ... or ... linen, all ar ... mata, pia ne....rozzolo)
- Replacements of words (*piegare* instead of *pigiare*, *aquiloni* instead of *inquilini*)
- Slowness in eye movement and orientation left to right, top down
- Tends to lose line ahead during reading
- Frequent fixations and some regression
- Inclination of the head
- Need to boost voice.

d. **Working method of Champion LIRM (2012)**

The Intervention programme designed for Valentina was divided up as follows:

First day

8:30 to 11:00 & 14:30 to 17:00

Second day

8:30 to 11:00 & 14:30 to 17:00

Third day

8:30 to 11:00 & 14:30 to 17:00

A break was planned every two and half hours of functional activity, alternating each time 15 minutes of physical activity with 3 to 4 minutes of reading until the completion of the specified times.

The Special Training has the following features.

- a. oriented to Sequences - Automaticity - Fluidity, which forms the Polo SAF;
- b. conducted in terms of fluidity with considerable attention to cognitive pressure.

This strengthening functional programme, is based, as in the common training, on the four major vectors named Physio Praxic Vectors (VFP) that constitute the energizing platform:

1. Incipit- initiation.
2. Fluency
3. Cross lateral patterns
4. Rotator patterns.

The main clinical importance of the Champion LIRM is that it is an intensive therapy conducted through

the repetition of physical activities and reading alternating each time, physical activity (15 minutes) and speeded reading (3 to 4 minutes).

The Champion LIRM is a Professional Practice that helps to maintain a high cognitive level providing fluid and automatic convergence of important components such as motor coordination, perception, and language, while reading and writing.

Phase 1

The application of the treatment consists of an initial phase of observational work on the motor behaviour of the child, an important moment since the early days of praxic-motor activity. Through the extension of coordinated activities repeated for over 15 minutes, the therapist takes into consideration the most dysfunctional areas that will be the subject of the intensive work in therapy.

In the case of Valentina, a lack of coordination in motor areas is highlighted, especially in fast movements and cross lateral patterns with loss of sequences.

Difficulty in postural balance is often accompanied by oscillations of the head and the trunk involving the entire body, producing clumsiness and poor self-regulation.

This functional disorder makes the child slow in activation (incipit) and discontinuous in the execution of skills, with a marked loss of attention.

Phase 2

Physical activity is immediately followed by reading for 3-4 minutes, which is outlined in a series of exercises that focus on improving predictive and global reading. The activities proposed in this phase are different and graduated.

The first one is global reading of words at a glance where the educator quickly shows a series of cards with words of varying complexity (two syllables, three, four etc.) and the subject must speed read.

The second activity consists of reading brief sentences that are cut out in cardboard. The therapist shows these quickly and the child has to read at a glance. This exercise is useful for building automaticity without breaking reading into single elements.

In this phase, Valentina appears immediately slow, stumbling in the middle of the word with general irregularities. After showing the card, there are frequently interruptions in perceptive tracking with fixed gaze, lack of initiation of reading, difficulties at a glance as a form of disorder in space-time.

Initial phase of treatment: consideration.

In this first observation, Valentina is characterized by cognitive discontinuity and insufficient coordination in acting, with a tendency to lose concentration and difficulty with sequences.

In summary, a previous list of indicators have emerged in motor, communicative

and perceptual areas. Valentina has difficulty in the following areas.

MOTOR AREA:

- Execution of fast motor sequences
- Execution of sequences with the ball
- Execution of motor coordination
- Executions of praxis using her hands
- Execution of ballistic coordination
- Simultaneous realization of multiple functions both perceptual-motor and verbal-motor)
- Control of multiple functions
- Frequent lack of lateral dominance (interference)
- Frequent dyspraxia in lateral and cross patterns

COMMUNICATIVE AREA

- following verbal instructions and putting in sequences
- using syntax in a communication

PERCEPTUAL AREA

- Perception of distance
- Execution of rhythms
- Execution of visual and auditory procedures

Results

General functional gains

One of the first signs of improvement that was recorded was the reduction of sequential disorder, a cause of slowness and disorganization in space-time. Valentina has improved in the coordination of motor areas (control of multiple functions, speeded cross patterns, general fluidity, incipit) and in reading.

