Dyslexia and Additional Academic Language Learning

Module 2

UNDERSTANDING DYSLEXIA

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Original version. Versions of this module adapted to the local contexts of partner countries can be downloaded from the relative sections (see appropriate flag symbols)

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Lifelong Learning Programme

Dyslang Module 2
Understanding dyslexia

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Learning outcomes

- Acquire basic knowledge about dyslexia, in terms of possible manifestations, causes, relation to other learning difficulties.
- Acquire an awareness of the neurodevelopmental systems involved in specific learning disabilities andthe possible observable behaviours related to them.
- Acquire an awareness of the psychological consequences of dyslexia.

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Introduction

Dyslexic learners have many talents that just don't happen to include reading and writing.

John Stein

Dyslexia is by now a widely known but poorly understood specific learning disability.
It can be difficult to define because the causes underlying its measurable manifestations can be very variable. However, dyslexia is a real problem, which affects the learning of reading and writing of many individuals and whose effects may be exacerbated by an inadequate education. The complexity of the problem is increased by the fact that dyslexia and reading and writing difficulties may vary according to the cultural and linguistic background.

You cannot talk about a "typical dyslexic". Each individual must be understood and helped in relation to their specific characteristics, linguistic background, learning styles, strengths and weaknesses.

Unfortunately, many schools are still *"unequipped for the diversity in learning that unfolds in the classrooms […]. Educators often lack the know-how that's emerging from the latest research on the mind, brain, and learning to adequately respond to individual student needs. When students are taught in a way that is incompatible with how they learn, the natural strengths of their minds are neglected"* [1]

1. Barringer et al., 2010 pag. XVII.

This will result in low self-esteem, anxiety, lack of motivation, and disengagement with learning and school.

For these reasons it is extremely important for teachers to understand the nature of dyslexia, its manifestations and its consequences, and to be aware of the support measures that can be put in place to help their pupils overcome their difficulties.

Teachers need to understand that by bringing "the science of learning to the art of teaching", they will be "rescuing those students who are struggling to learn right now, while transforming education for generations to come" [2]

2. Barringer et al., 2010 pag. XXIII.

2.1 Specific learning disabilities

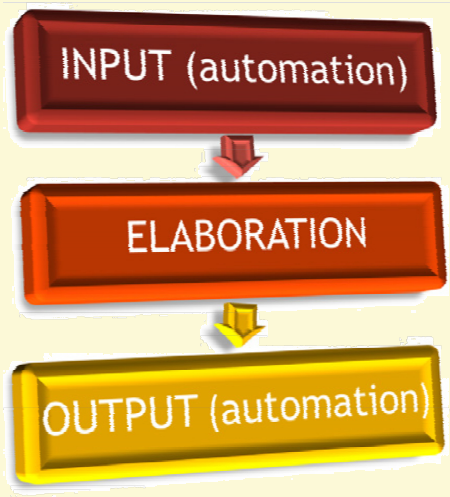
Dyslexia, dysorthography, dysgraphia and dyscalculia form together a heterogeneous group of developmental disabilities known as Specific Learning Disabilities (SLD). The main characteristic of these difficulties is that they are "specific", that is, they affect a specific range of abilities in a significant but selective way, leaving intact the general intellectual functioning. Other characteristics of SLD are the following:

They are developmental in nature: the neural structures are constantly developing and specific learning disabilities occur only when a child is exposed to reading, writing and calculation.

- They are expressed differently in the different stages of development: specific learning difficulties cannot be cured, since they are not diseases, but they can be compensated for "Children's disorders are disorders that change in people who change" (Bollea, 1989)
- They are almost always associated with each other and/or with other difficulties such as language disorder, dyspraxia, attention deficit disorder with or without hyperactivity, ...
- they are very heterogeneous in terms of functional individual profiles and manifestations.

SLD cannot be attributed either to a cognitive deficit, nor to a sensory deficit, or to unfavourable environmental conditions (exclusion criterion). They involve a discrepancy between performance tests of reading and / or writing and / or calculation, compared to the educational and intellectual level (criterion of discrepancy). Therefore, the difficulties which are manifested, are unexpected, if one takes into account the other aspects of the development of the subject.

Box 2.1 Cognitive processes



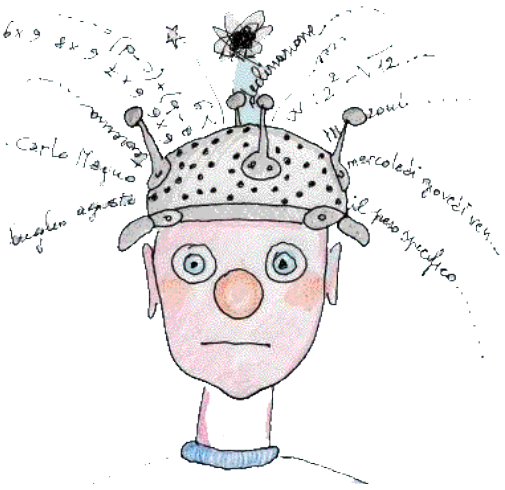
Those with dyslexia, who have a **deficit in the automation** of basic reading and writing, require support in the input and/or output part of the cognitive process. Through the appropriate compensatory measures students will be able to learn and acquire 'knowledge'.

SLD manifest themselves only at the beginning of schooling. They concern instrumental skills, those that should be performed automatically, such as decoding, association of symbols, calculation and that commonly provide access to learning the different school subjects (such as history, geography, literature, ...).

A student may have problems in a certain context, but this does not mean that they are not capable of learning. There is usually an alternative strategy that may be effectively used and the teacher's role is to help the student to explore all possibilities and to develop strategies that best suit them!

Specific learning disability have a major impact both at the individual and at the social level.They frequently lead to a lowering of academic performance and/or early dropping out of secondary school, and they reduce the potential in social and work environments. Particular caution should be used in the case of children whose first language (L1) is different from the language of schooling.(for example immigrants or adopted children from foreign countries).
In these cases the risk of both "false positives" and "false negatives" must be considered carefully.That is, there may be people who are diagnosed with an SLD, but whose difficulties can actually be explained by their linguistic and cultural background, and people who are not diagnosed a really existing SLD because their difficulties are mistakenly attributed to their multilingual background.
For this reason *"in order to define the functional profile of a child we need to formulate a synthesis between the intrinsic elements (neurobiology and neuropsychology) and the social, environmental and interactive elements in his development (inter subjectivity)*" (trad. from Cappa et al. 2012).

