Dyslexia and Additional Academic Language Learning

Module 2

Understanding Dyslexia

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Adapted for local contexts by Bulgarian, Czech, English and Welsh partners.

Please note that the original authors do not necessarily endorse all the adaptations made for the local context.

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Learning outcomes

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

Some useful terminology

**Homotypic comorbidity**: the simultaneous presence of different types of SpLD that are from the same diagnostic grouping, for example dyslexia and Specific Language Impairment are both SpLDs related to language.

**Heterotypic comorbidity**: the simultaneous presence of SpLD and other developmental disorders that are not from the same diagnostic grouping, e.g. dyslexia and ADHD, where dyslexia is a language disorder while ADHD is an externalising disorder.

**Dysgraphia**: a specific difficulty in handwriting.

**Dyscalculia**: a difficulty in understanding simple number concepts and learning number facts and procedures.

**Dyspraxia**: a disorder that affects the performance of intentional movements.

**Morphology**: the field of linguistics that studies the internal structure of words and the different forms that words can assume by adding affixes or by combining them with other words.

**Syntax**: the field of linguistics that studies the principles that rule the combination of words in more complex structures.

**Morphosyntactic area**: the field of linguistics relating to the rules governing word and sentence formation.

**Lexical competence**: the ability to understand, acquire and recall words and their meanings

**Semantic competence**: the ability to understand individual words and the awareness of rules that guide the construction of meaning

**Executive inhibition**: the ability to select the most relevant information and to choose the most appropriate answer to a question instead of making impulsive and automatic responses
Introduction

Dyslexia is 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 inappropriate education. The complexity of the problem is increased by the fact that the impact of dyslexia and reading and writing difficulties may vary according to the cultural and linguistic background of the individual.

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 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” (Barringer, Pohlman & Robinson, 2010, p. 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” (Barringer et al., 2010, p. xxiii).
2.1 Specific Learning Difficulties

Dyslexia is part of a group of developmental disabilities often referred to as Specific Learning Difficulties (SpLD). 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 general intellectual functioning intact. Other characteristics of SpLD are the following:

- They are developmental in nature.
- They cannot be cured, since they are not diseases, but it is possible to develop compensatory strategies.
- 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 individual functional profiles and manifestations.

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 difficulties 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. However, many dyslexic individuals also show positive attributes that may manifest themselves in areas where literacy is less demanding, such as engineering, science and business (West, 1991).

Particular caution should be used in the case of children whose first language (L1) is different from the language of schooling. In this case the risk of both “false positives” and “false negatives” must be considered carefully. That is, there may be people who are diagnosed with an SpLD, but whose difficulties are actually due to their being assessed in a language in which they are not yet fully competent, and people who are not diagnosed with an SpLD when one actually exists, but their difficulties are mistakenly attributed to their multilingual background. For this reason, we need to look at all aspects of the child.

Extension Material 2.1 - Cognitive Processes

Those who have a deficit in the automation of basic reading and writing require support in the input and/or output part of the cognitive processes involved. By developing appropriate compensatory measures students will be able to learn and acquire knowledge.
2.2 What is dyslexia?

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


“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.”

The British Dyslexia Association adopts the following definition (Rose, 2009):

- Dyslexia is a learning difficulty that primarily affects the skills involved in accurate and fluent word reading and spelling.
- Characteristic features of dyslexia are difficulties in phonological awareness, verbal memory and verbal processing speed.
- Dyslexia occurs across the range of intellectual abilities.
- It is best thought of as a continuum, not a distinct category, and there are no clear cut-off points.
- Co-occurring difficulties may be seen in aspects of language, motor coordination, mental calculation, concentration and personal organisation, but these are not, by themselves, markers of dyslexia.
- A good indication of the severity and persistence of dyslexic difficulties can be gained by examining how the individual responds or has responded to well founded intervention.
As well as these characteristics, the British Dyslexia Association:

...acknowledges the visual and auditory processing difficulties that some individuals with dyslexia can experience, and points out that dyslexic readers can show a combination of abilities and difficulties that affect the learning process. Some also have strengths in other areas, such as design, problem solving, creative skills, interactive skills and oral skills.

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.

(Lyon et al., 2003)

Other definitions can be found in the websites of various dyslexia associations in Europe and the rest of the world (see Links and further reading).

In this module we are going to talk about dyslexia in a brief but as detailed a way as possible, in order to provide teachers with the essential information they may need when they are faced with pupils presenting difficulties in the acquisition of literacy.
2.3 How does dyslexia manifest itself?