Below the evaluation about the four major vectors Physio - Praxis - Vectors (VPF), incipit, fluidity, cross patterns, rotary patterns.

1. **Incipit:** significant improvement in motor readiness, both in starting the coordinated motor gesture and in the readiness of language. A decrease is revealed in the initial suspension of word attack or interruptions in reading. Valentina showed sufficient capacity to maintain concentration and attention in execution of tasks. There was a reduction of excessive movements with head and body, coupled with an observable relationship between attention and gaze.
2. **Fluidity:** significant fluidity in the rhythms and the creation of more functions with sufficient appropriate monitoring of multiple functions and speed work. Cognitive participation became less disoriented and unsure. Reading more fluid with reduction of moments of fixed gaze on every word, more regular shifts from left to right.
3. **Cross patterns:** better efficiency of cross system (hand, foot, eye and ear) and directionality in space expressing a greater fluidity of the limb against the opposite side.
4. **Rotary patterns:** At the beginning, the movement was insecure and poorly organized in time-space, alternating abrupt gestures, slow and precipitous, but the frequency of exercises improve the result and allows the storage of the motor pattern.

Gains in reading

At the end of the intensive special training, Valentina was given a new reading test aimed at speed, obtainable from the time taken to read a new piece of the same length (bars and spaces) and the same index Difficulty of Text (IDT) of 0.05. The reading was performed in 2 minutes and 10 seconds, and with an index of Individual Fluidity (IFI) of 1.66.

The student also expressed:

- Reduction of hyphenation
- Greater accuracy
- Reduction in minor interruptions (more fluidity).

A substantial improvement was recorded in terms of speed (space/time) and accuracy compared to the first evaluation, best expressed by the Index of Individual Fluidity (IFI).

Individual Technical Report

At the end of the treatment lasting 3 days, for 15 hours, Valentina has made excellent progress. She has improved in her organizational functions in general, with particular reference to the motor area and in terms of reading fluidity her percentage improvement is 34% in three days.

All this information was provided in an Individual Technical Report and given to the family. It contains of both the evaluation output (post test) and recommendations for the family, school and therapist (work plan and monitoring), that is useful for the maintenance of gains obtained in motor coordination and fluidity of reading and writing.

Conclusions

Intensive Rehabilitative Treatment, in this case based on Champion LIRM, tends to accelerate improved neuromotor plasticity that is reflected in many performances coordinated in space and time.

The intensiveness, the right pressure and the consistency of the work, are the origin of the enhancement of this neurological pattern in the sense of the automation and speed work.

OUTCOMES AND ASSESSMENT

Assessment of Rehabilitation Treatments according to Crispiani method (Ecological Dynamics Practices)

The target

The study concerns the value of the speed of reading execution, measured before and after the treatment according to the Ecological and Dynamic practices belonging to the Crispiani Method. Assessment, treatment, measurement and data processing were conducted by the research team consisting of Piero Crispiani, Ivan Di Pierro, Antonio Grifoni, Eleonora Palmieri.

THE PARTICIPANTS

The tests and measurements were administered to a sample of n. 33 Italian dyslexic children between 7 and 13 years already diagnosed with qualitative or quantitative procedures, including 19 females and 16 males.

All the participants undertook a "Functional assessment" conducted in the Psychology and Pedagogy Clinic Centre

"Victor" in Macerata, including a syndromic picture affected by the following:

- General dyspraxia
- Clumsiness (difficulty in movement patterns and rapid crusaders (rapid movements combining opposing hand and foot in cross over , synesthesia, self)
- Hesitation (slow in activation - incipit) in praxic-motor planning and linguistic expression
- General lack of fluency in executive function, alternating slow and fast action, disorder in automaticity
- Lack of coordination in many areas
- Disorganization of space and time
- Lateral dominance not established
- Slow reading and lack of fluency, with breaks, inversions, cognitive loss, and tiredness
- Slow writing and irregular grapho-motor disorders, missed closures, interruptions (disconnected letters)
- Difficulties in the field of mathematics are considerable, with uncertainty in relation to writing long numbers, queuing, rapid movement in the line of numbers, calculation, oral comprehension, problems, etc.