2.2 What is dyslexia



The first definition of developmental dyslexia was formulated in 1896 by the British physician W.P. Morgan, who defined it as “congenital word blindness”. Since then, many other progressively more specific definitions have been provided. According to the European Dyslexia Association

> *Dyslexia is a difference in acquiring reading, spelling and writing skills, that is neurological in origin. The cognitive difficulties that cause these differences can also affect organisational skills, calculation abilities etc. It may be caused by a combination of difficulties in phonological processing, working memory, rapid naming, sequencing and the automaticity of basic skills*[3]

3. EDA - http://www.eda-info.eu/en/about-dyslexia.html [Last accessed 18/12/2013]

Other definitions have been provided by different authors, for example:

> *Developmental dyslexia is a specific learning disability that is neurobiological in origin. It is characterized by difficulties with accurate and/or fluent written word recognition and by poor spelling and decoding abilities. These difficulties are often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction*[4].

4.Lyon, G. R., Shaywitz, S. E., & Shaywitz, B. A. (2003). A definition of dyslexia. Annals of Dyslexia, 53, 1–14.

Other definitions can be found in the websites of various dyslexia associations or official documents in Europe and in the world (see module 3). In this module we are going to talk about dyslexia in a brief but as detailed as possible way, in order to provide teachers with the necessary information they may need in case they are faced with pupils presenting difficulties in the acquisition of literacy.

2.3 How does dyslexia manifest itself

Dyslexia concerns the ability to decode a written text, and manifests itself when reading accuracy and fluency are not automated. The first recognisable sign of dyslexia is the **slow and difficult learning of loud reading** (when we talk about reading, we always refer to the ability of our students to read at first sight correctly and fluently). The child shows difficulties in recognising letters, in associating graphemes to phonemes, and in automating these tasks, so in decoding quickly and without apparent effort. In students with dyslexia, **loud reading turns out to be is slower and/or less accurate** than expected, compared to the age, school level, and education received.
Gli errori commessi sono specifici e riguardano:

- Difficulties in alphabet learning
- Difficulties reading and pronouncing unfamiliar words or words that are rarely used.
- Difficulty in maintaining the reading line Dyslexia manifests itself in different ways, depending not only on individual cognitive characteristics, but also on the language used. According to some authors (Paulesu et al., 2001, Dehaene, 2007) a child's predisposition to dyslexia is determined by his/her genetic and neurobiological origin, and is independent of the linguistic and cultural background. However, in countries with non transparent alphabetic writing (Where acquiring the association between phoneme and grapheme requires a greater effort) shows stronger manifestations, becoming a considerable clinical and educational problem.

Therefore, if we can talk about **universality of dyslexia at a neurobiological level**, we definitely cannot at a **phenomenological level**, since the manifestations of difficulties in learning to read and write, can **be very variable and language dependent.** They vary depending on the degree of transparency of the language, its phonology and morphology.

In transparent languages (like Italian, Spanish, German, etc..), which have a direct correspondence between phoneme and grapheme, the incidence of dyslexia is much smaller than in non transparent languages such as English or French. In these languages, the phoneme-grapheme correspondence is often arbitrary and it is not always possible to read a word correctly if you have never heard it pronounced. For example, the 40 phonemes (sounds) of English can be represented by 1120 different grapheme combinations (letter

combinations) and the relation between phoneme and grapheme is fundamentally ambiguous. Therefore it is possible that an individual has greater manifestations of dyslexia in a language (the more opaque), rather than in another (the most transparent),-As a matter of fact, the estimated prevalence of dyslexia among school children in Italy (Cornoldi, 2007a) ranges between 3 and 5%, compared to 10% found in English speaking countries where the language is orthographically more complex.

Dyslexia is not related to written comprehension abilities, but the difficulty in understanding a written text, read autonomously, may be a secondary effect, that is a simple consequence of a slow and stunted decoding. This may lead to a reduced exposure to written texts, that can prevent the expansion of vocabulary and of general knowledge (Lyon et al. 2003).

Box 2.2 About English spelling

For a fascinating discussion of the peculiarities and inconsistencies of the English language, including the historical perspective, try this web page from Masha Bell: http://www.eda-info.eu/en/about-dyslexia.html [Last accessed 18/12/2013]

Many people with dyslexia also have **difficulties in learning information sequences** (for example letters of the alphabet, multiplication tables, months of the year) and in the **identification of space and time relations** (for example right / left).
When it comes to learning a new language, the difficulties a dyslexic student may have to face increase significantly. Because learning a second language is based on skills that are common to those necessary for the acquisition of the native language, **the difficulties that may occur in the mother tongue will be transferred to the second language**. So students with difficulties in phonology, spelling and syntax may also have similar difficulties in the new language (Sparks et al., 2006). For this reason, and considering the importance of knowing more than one language in the present days, teachers must be aware of the possible support measures that may help students with difficulties achieve a sufficient level of proficiency.
In 98% of cases (Gagliano et al. 2007), dyslexia is associated to dysorthography. This a difficulty that concerns written language and spelling abilities. These are generally poor, with respect to age, school grade and education received.
In students with dysorthography, writing is characterised by different types of spelling mistakes, and the same word can often be spelled in several ways within the same text.

The most common spelling mistakes made by students with dysorthography are:

- **Substitutions**
  - due to phonological similarity: d-t; f-v; c-g
  - due to graphical similarity: b-d; n-u
  - due to both phonological and graphical similarity: b-d; m-n

- **Omission**
  - letters: boat / bot
  - double consonants: little / litle, balloon, baloon
- **Insertion**
  - addition of letters: the / ther
- **Repetition**
  - cafeteria / cafefeteria
- **Transposition**
  - park / prak ; horse / hrose ; does / dose

- **Orthographic representation**
  - quater/ cwater; height/ hite
- **Lexical-semantic errors** (particularly homophones)
  their / there ; two / two / too

In addition, **capital letters are often left out or misplaced; accent marks, apostrophe and punctuation** "almost become an option". Finally, some pupils, perhaps unconsciously, try to reduce their handwriting size and make it incomprehensible, in order to hide spelling mistakes

ON REFLECTION TASK 2.1

- Have you ever noticed, in your students' written school work or homework, errors similar to those listed above? Are they variable within the same text and from one day to another?
- When your students happens to make some of the above errors, have you noticed any difference, in terms of amount and nature of those errors, between the foreign language and the mother tongue?

2.4 Hypotheses about the causes of dyslexia

Over the past 20 years, research in developmental neuropsychology has tried to identify the "core deficit" of dyslexia, but both clinical and experimental research have identified a variety of functions and cognitive processes that are related to developmental dyslexia. Therefore, the underlying causes of dyslexia, and consequently its manifestations, may vary in different individuals.

If the main cause of dyslexia, as recognised by the majority of the scientific community, is poor phonological awareness and deficits in phonological processing, large agreement has recently been achieved on the multifactorial origin of specific learning difficulties. The main factors involved are the following:

- visuo-perceptual disorders
- deficits in working memory
- deficits in the storage and retrieval of vocabulary
- alterations in the magno cellular system in the cerebellum.

