



Understanding Dyslexia

This Factsheet is about dyslexia and its impact on memory. The Factsheet includes examiner comments and the worksheet gives you the opportunity to apply what you have learned to exam style questions. Words in bold are explained in the glossary.

The examiner will expect you to be able to:

- Demonstrate knowledge of learning disorders such as dyslexia
- Explain how reading may be affected by dyslexia
- Identify differences in brain function related to dyslexia
- Apply psychological theories to explanations of dyslexia

What is dyslexia?

The most recent edition of **DSM-5**, released in 2013, classifies dyslexia as:

A specific **learning disorder** with impairment in reading including possible deficits in:

- Word reading accuracy
- Reading rate or fluency
- Reading comprehension



<https://upload.wikimedia.org/wikipedia/commons/8/8f/Dislexia.jpg>

It is often apparent that the individual's reading ability does not match their IQ. People with dyslexia can have specific difficulty in some or all of the following areas:

Phonological awareness which refers to using sounds to the letters that represent them. This makes it difficult to decode words.

Processing skills which refers to relating verbal information to semantic meaning. This makes it difficult to understand text.

Short term memory which refers to the storage of information for between 20-30 seconds. This makes it difficult to use the information to complete activities such as following instructions, mental arithmetic and reading comprehension.

Reading requires extensive knowledge of letter sounds and the ability to use this in order to read words and apply meaning. In order to transfer information to long-term memory, text needs to be processed, understood and rehearsed. This is the main barrier to learning for dyslexic students in relation to memory. The level of difficulties varies with each individual.

Exam Hint: Dyslexia is a specific learning disorder which can be used as an example of developmental difference in memory for questions about cognitive psychology.

How is dyslexia diagnosed?

The probability of dyslexia can be identified by a screening test called Wide Range Achievement Test (WRAT-4). It measures basic skills in reading, arithmetic and spelling. This is often considered sufficient to receive support in education settings and as evidence for exam access concessions. A full dyslexia diagnostic test is carried out by an **educational psychologist**.

Screening tests can be carried out using computer software. They indicate the probability of dyslexia, but are not always accurate. Some provide an analysis of strengths and weaknesses that are useful for choosing appropriate strategies. The criteria for a dyslexia diagnosis refers to reading achievement which has been measured for reading accuracy or comprehension, and is substantially below the level expected for chronological age.

Exam Hint: You should demonstrate evaluation of diagnostic methods in terms of strengths and limitations.

Effects of dyslexia

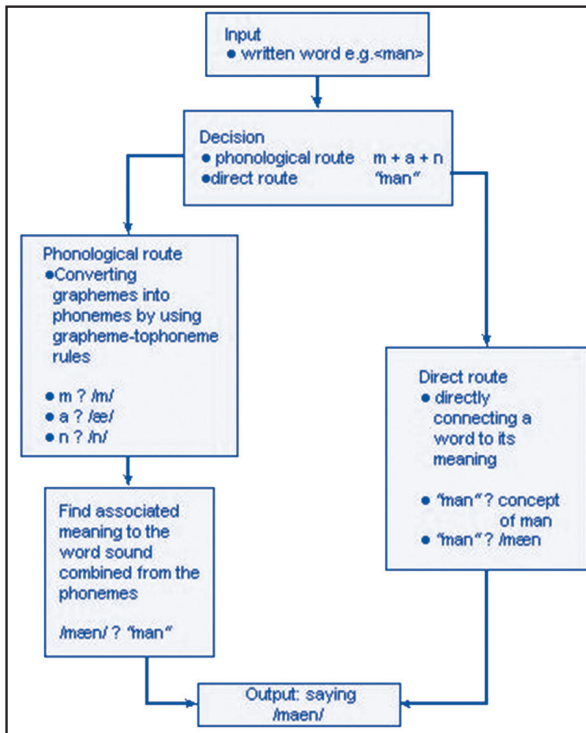
Dyslexia affects different people in different ways. Often those with dyslexia will struggle in a classroom environment where learning is structured into blocks of time. This is because their processing speed is slower, resulting in deficits in working memory, which in turn has a negative impact on their ability to commit information to long-term memory. This explains why people with dyslexia often have problems remembering/recalling information. In addition the connection between the visual representation of letters (**graphemes**) and the letter sounds (**phonemes**) is often confused resulting in difficulties identifying the order of letters or sounds in words. This makes reading difficult which can also have implications for learning and committing information to memory. Common difficulties experienced by people diagnosed with dyslexia include:

- Working memory inefficiency
- Difficulties with visual processing
- Slower processing speed
- Problems with organisational skills