Treatment

After the Clinical Evaluation, all the participants attended Rehabilitative Treatment for 3 months, three times a week, (one hour each time) at our Psychology and Pedagogy Clinic Centre "Victor" in Macerata, from September 2014 to January 2015.

Treatment consisted of the fluid dynamics of sequential actions/procedures and

control of executive functions: motor training, grapho-motor skills, perception, memory, thought, space-time organization, working left-right, language, reading, writing, maths skills and activities understanding of texts, together with practices of self-cognition and general educational support.

Practice in Motor Training (Training praxic-motor and general Activity Gym) was activated and 12 sessions of training programme based on the Crispiani Method, accompanied by advice for schools and families:

- Family Educational Practices (PEF)
- Warnings School (ASCO)

Assessment of Performance of Reading (VEL)

In the logic of our professional practice, the assessment of performance of reading follows a procedure at the beginning of each therapy. Our team has a series of narrative passages, unknown to the reader, that were written and standardized by the Itard Team.

The characteristics of the text are described in the Crispiani Method, in the first part of this article.

The outcomes

In this section we present the data with results for the improvement achieved after three months of treatment. In terms of the variability of initial reading, there is a difference at the pre-test, as it is not similar in all subjects, but depends on the level of severity of the disorder. This aspect is necessary because it is reasonable to expect major changes to

be variable based on the level of initial performance.

Effectiveness was evaluated by the difference in fluidity in reading before and after training, and also, as a further measure, it was decided to consider not only the simple difference between before and after, but also the incipit (the start of the word) inversions and so on.

In summary, our treatment is effective because it provides the best changes in fluidity, in terms of consistency, which does not reflect absolute speed but the following:

- Readiness
- Constant trend
- Right speed
- Lack of interruptions
- Scarcity of errors
- Self auto regulation
- Constant attention

The tables and graphs below show the results achieved.

Table 2 displays the average of the differences between reading speed before and after treatment according to the calculation index of Individual Fluidity. In this table, starting from the left, we report the initial value of each subject, then the value after three months of treatment, and the percentage of improvement for each one (a mean of 30% improvement).

Figure 1 displays the score for each subject at pre and post test.

Figure 2 shows a chart presenting reading performance at the beginning and end of therapy: as you can observe the changes appear to be significant. The gray line

Table. 2 Average of the differences between reading speed before and after treatment

	Start	After 3M	- %
Samuele	3m 21s	2m 49s	15,9
Viola	4m 36s	3m 58s	13,77
Giacomo	2m 48s	2m	28,57
Veronica	2m 43s	2m 8s	21,47
Matteo	2m 32s	1m 24s	44,74
Tommaso	1m 33s	44s	52,69
Michelle	1m 25s	1m 4s	24,71
Rebecca	1m 2s	38s	38,71
Mandarina	2m 20s	1m 20s	42,86
Giacomo II	1m 50s	50s	54,55
Daniele	2m	1m 23s	30,83
Serena	1m 20s	45s	43,75
Angelica	1m 25s	1m 2s	27,06
Giorgio	2m 40s	1m 58s	26,25
Emma	3m 10s	2m 34s	18,95
Matteo II	5m 32s	4m 36s	16,87
Marco	2m 34s	2m 7s	17,53
Anna	2m 57s	2m	32,20
Assunta	1m 45s	1m 2s	40,95
Alessio	3m 5s	2m 15s	27,03
Chiara	1m 26s	46s	46,51
Margherita	3m 17s	2m 45s	16,24
Sara	2m 22s	1m 40s	29,58
Tommaso II	2m 54s	1m 49s	37,36
Alessio	2m 49s	1m 43s	39,05
Diego	3m 39s	2m 35s	29,22
Umberto	2m 29s	1m 39s	33,56
Laura	1m 34s	44s	53,19
Luca	1m 44s	56s	46,15
Riccardo	2m 21s	1m 34s	33,33
Francesco	3m 23s	2m 47s	17,73
Chiara II	2m 14s	1m 10s	47,76
Vanessa	2m 33s	1m 16s	50,33
Media in sec.	152s	105s	-30,92%