Certain authors (Pennington, 2006), in recent research, prefer to talk about shared mechanisms at the neuropsychological and genetic level underlying reading ability. (See Box 2.3 - "The Reading Pyramid").

This explains comorbidity as being caused by common risk factors, and this has important implications for both clinical practice and for educational interventions. Therefore it would seem necessary to intervene, not only on specific deficiency factors, but also in enhancing the neuropsychological prerequisites.

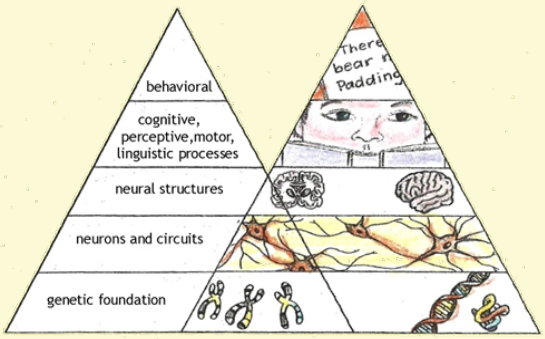
As already mentioned, another important factor to take into consideration is environmental variability, that is the linguistic background of the individual. Some aspects may prevail in regular orthographies (Italian, Finnish, German, etc. ..), some others in non-transparent languages (English, ...) and in languages with different writing systems, such as the logo-syllabic ones (Chinese, Japanese).

For a recent review on developmental dyslexia see Peterson & Pennington (2012).

Peterson R.L., and Pennington B.F. Developmental dyslexia. www.thelancet.com Published online April 17, 2012 DOI:10.1016/S0140-6736(12)60198-6
http://www.lineeguidadsa.it/criteri_diagnostici/DyslexiaRev_Peterson012.zip

Box 2.3 The reading pyramid

Starting from the model of Pennington (2006), Maryanne Wolfe (2007) described the pyramid of the behaviours of reading (see fig.) We can imagine this pyramid as an iceberg. The visible part of the iceberg is the behavioural level of the child, who manifests difficulties in associating phonemes to graphemes, in automating the decoding process and in acquiring spelling abilities, despite good general cognitive skills.ali.



Immediately below the surface there are cognitive processes (perceptual, linguistic, motor, mnemonic, attentive) and executive functions, which determine the performance examined and assessed at a neuropsychological level.
The variety and complexity of these processes and of their interactions can explain how the same "symptom" (deficit in reading and writing) can be determined by a variety of factors their different interactions.

Below this level, we have the structures of the neural networks, made up of the neurons and of their synaptic circuits. At this level, the clinical investigation stops, although there are data coming from neuroscientific research documenting damage of the "neural circuits of reading". These findings come both from classic works like Galaburda (1993) but also from more recent studies of the group S. Dehaene.

Finally, at the base of the pyramid, we have the genetic foundation, responsible for the development of cells of our body, in interaction with the particular life environment.
Today we know that there is no single "gene for dyslexia", but research on familiarity in dyslexia have identified multiple genetic loci (E. Grigorenko 2005). The variety of loci involved determines the variability of neuropsychological deficits encountered, and consequently the subtypes of SLD that may manifest themselves as different phenotypes.

Reading does not seem to have a direct hereditary basis, but every time the brain learns to read, it must activate the higher levels of the pyramid to forge the neural circuits necessary for reading ex novo (S. Dehaene, 2007).

Wolf, M.,(2007), Proust and the Squid: The Story and Science of the Reading Brain, Harper

2.5 Comorbidity and dyslexia

Comorbidity is defined as the **simultaneous presence, in the same person, of multiple difficulties** that are not related by any causal link.

As mentioned previously, recent research explains that comorbidity is caused by **common risk factors** (Pennington, 2006), with important implications for both clinical practice, and educational interventions.
The enhancement of cognitive processes in education could play a key role also in terms of prevention and containment of comorbid disorders and relapse in daily life.
There are two different types of comorbidity, **homotypic** and **heterotypic,** as described in the following paragraphs.

2.5.1 Homotipic comorbidity

The term **homotypic comorbidity** is used for the simultaneous **presence of different types of SLD.**
Homotypic comorbidity of dyslexia with dysorthography, dysgraphia and/or dyscalculia is very frequent.

a) Dysgraphia

Dysgraphia is a disorder that affects the **praxis of writing** . In relation to age and education, writing will be less fluent and/or the graphic aspect will be of lesser quality and more difficult to understand. The student will also show signs of greater fatigue in comparison to his/her peers.
Dysgraphia is therefore a specific difficulty in handwriting: the graphic sign of a student with dysgraphia will be uncertain and inadequate in shape and size.

The most important indicators for dysgraphia are the following:

- letters or words poorly aligned
- insufficient space between words
- tight connecting bends
- irregularities in links (pauses)
- absence of connections
- collision of letters
- variable shape and size of the letters
- deformations of letters
- reworking and corrections.

Dysgraphia affects only the executive skills of writing and is not to be confused with abilities in drawing, unless it has a dyspraxic basis.

In fact, a student with dysgraphia may have good skills in drawing. In this case, the difficulties do not arise at the beginning of literacy, but only around the third year of schooling, when writing should be automatic. A child with these sort of difficulties has well expressed to this condition:

"Before I used to draw letters, now I have to write!"

A similar case is also described by Mel Levine (2002)

5. Mel Levine (2002) Mind at a time. Simon & Schuster

> *From the age of two, Raoul loved to draw. At nine his cartoon creations displayed precise fine motor control. But somehow Raoul could not engage in the rapid assignment and activation of his finger muscles required for letter formation, a classic example of strong fine motor function accompanied by a stubborn graphomotor dysfunction[5].*

Therefore, if dysgraphia has a dyspraxic basis (See par. 2.5.2, point b), the student will manifest difficulties both in writing and in drawing.

b) Dyscalculia

This is a deficit in understanding simple number concepts and learning number facts and procedures. Dyscalculia affects:

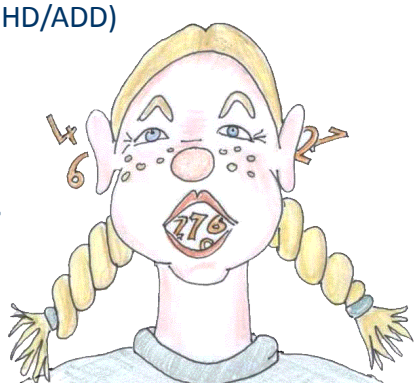
- **basic numerical skills**
  making it difficult to:-
  - o subitizing (see small quantities of numbers (3 or 4) without counting)
  - o quantifying mechanisms
  - o seriation
  - o comparison of quantities
  - o strategies for composition and decomposition of quantities.