Dyslexia relates to the ability to decode a written text, and manifests itself when reading does not develop accuracy and/or fluency.

Since by definition you need to be able to read before you can show signs of difficulty in reading, it would seem obvious that you cannot recognise dyslexia until the child has been receiving written instruction for several years. However, there are a number of sub-skills necessary to develop good literacy skills and some of them are excellent predictors of those at risk of developing dyslexia when they begin learning to read. (For a summary, see the list by Luisa Moats cited at http://www.learning-inside-out.com/dyslexia-in-children.html).

One of the first recognisable signs of dyslexia is the slow and difficult learning of reading aloud. 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, reading aloud turns out to be slower and/or less accurate than expected, in relation to age, school level, and education received.

The reading errors made may, depending upon the language, include:

- Substitution of similar/homophone letters: d-b, p-q, m-n, t-f / b-p, t-d, f-v, s-z
- Inversion of letter sequence: da = ad, per = pre
- Omission of letters: ladybird - laybird
- Difficulties learning the alphabet
- Difficulties reading and pronouncing unfamiliar words or words that are rarely used
- Difficulty in maintaining the reading line or proceeding from right to left in order to read the next line.

Myths of dyslexia - Prevalence

Some people assume that there will be fewer dyslexic individuals in a culture where the language is transparent. However, this is not the case. The definition of dyslexia talks about reading and writing difficulties, and not the causes. Therefore you can walk into a school anywhere and identify those who are struggling with reading and writing. How many you identify will depend upon your cut off criteria.

As Snowling (2000) states, statistically 2.28% of any given population will be two standard deviations or more below the mean in a normal distribution, and results from dyslexia related studies reflect this figure derived from statistical theory. Thus Yule et al., (1974) calculated that 3.1% of ten year olds on the Isle of Wight had a “specific reading retardation”. But researchers who use different criteria would have provided different results.

The confusion comes from the causal component. If the definition said that the difficulty was caused by phonological awareness difficulties and nothing else, then it would be true to suggest that dyslexia is less prevalent in transparent languages. However, this is not the case.
The most common spelling mistakes made by dyslexic students include:

**Substitution**
- 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 / cworta; height / hite

**Lexical-semantic errors** (particularly homophones)
- their / there; two / to / too

In addition, capital letters are often left out or misplaced; accent marks, apostrophes and punctuation appear to be considered optional. Finally, some pupils, perhaps unconsciously, try to reduce their handwriting size and make it incomprehensible, in order to hide spelling mistakes.

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 the slow development of decoding skills. 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).

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**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:
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). However, the extent to which difficulties manifest themselves depends on the significance of those skills in the new language. For this reason, considering the importance of knowing more than one language in the present day, teachers must be aware of possible support measures that may help students with difficulties achieve a sufficient level of proficiency.

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 happen 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 on 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.

There are many possible causes of dyslexia, as exemplified by numerous research studies over the past 50 years. These factors include poor phonological awareness, deficits in phonological processing, auditory memory, working memory, visual perception and storage/retrieval processes.

Certain authors (e.g. Pennington, 2006) in recent research prefer to talk about shared mechanisms at the neuropsychological and genetic level underlying reading ability (See Extension Material 2.2 - The Reading Pyramid).

Comorbidity is explained 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 in all areas.

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 (e.g. English) and in languages with different writing systems, such as the logographic ones (Chinese, Japanese).
Extension Material 2.2 - The Reading Pyramid

Starting from the model of Pennington (2006), Maryanne Wolf (2007) described the pyramid of the behaviours of reading (see figure below). 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.

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 manifest itself in different ways.

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 Dehaene group (2007).

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

Reading does not seem to have a direct hereditary basis. Every time a child learns to read, their brain must activate the higher levels of the pyramid in order to forge the necessary neural circuits from scratch (Dehaene, 2007).
### Extension Material 2.3 - Comorbidity Research

The following table highlights the amount of overlap between different SpLDs found in a group of 4273 individuals seeking employment in the UK with Remploy, a government-based UK employment agency (Kirby, 2012).

The difficulties and combinations of difficulties identified in this group are listed down the left: R - Reading difficulties (e.g. dyslexia), M - Motor difficulties (e.g. dyspraxia), A - Attention difficulties (e.g. ADHD), S - Social difficulties (e.g. Asperger’s). The 2nd and 3rd columns show the number and percentage of individuals with either a single SpLD or a combination.