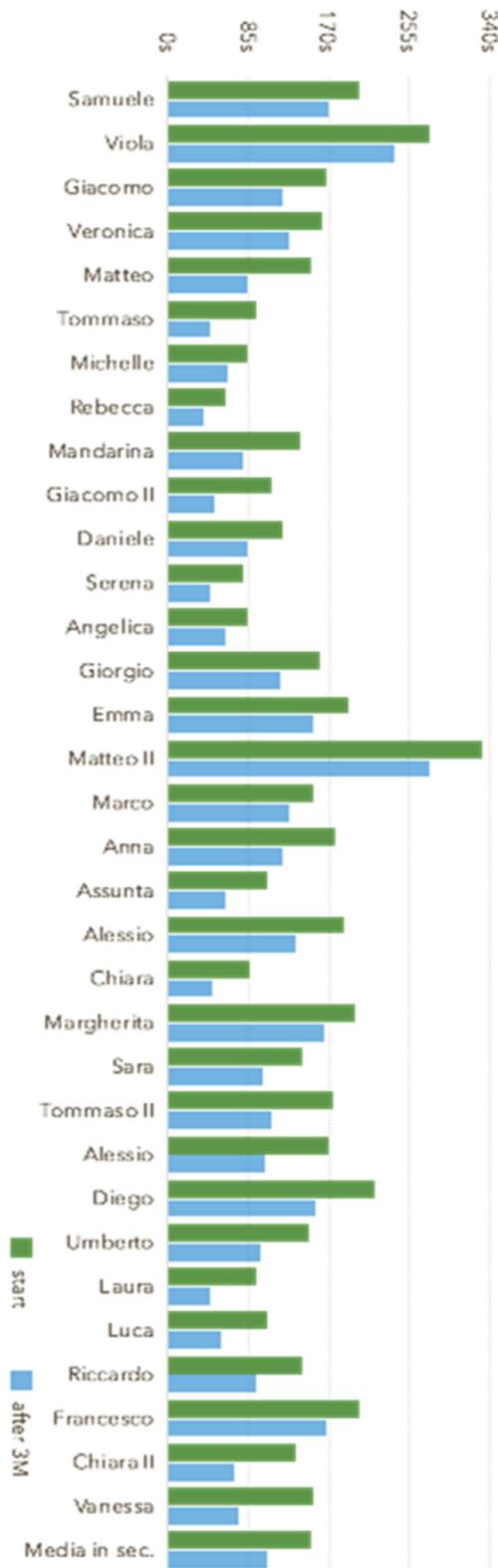


Figure 1 Pre and post test scores



Figure 2 Pre and post test scores

shows that all subjects improve in fluidity compared to the initial phase, the orange line shows the slow process of production at the beginning of treatment.

Table 3 and Figure 3 show the percentage improvement after three months of treatment. This improvement ranges from 10-60% compared to the initial phase. The majority of subjects achieved results between 20 and 50%.

Table 3 The percentage improvement after three months of treatment

differenza %	f %
< 10	
10-20	7
20-30	8
30-40	7
40-50	7
50-60	4

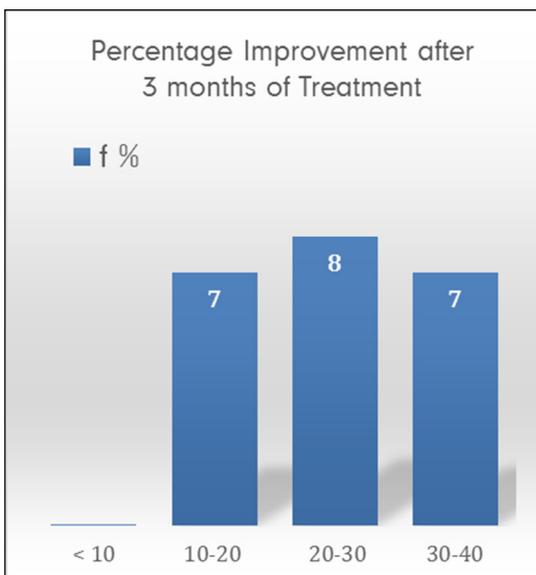


Figure 2 Percentage improvement after three months of treatment

In a further explanation of increased fluidity, the sample shows that the improvements are in readiness to start with decreased interruptions (stumbling) and a more consistent rhythm.