- **the procedural area:** making executive procedures related to written calculations more difficult. This means that errors or slowness will occur in:
  - o reading and writing of numbers
  - o aligning numbers into proper columns
  - o retrieving numerical facts (eg. multiplication tables)
  - o written calculation algorithms.

Discalculia has nothing to do with problem solving abilities. So it is important, when trying to understand the difficulties of the individual in the area of maths, to separate the actual mathematical problem solving from any possible difficulties reading the text that presents the maths part of the question.

2.5.2 Heterotipic comorbidity

Researchers talk about **heterotypical comorbidity** when **SLD are associated to other developmental disorders.** The disorder that occurs most often in heterotypic comorbidity with dyslexia is certainly language disorder, but it is also common to find dyslexia associated with dyspraxia (motor learning disability) and with attention deficit disorder with or without hyperactivity (ADHD/ADD)



a) Language disorder

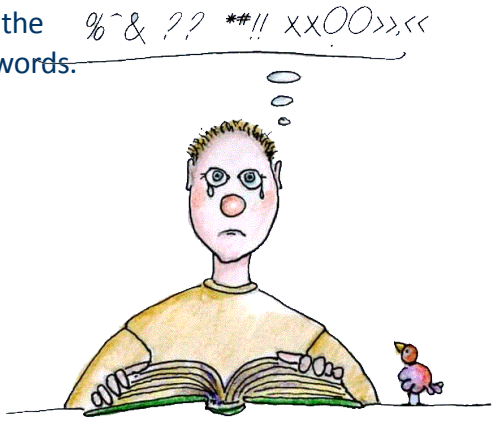
Children who have or have had difficulty in phonological abilities (especially when these have persisted after four years of age) **are at high risk** (> 50%) **of developing delays or disorders in reading and writing learning.** Sometimes, these disorders are accompanied by problems of attention control, probably due to excessive mental fatigue when carrying out such activities.

An adequate lexical and semantic competence (concerning the set of known words and their meanings) as well as a morphosyntactic competence (concerning the set of rules governing word and sentences formation) are necessary requirements to improve reading and writing skills. Difficulties within the semantic / lexical area, may make it difficult to understand the meaning of words, especially low frequency words. In this case, the student will tend to use only common words, without incorporating in his vocabulary new words learned at school, and unusual terms like those related to particular subjects such as history, geography, etc. In the morphosyntactic area, the student will have problems in interpreting and understanding the meaning of complex sentences within a text.

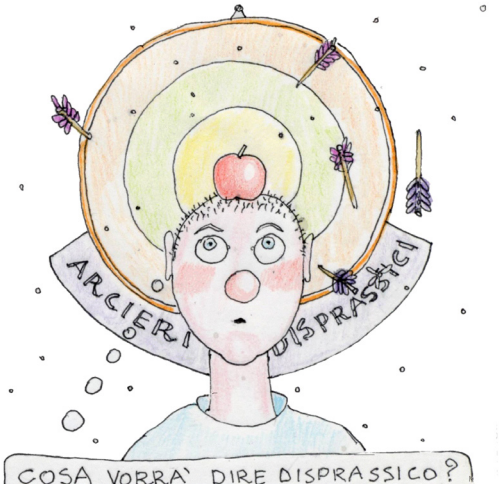
There may be also difficulties in written text comprehension (the ability to distinguish the single elements in a text that are coherently organised, meaningful and oriented to a specific purpose) which can cause the student difficulty in capturing aspects of “textual organisation” such as the hierarchy of

a text, textual inferences etc.

Finally, difficulties may arise in retrieving the sound shape and orthographic shape of words.



b) Dyspraxia



Dyspraxia is a disorder that affects the performance of intentional movements. The difficulties it entails concern the abilities to plan, program and complete an intentional action, oriented to a purpose. According to Habib (2003) disorders related to motor skills can be found in about 26% of a population with learning disabilities (study carried out on 209 children with learning disabilities), while according to Stein (2004) comorbidity with reading disability goes up to 50%. The main characteristic of dyspraxia is difficulty in the development of motor coordination that significantly interferes with learning school subjects and with daily life activities. Manifestations of the disorder, as well as dyslexia and other SLD, vary with age and development. Younger children present clumsiness and delay in reaching the fundamental stages of motor development (eg., walking, crawling, sitting, tying shoes, buttoning a shirt, etc..). Older children may exhibit difficulties in building activities, assembling puzzles, model making, playing ball, handwriting and writing block capital letters (DSM IV, APA 1994, 1995, 2000).

Not all children with reading disabilities have motor difficulties. Also, when such difficulties are present, they tend to progressively decrease with age Denckla, 2003). This a typical spontaneous tendency of minor motor symptoms (problems with balance, accuracy of gesture, execution of praxis).

c) Attention Deficit Disorder

Attention Deficit Disorder/Hyperactivity Disorder, or **ADHD** (English acronym for Attention Deficit Hyperactivity Disorder), **is a developmental disorder of self-control.** It includes **inattention** and **impulsiveness/ hyperactivity.** These problems stem mainly from the i**nability of the child to regulate their own behaviour in relation to th**e passing of time, the achievements of their objectives, and the demands coming from the environment. Attention difficulties can be in isolation or associated with hyperactivity (ADHD), and can involve one or more monitoring processes.

The Attention Deficit Disorder may include:

- **Inattention**: involves difficulties in focusing on details, a tendency to easily get distracted and the inability to concentrate on a certain activity until it is completed.
- **Impulsiveness**: the inability to inhibit responses or behaviours that are not appropriate. Children with this disorder have a deficit in executive inhibition, that is a difficulty in selecting the most relevant information, in choosing the most appropriate answer to a question and in inhibiting impulsive and automatic responses.
- **Hyperactivity**: defined as an excessive and inappropriate level of motor activity that manifests itself with constant restlessness.

Dyslexia and ADHD are often associated (Germanò et al, 2010), whether the initial diagnosis is of reading disability (Willcutt & Pennington, 2000) or ADHD (Semrud-Clickeman et al., 1992).

ON REFLECTION TASK 2.2

- Does any of your students manifest symptoms that are typical of dysgraphia and dyscalculia, as described above? Have you ever noticed any those symptoms in your students with dyslexia?
- Does any of your students manifest language difficulties, motor difficulties or a tendency to inattention, impulsiveness or hyperactivity. Have you ever noticed any those symptoms in your students with dyslexia?