The final 4 columns show the spread of comorbidities for each group, e.g. the 4th column selects all those with a reading difficulty and shows the different combinations of comorbidities within that group. It can be noted that of the 752 individuals with reading difficulties only 32.18% had no other difficulty, and of the entire cohort only 58.37% didn’t present with any specific learning difficulty.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>%</th>
<th>Those with reading difficulties</th>
<th>Those with social difficulties</th>
<th>Those with attention difficulties</th>
<th>Those with motor difficulties</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>242</td>
<td>5.66</td>
<td>752</td>
<td>1108</td>
<td>483</td>
<td>776</td>
</tr>
<tr>
<td>RM</td>
<td>79</td>
<td>1.85</td>
<td>10.51</td>
<td></td>
<td></td>
<td>10.18</td>
</tr>
<tr>
<td>RA</td>
<td>22</td>
<td>0.51</td>
<td>2.93</td>
<td></td>
<td>4.55</td>
<td></td>
</tr>
<tr>
<td>RAM</td>
<td>32</td>
<td>0.75</td>
<td>4.26</td>
<td></td>
<td>6.63</td>
<td>4.12</td>
</tr>
<tr>
<td>RS</td>
<td>111</td>
<td>2.6</td>
<td>14.76</td>
<td>10.02</td>
<td></td>
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</tr>
<tr>
<td>RSM</td>
<td>98</td>
<td>2.29</td>
<td>13.03</td>
<td>8.84</td>
<td></td>
<td>12.63</td>
</tr>
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<td>5.98</td>
<td>4.06</td>
<td>9.32</td>
<td>15.85</td>
</tr>
<tr>
<td>RSAM</td>
<td>123</td>
<td>2.88</td>
<td>16.36</td>
<td>11.1</td>
<td>25.47</td>
<td>25.13</td>
</tr>
<tr>
<td>M</td>
<td>195</td>
<td>4.56</td>
<td></td>
<td></td>
<td></td>
<td>14.7</td>
</tr>
<tr>
<td>AM</td>
<td>71</td>
<td>1.66</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>S</td>
<td>30</td>
<td>0.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SM</td>
<td>421</td>
<td>9.85</td>
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<td></td>
<td></td>
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<td>SA</td>
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<td>3.51</td>
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<td>1.61</td>
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<td>4273</td>
<td>100</td>
<td>100</td>
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</tr>
</tbody>
</table>
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 also play a key role in terms of prevention and containment of comorbid disorders and relapse in daily life.

There are two different types of comorbidity, homotypic and heterotypic. The following definitions may be used.

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

**Heterotypic comorbidity**
Researchers talk about heterotypical comorbidity when SpLD 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).

However, the use of these terms will vary between professionals and between countries. Thus in some countries dyspraxia may be seen as an SpLD, and therefore its co-existence with dyslexia would be homotypic, while in other countries it may not be seen as an SpLD, and therefore would be classed as heterotypic.

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**Videos on Comorbidity**
Here are two videos that talk about overlapping difficulties.
The following pages contain descriptions of the most common difficulties that co-occur with dyslexia.

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 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 expressed this condition well: “Before I used to draw letters, now I have to write!”

What’s in a name?

In the UK, the term dyslexia is generally used for both reading and writing difficulties. However, in other countries, more specific terminology is often used. For example in Russia, the term dyslexia is restricted to reading difficulties, and dysgraphia for spelling difficulties. But in Poland, dysgraphia is often used for fine motor difficulty, dysorthographia is used for spelling difficulties and dysautographia for handwriting difficulties.
b) Dyscalculia

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

- **basic numerical skills**, making it difficult to:
  - see small quantities of numbers (3 or 4) without counting
  - quantify easily
  - perform seriation
  - compare quantities
  - understand 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:
  - reading and writing of numbers
  - aligning numbers into proper columns
  - retrieving numerical facts (e.g., multiplication tables)
  - written calculation algorithms.

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.
c) 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, possibly 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 sentence 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 into their 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 also be 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.
d) Dyspraxia

Dyspraxia (also known as Developmental Coordination Disorder) is a disorder that affects the performance of intentional movements. The difficulties it entails concern the abilities to plan, programme 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 Kirby (see panel above) comorbidity with reading disability is far more common than dyspraxia or dyslexia occurring by themselves.

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 SpLD, vary with age and development. Younger children present with clumsiness and delay in reaching the fundamental stages of motor development (e.g., walking, crawling, sitting, tying shoe laces, 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).