However, there have been some positive elements highlighted by people diagnosed with dyslexia. Strengths can include:

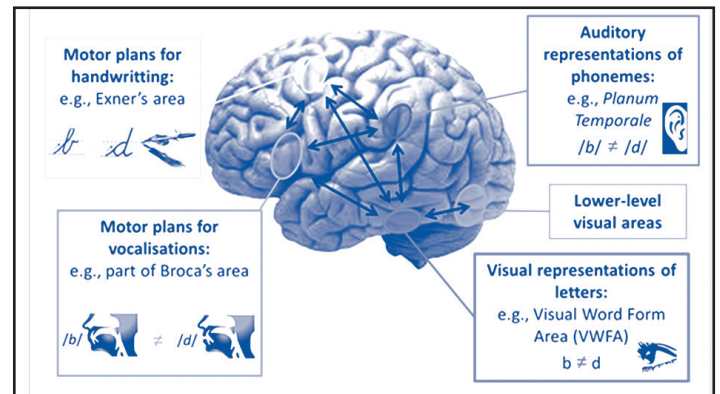
- Cognitive skills including reasoning and abstraction
- Creative or artistic abilities
- Visual and perceptual skills
- Engagement with new ideas and concepts
- Ability to see the bigger picture

215. Understanding Dyslexia



The two route model in reading

https://upload.wikimedia.org/wikipedia/commons/e/e5/1_1_twoRouteModelInReading.JPG



https://upload.wikimedia.org/wikipedia/commons/a/a9/Brain_pathways_for_mirror_discrimination_learning_during_literacy_acquisition.jpg

In studies of people with dyslexia it is noted that some of these areas are not activated in the same way. MRI scans have shown the two posterior systems (parieto-temporal and occipito-temporal) can be underdeveloped in people with dyslexia. Functional MRI (fMRI) detects increased blood flow caused by neurons 'firing' in different areas of the brain. Under-activation is shown in the parieto-temporal and occipito-temporal areas when a dyslexic person reads. Research has shown that in children with dyslexia, there is also an over stimulation of Broca's area which could be interpreted as the child attempting to compensate for the deficit in other areas. This suggests that they have developed their memory skills in order to remember whole words instead of decoding them. The function of the brain can be analysed before and after intervention to establish the most effective method.

Exam Hint: You can demonstrate your understanding of how dyslexia affects memory and reading ability by referring to cognitive processes.

Exam Hint: Answers in the top band demonstrate detailed knowledge and understanding and use specialist terminology appropriately.

Causes of dyslexia

Dyslexia is a **neurodevelopmental disorder**. Neurodevelopmental disorders affect the function of the brain and often occur during brain development. Genetic studies suggest that dyslexia has a high probability of being genetic. The genes that have been identified so far as markers of dyslexia are all related to brain development.

Dyslexia and the brain

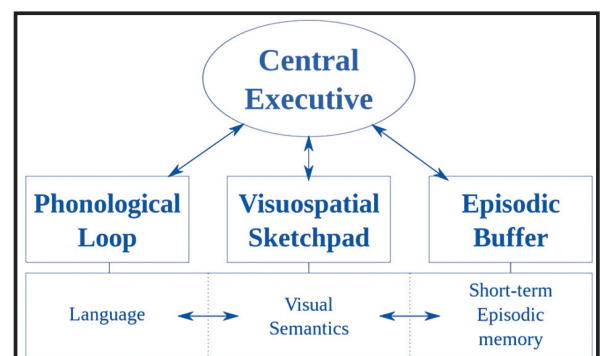
Research has shown that the brains of people with dyslexia work differently to those without when they read. Reading involves understanding that words are made up of sounds and that these sounds also have a written representation consisting of one letter or a combination of letters. These sounds can have several different representations. The reader also needs to understand that sounds are blended together to make the sound of the whole word. For example, cat is made from blending three separate letter sounds together c-a-t.

Three different areas of the brain are active during reading:

- **Broca's area:** For speech and language including whole word processing.
- **Left parieto-temporal:** For decoding words using auditory representations of phonemes (**Wernicke**).
- **Occipito-temporal:** For visual memory of words and letters. The left side is used to support the grapheme-phoneme principle, the right side helps with word forms.

Memory and dyslexia

Verbal working memory relates to remembering information about verbal items or words in order to use that information to perform an activity. Memory involves a multifunctional series of events that occur in a variety of areas in the brain. According to Baddeley and Hitch's (1974) model of working memory the **central executive** will instruct either the **phonological loop** or the **visual spatial scratchpad** to deal with this symbolic information.