2.6 Neurodevelopmental systems involved in learning

As already mentioned, dyslexia and SLD (Specific Learning Difficulties), are independent of cultural, social, economic, pedagogic or psychological factors. However, this does not mean that such factors are irrelevant. As a matter of fact, when observing a pupil, it is always important to make a synthesis between intrinsic components (neurobiological and neuropsychological) and social, environmental and interactive components of his development (intersubjectivity).

Fig. 2.1 Factors affecting the neurodevelopmental profile

While leaving the responsibility of the diagnosis to specialist, teachers need to learn to observe and assess the single characteristics of the learning process of their students, and be ready to deal with their specific needs. Therefore, the task of education is to enhance the development of learning processes in any context or circumstance, but this is possible only if all the characteristics of each pupil are well known.

Everybody is different. We can see clearly that two people of the same height may have different shoe sizes. That is, just because we know one aspect of their physical structure does not mean we know another aspect.

Smythe (Dessdys, 2010)

Twenty years ago, in a country like Italy, the main problem was to make people understand that dyslexia and the other SLD were unrelated to emotional disorders and cognitive deficits. Now, the problem is to get people understand that, in order to help a child with SLD to grow up harmoniously, we must take into account, in everyday practice, not only the specific difficulty, but also the strengths and weaknesses associated with all the areas of his/her development and the integration of these areas. Furthermore, we must not forget that **emotion and cognition develop in parallel and must therefore be considered together!!!**

The learning processes require the development and the integration of different neurodevelopmental systems. So far, developmental neuroscience has identified 9 neurodevelopmental systems, which will be described here, with respect to the role they may play in language teaching and learning.
As already stated these systems are genetically determined, but their development is influenced by individual experiences.

Disorders that may arise in the development of one or more of these systems are at the basis of learning difficulties (fig. 2.2). When these difficulties start showing, it is necessary to go back to deficits in the neurodevelopmental systems, in order to make a correct diagnosis but mostly to define a specific educational pathway.

SLD must be considered in relation to developmental disorders. For this reason, schools should be considered the most appropriate place where they are faced: learning disabilities should be dealt with in the place where learning actually takes place. This apparently obvious remark implies the necessity of a specific training, based on the latest results of neuroscientific research, for teachers and for all other professionals working in the educational field.

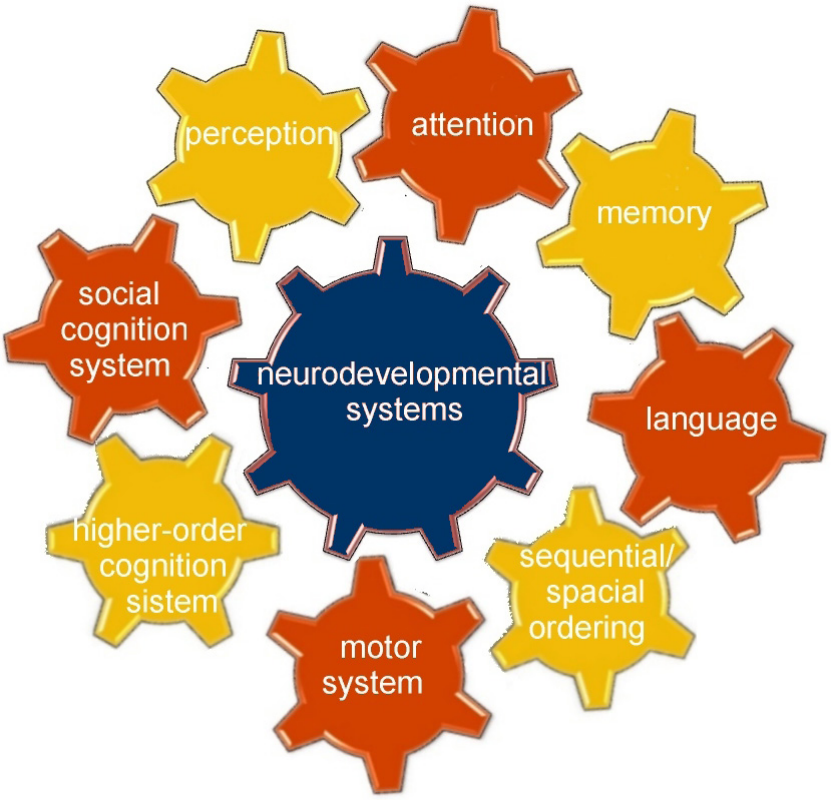


Fig. 2.2 Neurodevelopmental Systems

2.6.1 Perceptive system

School demands of pupils and students, not only the ability to **perceive different** environmental **stimuli** (listening to the teacher's words, seeing what is on the black board, etc.), but also the ability to **recognise** them, give them a meaning, and **select those that are relevant** while ignoring the irrelevant ones. Finally, the stimuli need to be integrated and 'filtered' through previous knowledge and experiences.

If this process happens in all the stages described above, the student can reach a minimum level of comprehension. This is particularly important, as learning can happen only if the input provided allows a minimum level of understanding. As Vygotsky suggests, the most useful input is the one that we can find in the so called **"zone of proximal development"**, that is just above the learner's abilities.

The perceptive systems that are normally most involved in language learning are the auditory system and the visual system (the last one mainly used to reinforce learning of words and their orthography). However, it has been demonstrated that pupils learn more if many sensory channels are simultaneously activated through the use of **multisensory techniques**. (see module 4 par. 4.8.1)

2.6.2 Attention system

The level of attention is very often a critical element in the learning process and in school activities. Statements like “he never pays attention”, “he switches from one task to another”, “he always needs a great spur to start his exercise”, etc. often recur in teachers and parents’ comments.
Attention is not an easy task and concerns processing of information, reception control, elaboration and production (carrying out of a task).

In fig. 3 different control systems of attention abilities are illustrated.
When a deficit is suspected at this level, the teacher should be able to understand if a student has difficulties in selecting stimuli, in using his mental energy, or in monitoring production. Also, the educational intervention, inside and outside the classroom, should try to enhance abilities such as evaluating predictions, selecting among different options and monitoring of one’s work. These abilities are at the basis of the control of impulsiveness.