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 is a typical spontaneous tendency of minor motor symptoms (problems with balance, accuracy of gesture, learning new movements).
**e) Attention Deficit Disorder**

Attention Deficit Disorder (ADD), or Attention Deficit Hyperactivity Disorder (ADHD), is a developmental disorder of self-control. It includes inattention and impulsiveness/hyperactivity. These problems stem mainly from the inability of the child to regulate their own behaviour in relation to the passing of time, the achievement of their objectives, and the demands coming from the environment.

Attention difficulties can occur in isolation or associated with hyperactivity (ADHD), and can involve one or more monitoring processes.

Attention Deficit Disorder may include:

- **Inattention**: involves difficulties in focusing on details, a tendency to be easily 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).

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**On Reflection Task 2.2**

- Do any of your students manifest symptoms that are typical of dysgraphia and dyscalculia, as described above? Have you ever noticed any of those symptoms in your students with dyslexia?

- Do any of your students manifest language difficulties, motor difficulties or a tendency to inattention, impulsiveness or hyperactivity? Have you ever noticed any of those symptoms in your students with dyslexia?
2.6 Neurodevelopmental systems involved in learning

As already mentioned, dyslexia and SpLD (Specific Learning Difficulties), are independent of cultural, social, economic, pedagogic or psychological factors. However, this does not mean that such factors are irrelevant. 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 their development (intersubjectivity).

Fig. 1- Factors affecting the neurodevelopmental profile

While leaving the responsibility of the diagnosis to specialists, teachers need to learn to observe and assess the 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 it does not mean we know another aspect.”

Smythe (Dessdys, 2010 , p.8)
Twenty years ago, the main problem was to make people understand that dyslexia and the other SpLD were unrelated to emotional disorders and cognitive deficits. Now, the problem is to get people to understand that, in order to help a child with SpLD 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 areas of their development and the integration of these areas. Furthermore, we must not forget that emotion and cognition develop in parallel; therefore, cognitive and emotional development have to be considered together.

The learning processes require the development and the integration of different neurodevelopmental systems. So far, developmental neuroscience has identified nine 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.

Each neurodevelopmental system (in the literature sometimes called “constructs”) consists of several neurodevelopmental subsystems (or functions) that may be related to each other and have overlapping features, but are also sufficiently distinct to be considered separate entities (Barringer et al., 2010). The memory system, for example, is made up of three subsystems: long term memory, short term memory and working memory. Similarly, the attention system is made up of three subsystems: mental energy control, production control and intake control. Each of them include, in turn, several subfunctions, as explained in the paragraphs that follow.

Disorders that may arise in the development of one or more of these systems are at the basis of learning difficulties. 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.
SpLD should be considered in relation to developmental disorders, and schools should be considered the most appropriate place for reading and writing difficulties, since that is the primary place for literacy learning. It is therefore important that teachers and other professionals working in the area are offered continuing professional development that will allow them to take advantage of the latest research.

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 blackboard, 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 (1978, p. 86), 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 the learning of words and of their orthography). However, it has been demonstrated that pupils learn more if many sensory channels are simultaneously activated through the use of multisensory techniques.
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”, “she switches from one task to another”, “he always needs a great push to start his homework”, 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).

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 their mental energy, or in monitoring production. Also, any educational intervention, inside or outside the classroom, should try to enhance abilities such as evaluating predictions, selection among different options, and monitoring of one’s work. These abilities are at the basis of the control of impulsiveness.

2.6.3 Memory system

Teachers or parents may 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 duration (short-term and long-term memory) and to the activated sensory channel (visual memory, auditory memory, kinaesthetic memory).

The mnemonic system is at the base of learning processes and the variability of its efficiency, together with the sensory channel preferentially used, influences the cognitive styles of learning processes and determines different methodologies of study.

In the classic model of memory (Atkinson and Shiffrin, 1968), the quantity of reiteration in short-term memory is proportional to the probability that information is fixed into long-term memory.

But, as clinical studies have demonstrated, it does not work exactly like that otherwise the presence of a deficit in short-term memory 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.
Extension Material 2.4 - Working Memory

Working memory is multicomponential and it is “[a] system for the temporary maintenance and manipulation of information during the execution of different cognitive tasks, 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 working memory 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.

Model of working memory - after Baddeley and Hitch, (see references)
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 use it to communicate (expressive language), is crucial for learning and successful achievement in school.