Also refer to Factsheet 158: Models of Memory

<https://upload.wikimedia.org/wikipedia/commons/thumb/a/ae/Working-memory-en.svg/1280px-Working-memory-en.svg.png>

215. Understanding Dyslexia

The role of the phonological loop is to store auditory information. It is divided into two subsections: **phonological store** and **articulatory process**. The phonological store holds the information that you hear. The articulatory process rehearses this verbal information, keeping it in working memory. The visuo-spatial sketchpad stores visual and spatial information. The **episodic buffer** (added to the model in 2000) involves the transfer of information into long term memory.

Dyslexia makes it harder to learn new information due to less effective rehearsal and encoding mechanisms and difficulties with verbal processing. When someone has a deficit in verbal working memory, access to prior knowledge is also decreased due to less effective rehearsal, encoding and retrieval abilities. Attention is another aspect that needs to be considered in the creation of effective memory. Rehearsal requires consistent attention in order for information to become encoded. People with dyslexia often experience difficulties with attention and distraction or interference during the processing of verbal information and this will have a significant impact on encoding and storage. If the interference involves unrelated verbal information, there is an increased level of distraction.

In order for memory to be effective, information needs to be stored, retained and retrieved. A reduced working memory capacity is a key indicator of dyslexia. Distraction will cause information to be lost; the working memory is a short-term storage area. Typically, people can store between 5 and 7 chunks of information in their working memory, however the dyslexic learner has difficulty with more than 3.

Another theory that is valuable to examine when discussing memory difficulties in dyslexia is the **Levels of Processing Model of Memory** (Craik and Lockhart), which identifies three levels of processing;

- Shallow: what the word looks like (visual)
- Deep: how the word sounds (acoustic)
- Deepest: what the word means (semantic)

In order for memory to be effective, the deepest level of processing needs to occur. A person with dyslexia has deficit in the skills required for processing what a word sounds like (deep level) and what the word means (deepest level). This results in a shallower processing level where the individual relies on what the word looks like in order to create memory. If memory consists of three stages: encoding, storage and retrieval, and dyslexic learners have difficulties at the encoding stage, then this will impact the storage and retrieval stage. Dyslexia results in less information being encoded due to slower processing ability and because information being processed at a shallower level, the strength of the memory trace is reduced.

Exam Hint: Drawing on psychological research and theory grounds your knowledge in evidence and demonstrates effective application.

Conclusion

Dyslexia is a learning disorder that can be explained by cognitive psychology and theories of memory. Evidence from fMRI scans show that the brain functions differently in a person with dyslexia, resulting in strengths and limitations. Dyslexia affects the ability to develop effective reading skills due to difficulties with working memory, processing skills and phonological awareness. The view of dyslexia is moving away from a **deficit model** to one of difference in cognitive processes, supported by evidence from brain scans and other research.

GLOSSARY

Articulatory process: Aspect of the memory process where information is rehearsed.

Central Executive: A component of Baddeley and Hitch's model of working memory and controls attention and decisions about how information needs to be processed.

Deficit model: Focuses on the deficiencies resulting from dyslexia instead of working with strengths.

DSM-5: The Diagnostic and Statistical Manual of Mental Disorders (DSM) is the reference manual used to diagnose mental disorders.

Educational psychologist: Professional who assesses the learning and emotional needs of children and young people.

Episodic buffer: A component of Baddeley and Hitch's model of working memory which communicates between short and long memory.

Grapheme: The visual representation of phonemes (letter sounds).

Neurodevelopmental disorder: Affects the growth, development and/or function of the brain.

Occipito-temporal: The part of the brain responsible for visual processing.

Parieto-temporal: The part of the brain responsible for auditory processing.

Phoneme: the smallest unit of sound represented by a letter or group of letters

Phonological awareness: Identifying and manipulating units of sounds (phonemes).

Phonological loop: A component of Baddeley and Hitch's model of working memory responsible for the processing of auditory information.

Phonological store: Responsible for storing auditory information.

Processing skills: Cognitive processes that involve dealing with and responding.

Short term memory: Part of the memory system where information is stored for approximately 30 seconds. Short-term memory is sometimes referred to as working memory.

Visuo-spatial sketchpad: Responsible for storing visual and spatial information.

Wernicke: Area of the brain associated with recognising and understanding spoken language.

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Worksheet: Understanding Dyslexia

Name: _____

1. Evaluate the use of diagnostic tools in relation to learning difficulties such as dyslexia.

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2. Draw on models of memory to explain why people with dyslexia may have difficulties with processing and recalling information.

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3. Explain why reading may be difficult for individuals diagnosed with dyslexia.

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4. Describe the areas of the brain that are involved in reading and how these may function differently in individuals diagnosed with dyslexia.

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