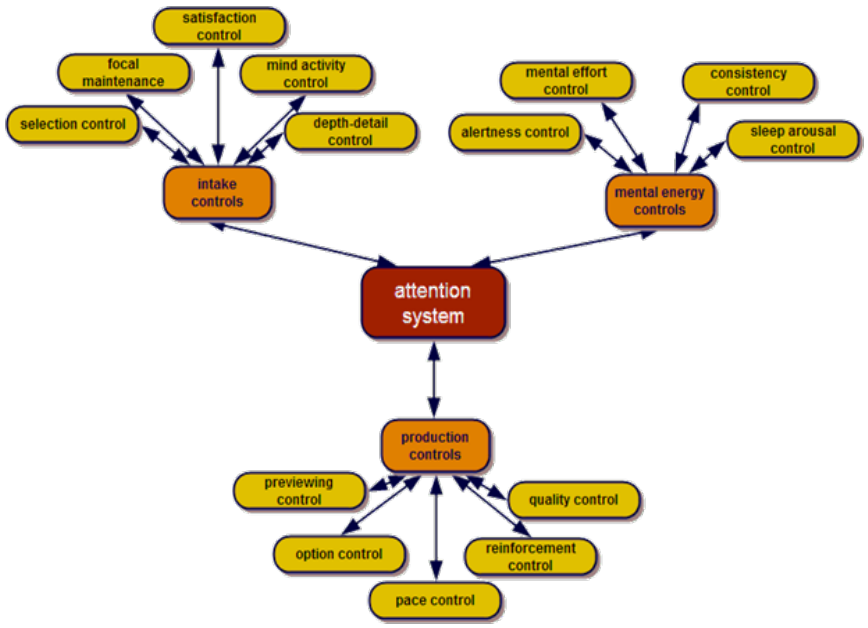


Fig. 2.3 Attention System

2.6.3 Memory system

Teachers or parents might still be heard saying that a pupil “has a good memory” or “has a bad memory”, but when it comes to the memory system, as for the attention system, things become much more complex.

Memory is mainly studied in relation to the duration parameter (Short-Term and Long-Term Memory) and to the activated sensory channel (visual memory, auditory memory, kinaesthetic memory, etc.).

The mnemonic system is at the base of the learning processes and the variability of its efficiency, together with the sensory channel preferentially used, influences the cognitive styles of learning processes and determines a different methodologies of study.
In the classic model of memory (Atkinson e Shiffrin, 1968), as represented in fig.4, the quantity of reiteration in Short-Term Memory is proportional to the probability that information is fixed into Long-Term Memory.

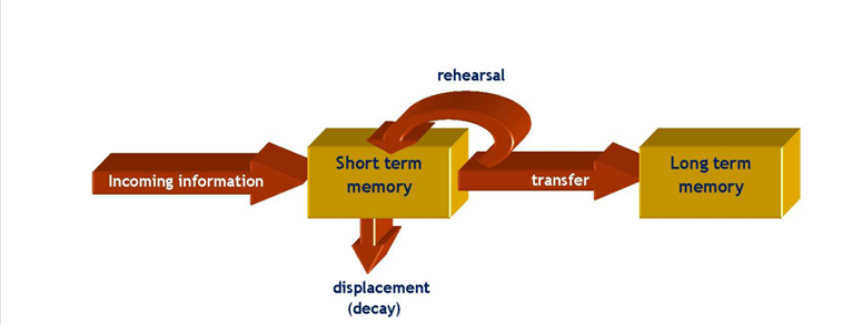


Fig. 2.4 Classic Memory System

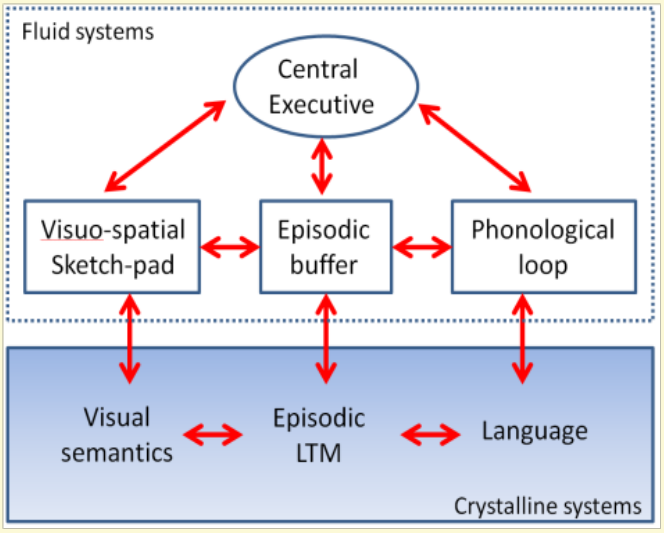
But, as clinical studies have demonstrated, it does not work exactly like that, otherwise the presence of a deficit in STM would make a person unable to learn anything!

A key role is played by Working Memory, which is not included in the classic model and is fundamental during the first steps of any learning. Recent studies have highlighted the importance of this function in foreign language learning, the main focus of this project.

Box 2.4 can be very helpful to understand a new model of the functioning of the Memory System, where the concept of active working memory is introduced.

Box 2.4 Working Memory (wm)

Working memory is multicomponential and it is "a system for the **temporary maintenance** and **manipulation** of information during the execution of different cognitive tasks, like such as comprehension, learning and reasoning" (Baddeley, 1986, p 46)



Working memory, therefore **retrieves information** from Short-Term Memory (auditory or visuo-spatial) and **simultaneously elaborates its content**

The main characteristics of wm are:

- quick decay
- limited capacity
- it is active
- it can be enhanced

During the age of development, working memory increases with age. However, within the same age range there may be big differences in terms of capacity.

As far as language learning is concerned, a typical task of working memory is retrieving a grammatical rule from Long-Term Memory, keeping it for a short time in one of the Short-Term Memories (verbal or visuo-spatial) and applying it where appropriate.

Baddeley, A.D. (1986). Working memory. Oxford: Clarendon Press.

Ulteriori informazioni rguardo la memoria di lavoro si possono trovare nei seguenti link:

•**Baddeley, A.D.**, Is Working Memory Still Working? European Psychologist, Vol. 7, No. 2, June 2002, pp. 85–97 www2.psych.ubc.ca/~pgraf/Psy583Readings/Baddeley%202002.pdf

• **Baddeley A.D., Hitch G.J,** Working memory, Scholarpedia. www.scholarpedia.org/article/Working_memory

•**Alloway T.P.** How does working memory work in the classroom? Educational Research and Reviews Vol. 1 (4), pp. 134-139, July 2006 https://dspace.stir.ac.uk//bitstream/1893/786/1/Alloway_ERR.pdf [Last accessed 20/12/2013]

2.6.4 Language system

Language is one of the cognitive functions more widely investigated within the field of neuropsychology.
Being able to understand and process incoming oral and written information (receptive language), and to use it to communicate (expressive language), is crucial for learning and successful achievements in school.
Language involves many different abilities that are necessary for communication:

- discrimination and production of word sounds
- sound manipulation
- manipulation of word subparts (morphemes)
- use of whole words
- understanding of syntax and sentence building
- decoding written symbols
- understanding and production of oral or written texts made up of multiple sentences.

These abilities relate to the different subsystems of language: phonetics, phonology, morphology, vocabulary, syntax, semantics and pragmatics. Deficits in phonological awareness are particularly relevant in children with dyslexia, but all language subsystems may be involved to some extents. In Module 4 they are described and discussed with particular reference to the difficulties they may induce in students with dyslexia.