Language involves many different abilities that are necessary for communication:

- discrimination and production of word sounds
- sound manipulation
- manipulation of words 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 extent. In Module 5 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 research 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 of the cognitive abilities proceeding from perception to the organisation of memorised 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 action planning and phonologic planning, that interact in the development of motor organisation and linguistic systems (Lieberman, 2000).
2.6.6 Motor system

In traditional cognitive research, the body was considered to be a “vehicle” that executes orders generated by mental activity. Nowadays it is known how the development of new learning, from the first steps of a baby’s growth, depends on close relationships within 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, resulting in more complex and articulated than it was conceived in the past, but the acting brain is above all an understanding brain.” (Rizzolatti & Sinigaglia, 2006, p. 3)

Thanks to the mirror neurons, motor involvement enhances learning not only in the person who is acting but also in the person who is watching.

In spite 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 language teaching and learning, particularly during the first steps of the learning process (see Module 5, par. 5.8.2).

2.6.7 Higher order cognition system

The current idea of neurodevelopmental systems encompasses both the specificity of different neural systems and subsystems, and their necessary integration in the individual’s development and learning processes.

The functions of the 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, 2007).
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 specific learning difficulty, the greater the efficiency of higher-order thinking, the greater the chance for the individual to autonomously find compensatory strategies to overcome their difficulties.

### 2.6.8 Social cognition system

The social cognition system includes the ability 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 in relation to language.

Successful communication and the creation of good relationships with other people depends on the individual’s ability to detect verbal and nonverbal 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 5, par. 5.8.2).

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

### 2.6.9 Behaviours observable in the classroom

The strong or weak functioning of the above neurodevelopmental systems may lead pupils 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 strengths and weaknesses that should be detected. Information is mostly taken from Barringer at al. (2010), with some integration and minor changes.