A repeated measures *t* test was undertaken on the times for pre and post test, (mean pre-test, 153seconds, mean post-test 108 seconds, standard deviation 55.4 and 54.4 respectively), *df* 32, $p < .0001$. This shows a highly significant effect of the intervention, with the time for each child reduced from pre to post. In terms of our high and low achievers, if we split the groups into 2 with group 1 subjects (fast) completing the pre-test in less than 150 seconds, and group 2 (slow) taking longer than 150 seconds, it is interesting to note that the improvement in group 1 is 50 seconds and in group 2, 49 seconds. Although there is more room for improvement in the 2nd group, it should be evident that both groups make good progress.

Conclusions on our research

The treatment based on Ecological Dynamics Practices within which the Method is performed, shows improvement in a concise time of 3 months. This study provides evidence that the treatment is efficient because it aims to affect the automaticity of the reading process through qualitative and intensive procedures.

The reading speed, translated as fluidity, is the potential recovery obtained by all subjects, which is pervasive in all areas of the personality in an ecological and dynamic approach impacting on the whole child and their performance. In this sense the issue of the potential recovery is

central, since our treatment is aimed at people of all ages and regardless of the initial level of severity. Our treatment is open to all, not only at the early grades of elementary school, getting the first results in the first month. To be effective, these treatments must be carried out intensively, 3 hours a week for three months. The treatment has been designed to be not only effective but also cost effective, with moderate charges for participation in the treatment.

In conclusion, and in terms of the requirements of fluency and comprehension, we have been able to speed the reading and increase the word attack and concentration of a group of children with evidence of dyslexia. Building on theoretical perspectives that are well-regarded in Italy, of the need for attention and motor fluency, we have combined reading and co-ordinated movement in order to smooth the sequencing and fluidity of reading. The approach restores an element of fun and challenge to the reading process and can impact on the self-esteem and success of the whole child.

Limitations and directions for further research

Although the data provided in conjunction with the case study provide some evidence for the effectiveness of the Crispiani approach, we cannot extrapolate too strongly from these results. Ideally, the gold standard for educational research would be a double blind controlled study. However, it is clear that this is not really possible to deliver within an educational setting and the best we could hope for would be a controlled study where the performance of children

undertaking the Crispiani method was compared with a matched group of children who did not undertake this approach. Nevertheless, the quasi-experimental approach adopted here, with each child acting as their own control, has been widely used in intervention research. Secondly, it may well be that there is an experimenter effect with a whole child intervention of this type with the relationship between the child and the therapist influencing the results.

Clearly further research would need to be undertaken to address these issues. It should also be noted that concerns have been expressed over the use of motor skill interventions that do not include reading practice in the UK and USA, with English particularly susceptible to problems in phonology. Nevertheless, the evidence provided here is suggestive of a highly significant positive impact for the approach for the Italian language, and this reflects similar evidence from other studies of co-ordinated movement (e.g. McPhillips et al., 2000 in Ireland) but here for the first time providing some evidence of improvement in fluency of reading, one of the key issues in literacy research.

It is important to acknowledge that the children who took part in this study in the main showed severe impairments reflecting complex needs, and that Italian is a regular language that may be less susceptible to problems in phonology. If this pattern of results can be found with other children with co-morbid problems who have proved resistant to traditional remediation, it has implications for our understanding of the importance of the whole child in therapy. In particular, the emphasis in success and positive

feedback to enhance self-esteem and commitment to succeed may prove to be an important contributory factor for remediation in all languages.

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