2.6.5 Sequential and spatial ordering system

Recent researches has identified specific neural systems responsible for spatial and sequential abilities. These systems are responsible for the development of an adequate space-time organisation, which is at the heart the cognitive abilities of proceeding from perception to the organisation of memorized data and to the construction of new mental representations and concepts, that are integrated with previous knowledge and into the semantic system.

The sequential neurodevelopmental system includes aspects, such as actions planning and phonologic planning, that interact in the development of motor organisation and linguistic systems (Lieberman, 2000).

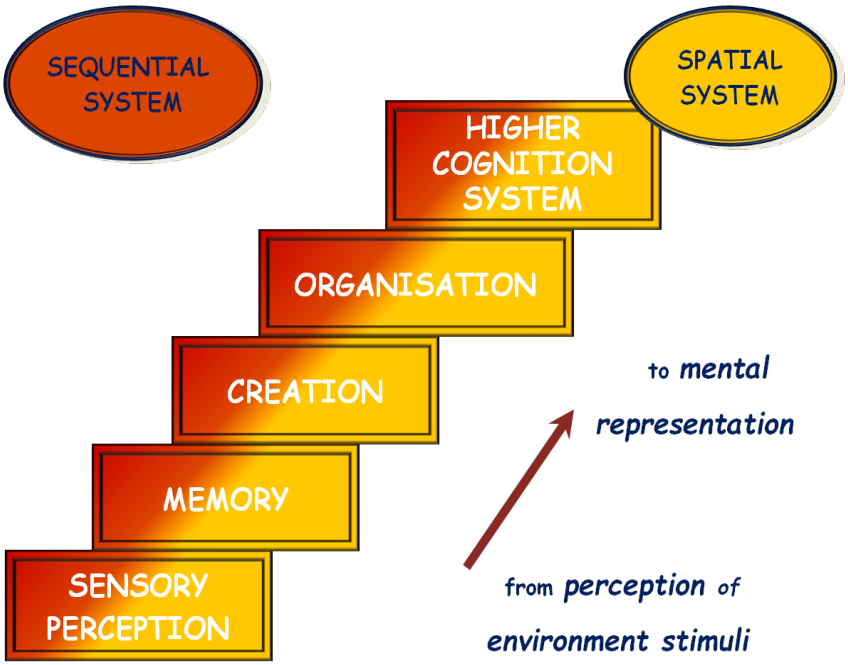


Fig. 2.5 Dalla percezione degli stimoli ambientali alla creazione delle rappresentazioni mentali.

2.6.6 Motor system

In traditional cognitive research, the body was considered as a "vehicle" that executes orders generated by the mental activity.
Nowadays it is known how the development of new learning, from the first steps of the baby's growth, depends on close relation of the action-perception-cognition cycle. Thoughts are generated and develop through the interaction between the body and the environment (Neisser,1999).

These ideas, elaborated in the field of cognitive neuroscience, have been confirmed today on the basis of the discovery of mirror neurons (Gallese, 2005). Such results have demonstrated that "imagining" and "doing" share the same neuronal substratum. As a consequence, "imagining" can be considered as a kind of mental simulation of actions or perceptions, as if we were actually acting or perceiving (Gallese & Lakoff, 2005).

It is in these acts, as acts and not mere movements, that our experience of the surrounding environment takes shape and that things immediately become meaningful to us. The same strict boundary among perceptive, cognitive and motor processes turns out to be mainly artificial. Not only does the perception appear plunged in the dynamic of action, so to result more complex and articulated than it was conceived in the past, but the acting brain is above all an understanding brain[6].

6. Giacomo Rizzolatti e Corrado Sinigaglia (2006 p. 3) "So quel che fai. Il cervello che agisce e i neuroni specchio" . Milano: Raffaello Cortina Editore English translation of Italian text

As a matter of fact, thanks to the mirror neurons, motor involvement enhances learning Not only in the person who is acting but also in the person who is observing.
In spite in the light of these considerations it is necessary to emphasise the importance of the pupil's active participation in the learning process through practical experience and of his/her motor participation through the creation of a stimulating physical and emotional context.

The discovery of mirror neurons is of great importance for languages teaching and learning, particularly during the first steps of the learning process (see Module 4, Box 4.8)

2.6.7 Higher order cognition system

The current idea of neuro-developmental systems, as conceived by Mel Levine encompasses both the specificity of different neural systems and subsystems, and their necessary integration into the individual's development and learning processes.

The functions of higher-order cognition system (the general intelligence of an individual) depend on the neural circuits that integrate and elaborate information coming from perceptual, spatial, sequential, linguistic and motor systems, while working memory and the attention systems play a fundamental role in the distribution of mental energy (Cornoldi, 2007b).

The higher order cognition system is important for a deep understanding of a wide variety of ideas and concepts that students may encounter at school. It is involved in all tasks that require the use of logic, such as solving mathematical problems, making decisions to set up experiments, supporting ideas or opinions with the use of evidence, expressing new original ideas, overcoming obstacles etc. (Barringer et al., 2010).

Individuals with a more developed intelligence can handle a greater amount of information at the same time. They are able to automate a lot of basic information and save energy for elaboration of new mental representations.

In the case of difficulties like those attributable to a SLD, the greater the efficiency of higher-order thinking, the greater the chance for the individual to autonomously find compensatory strategies to overcome his/her difficulties.

2.6.8 Social cognition system

The social cognition system includes the abilities to interact with others (both verbally and non verbally), to detect their emotions, to perceive and monitor social information, and to respond appropriately to the social setting.
As higher order cognition, social cognition is therefore extremely important to successfully carry out a wide variety of activities. It is also easy to understand the importance of this system is in relation to language. Successful communication and the creation of good relationship with other people depends on the individual's ability to detect verbal and non verbal signals, select appropriate conversation topics, handle episodes of miscommunication, take conversation turns appropriately and infer the interlocutor's feelings and intentions, based on facial expression and body language.
These social cognition abilities used to be considered typical "psychological" qualities. In fact, recent research has shown that they are strictly related to the mirror neuron system (see Module 4).

A specific deficit at the level of social cognition is responsible for Asperger Syndrome, a kind of so-called high-functioning autism characterised by difficulties in social interactions and limited empathy with other people.

2.6.9 Observable classroom behaviors

The strong or weak functioning of the above neuro-developmental systems may lead pupils and students to manifest signs and behaviours that a teacher should be able to recognise, in order to understand whether investigation and intervention are to be enacted.

The following table describes the most strengths and weaknesses that should be detected. Information is mostly taken from Schools for Barringer at al. (2010), with some integration and minor changes.