<table>
<thead>
<tr>
<th>Neurodevelopmental system</th>
<th>When working the student appears to:</th>
<th>Negative signs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perception</strong></td>
<td>Positive signs</td>
<td>Negative signs</td>
</tr>
<tr>
<td></td>
<td>• Be able to listen to the teacher or look at the blackboard for a long time without getting tired</td>
<td>• Get easily tired when faced with visual and auditory stimuli, like listening to the teacher, or looking at the blackboard</td>
</tr>
<tr>
<td></td>
<td>• Easily recognise environmental stimuli and give them meaning</td>
<td>• Have trouble in recognising environmental stimuli and giving them a meaning</td>
</tr>
<tr>
<td></td>
<td>• Easily select relevant from irrelevant stimuli and information</td>
<td>• Have difficulties selecting relevant from irrelevant stimuli and information</td>
</tr>
<tr>
<td></td>
<td>• Be able to integrate the new stimuli with previous knowledge and experience</td>
<td>• Have difficulties in integrating new environmental stimuli with previous knowledge and experience</td>
</tr>
<tr>
<td><strong>Attention</strong></td>
<td>Positive signs</td>
<td>Negative signs</td>
</tr>
<tr>
<td></td>
<td>• Have enough mental energy</td>
<td>• Get excessively tired</td>
</tr>
<tr>
<td></td>
<td>• Be able to maintain effort for a long time</td>
<td>• Be unable to maintain effort and stick with tasks</td>
</tr>
<tr>
<td></td>
<td>• Be able to keep focused</td>
<td>• Lose focus easily</td>
</tr>
<tr>
<td></td>
<td>• Be able to notice key detail</td>
<td>• Miss key details</td>
</tr>
<tr>
<td></td>
<td>• Be able to identify mistakes and correct them</td>
<td>• Miss mistakes</td>
</tr>
<tr>
<td></td>
<td>• Control impulses</td>
<td>• Be susceptible to impulses</td>
</tr>
<tr>
<td></td>
<td>• Plan a task before starting it</td>
<td>• Start tasks without any previous planning</td>
</tr>
<tr>
<td></td>
<td>• Work at an appropriate pace</td>
<td>• Work at a variable pace: sometimes rushing, sometimes slowing down excessively</td>
</tr>
<tr>
<td><strong>Memory</strong></td>
<td>Positive signs</td>
<td>Negative signs</td>
</tr>
<tr>
<td></td>
<td>• Easily retain information from beginning to end of a passage, when reading it</td>
<td>• Forget information from beginning to end of a passage, when reading it</td>
</tr>
<tr>
<td></td>
<td>• Learn new words, facts and procedures easily</td>
<td>• Have difficulties recalling words, facts and procedures</td>
</tr>
<tr>
<td></td>
<td>• Recognise previously encountered patterns</td>
<td>• Have difficulties recognising previously encountered patterns and tends to study by rote</td>
</tr>
<tr>
<td></td>
<td>• Be able to handle the different tasks involved in writing</td>
<td>• Have difficulties handling the different tasks involved in writing</td>
</tr>
<tr>
<td></td>
<td>• Be able to perform mental calculation</td>
<td>• Have difficulties in performing mental maths calculation</td>
</tr>
<tr>
<td></td>
<td>• Be able to execute multistep maths procedures</td>
<td>• Tend to lose track in multistep procedures</td>
</tr>
<tr>
<td></td>
<td>• Be able to recall the right procedure that is necessary to solve a problem</td>
<td>• Have trouble recalling the right procedure for the solution of a problem</td>
</tr>
<tr>
<td></td>
<td>• Easily retrieve information when given a cue</td>
<td>• Have difficulties in retrieving information even when given cues</td>
</tr>
<tr>
<td><strong>Language</strong></td>
<td>Positive signs</td>
<td>Negative signs</td>
</tr>
<tr>
<td></td>
<td>• Be able to decode and spell correctly</td>
<td>• Make decoding and spelling mistakes</td>
</tr>
<tr>
<td></td>
<td>• Understand complex sentences and explanations</td>
<td>• Have difficulties understanding word meaning, complex sentences and explanations</td>
</tr>
<tr>
<td></td>
<td>• Understand abstract words</td>
<td>• Have difficulties in understanding abstract words</td>
</tr>
<tr>
<td></td>
<td>• Select words appropriately</td>
<td>• Select words inaccurately</td>
</tr>
<tr>
<td></td>
<td>• Be able to manipulate words’ subparts (prefixes and suffixes)</td>
<td>• Have difficulties in using prefixes and suffixes to alter words</td>
</tr>
<tr>
<td></td>
<td>• Be able to build grammatically correct sentences</td>
<td>• Make syntactic mistakes while building sentences</td>
</tr>
<tr>
<td></td>
<td>• Be able to elaborate oral or written texts to express thoughts and opinions</td>
<td>• Lack coherence and cohesion when producing long texts</td>
</tr>
<tr>
<td>Neuro-developmental system</td>
<td>When working the student appears to:</td>
<td>Negative signs</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------------------------------</td>
<td>----------------</td>
</tr>
</tbody>
</table>
| **Sequential and spatial ordering** | • Be able to execute sequential procedures and follow instructions accurately  
• Learn sequential or chronological facts, processes or phenomena  
• Be able to present thoughts and ideas in a clear serial order  
• Easily understand maps, graphs or diagrams  
• Copy and draw accurately  
• Have good building and fixing skills | • Have difficulties in following the successive steps of procedures 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 skills requiring manual dexterity  
• Have difficulty coordinating finger and hand movements  
• Have poor balance and body movement coordination  
• Have difficulties in learning new athletic skills |
| **Higher order cognitive 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 understand 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 generalisations and abstractions |
| **Social cognition system** | • Be able to demonstrate a collaborative attitude  
• Show a positive attitude towards the opinions and interests of peers  
• 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 of the opinions and interests of peers  
• Tend to be either passive or dominant in conversations  
• Ignore signals about the moods and feelings of others |
2.7 Psychological consequences of dyslexia

Even today many pupils and students with dyslexia are not diagnosed in time (as can be seen by the rate of dyslexia among youth offenders (Kirk & Reid, 2001)). Late diagnosis or lack of diagnosis may have significant negative effects on their academic success and may have serious social and personal consequences in adulthood.

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 SpLD 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 attacks etc., and development of severe deviant behaviours.

It is therefore necessary to identify those with or at risk of reading difficulties as early as possible, before any of the above effects manifest 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 better prognosis, since it reduces 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 manifestations of anxiety, feelings of inadequacy or a loss of motivation towards learning in any of your students?
- Have you ever noticed those symptoms in students who also manifest difficulties in reading and writing?
- If you did notice one or more of those manifestations, what would you do?
References


Module 2 - Understanding Dyslexia


Links and further reading

All kinds of minds www.allkindsofminds.org [Last accessed 1/12/2013]


British Dyslexia Association www.bdadyslexia.org.uk

Do-IT Solutions (Free videos) www.doitprofiler.com/resources.aspx

Dystalk (Free videos) www.dystalk.com [Last accessed 1/12/2013]

European Dyslexia Association www.eda-info.eu [Last accessed 1/12/2013]