NEURO-DEVELOPMENTAL SYSTEMS	When working, the student appears to:	
	POSITIVE SIGNS	**NEGATIVE SIGNS**
PERCEPTION	• Be able to listen to the teacher or look at the blackboard for a long time without getting tired • Easily recognise environmental stimuli and give them meaning • Easily select relevant from irrelevant stimuli and information • Be able to integrate the new stimuli with previous knowledge and experience	• Get easily tired when faced with visual and auditory stimuli, like listening to the teacher, or looking at the blackboard • Have trouble in recognising environmental stimuli and give them a meaning • Have difficulties selecting the relevant from the irrelevant stimuli and information • Have difficulties in integrating new environmental stimuli with previous knowledge and experience
ATTENTION	• Have enough mental energy • Be able to maintain effort for a long time • Be able to keep focussed • Be able to notice key detail • Be able to identify mistakes and correct them • Control impulses • Plan a task before starting it • Work at an appropriate pace	• Get excessively tired • Be unable to maintain effort and sticking with tasks • Lose focus easily • Miss key details • Miss mistakes • Be susceptible to impulses • Start tasks without any previous planning • Work at a variable pace: sometimes rushing, sometimes slowing down excessively
MEMORY	• Easily retain information from beginning to end of a passage, when reading it • Learn new words, facts and procedures easily • Recognise previously encountered patterns • Be able to handle the different tasks involved in writing • Be able to perform mental calculation • Be able to execute multistep maths procedures • Be able to recall the right procedure that is necessary to solve a problem • Easily retrieve information when given a cue	• Forget information from beginning to end of a passage, when reading it • Have difficulties recalling words, facts and procedures • Have difficulties recognising previously encountered patterns and tend to study by rote. • Have difficulties handling the different tasks involved in writing • Have difficulties in performing mental maths calculation • Tend to lose track in multistep procedures • Have trouble recalling the right procedure for the solution of a problem • Have difficulties in retrieving information even when given cues

NEURO-DEVELOPMENTAL SYSTEMS	When working, the student appears to:	
	POSITIVE SIGNS	**NEGATIVE SIGNS**
LANGUAGE	• Be able to decode and spell correctly • Understand complex sentences and explanations • Understand abstract words • Select words appropriately • Be able to manipulate words' subparts (prefixes and suffixes) • Be able to build grammatically correct sentences • Be able to elaborate oral or written texts to express thoughts and opinions	• Have difficulties in following the successive steps of procedure or instructions • Have trouble learning sequences and chronological information • Have difficulties in presenting ideas in clear serial order • Have trouble interpreting visual information without help from others • Have difficulties in copying accurately and drawing • Not be very skilled at building and fixing things.
SEQ. & SPAT. ORD.	• Be able to execute sequential procedures and follow instructions accurately • Learn sequential or chronological facts, processes or phenomena • Be able to present thought and ideas in a clear serial order • Easily understands maps, graphs or diagrams • Copy and draw accurately • Have good building and fixing skills	• Have difficulties in following the successive steps of procedure or instructions • Have trouble learning sequences and chronological information • Have difficulties in presenting ideas in clear serial order • Have trouble interpreting visual information without help from others • Have difficulties in copying accurately and drawing • Not be very skilled at building and fixing things.
MOTOR SYSTEM	• Write letters and numbers that are regular in size and shape. Handwriting is legible • Be able to keep writing for a long time • Use a comfortable handwriting grip • Have good manual dexterity • Coordinate finger and hand movements well • Have good balance and body movement coordination • Quickly learn athletic skills	• Write letters and numbers that are inconsistent in size and shape. Handwriting is not legible. • Get tired very quickly when writing • Use an uncomfortable handwriting grip • Slowly learn skill requiring manual dexterity • Coordinate with difficulty finger and hand movements • Have poor balance good balance and body movement coordination • Have difficulties in learning new athletic skills.

NEURO-DEVELOPMENTAL SYSTEMS	When working, the student appears to:	
	POSITIVE SIGNS	**NEGATIVE SIGNS**
HIGHER-ORDER COGNITION SYSTEM	• Be able to identify connections among different materials and disciplines • Make inferences from limited information • Have good imagination and creativity • Be able to solve problems in a systematic way • Be able to understand concepts and ideas, by identifying their components and/or connections to other concepts and ideas • Be willing to risk expressing new ideas • Be able to make generalisations and abstractions	• Have difficulties in identifying connections among different materials and disciplines • Have difficulties in making inferences and understanding underlying meaning • Show little creativity and a tendency to stick with already existing sources for ideas • Try to solve problems in a confusing and non systematic way • Have difficulties in understanding new concepts without support from others • Prefer sticking with already existing ideas and avoid proposing new things. • Have difficulties in making generalisation and abstraction
SOCIAL COGNITION SYSTEM	• Be able to demonstrate a collaborative attitude • Show a positive attitude to peers' opinions and interests • Engage effectively in conversation, without dominating or being too passive • Be inclined to detect people's moods and feelings	• Have difficulties in collaborating with peers • Show little appreciation to peer's opinions and interests • Tend to be either passive or dominant in conversation • Ignore signals about others' moods and feelings

2.7 Psychological consequences of dyslexia

Late diagnosis or lack of diagnosis may have significant negative effects on their academic success and may have serious social and personal consequence in adulthood. Even today many pupils and students with dyslexia are not diagnosed in time.

Frustrations due to the difficulties dyslexic individuals may encounter in learning can lower self-esteem and increase the risk of psychological and emotional disorders. If students with SLD are not understood in their difficulties they can:

- Start perceiving themselves as inadequate, especially at school, and create a negative representation of themselves.
- Lose motivation and disengage from school
- Experience new failures that will strengthen their feeling of inadequacy.

All this can lead to a number of consequences: withdrawal from school, (complex) psychiatric disorders like depression, anxiety, panic attack etc., and development of severe deviant behaviours.
It is therefore necessary to achieve a diagnosis of dyslexia as early as possible, before any of the above effects manifests themselves.
Parents, teachers and specialists in the field of education must bear in mind that an earlier identification allows a more effective intervention and leads to a better prognosis, since it reduces the negative effects on learning, and protects the child from the risk of developing secondary psycho-pathological disorders (Palladino et al.,2000; Bosman & Braams, 2005).

ON REFLECTION TASK 2.3

- Have you ever noticed in any of your students' manifestations of anxiety, feeling of inadequacy or lost of motivation towards learning?
- Have you ever noticed those symptoms in students who also manifest difficulties in reading and writing?
- In case you did notice one or more of those manifestations, what would you do?

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Notes

Dyslang

Module 2

UNDERSTANDING DYSLEXIA

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Lifelong Learning Programme

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