



# Causes and consequence of dyslexia

by  
Dr Ian Smythe

© Ian Smythe 2014

## Contents

Aims and objectives

But why do we need to know, and who cares?

Introduction

Biological basis

Cognitive process

Environmental

## Learning Objectives

The purpose of this module is to provide an understanding of the causes and consequences of dyslexia.

Every attempt has been made to make it accessible to the reader, with links to additional online resources being provided where appropriate.

## Aims and objectives of this module

In this module we will be briefly looking at the issues around the causes and consequences of dyslexia. We would hope to achieve the following:

1. Be able to understand current scientific explanations of dyslexia
2. Understand the importance of knowing the causes
3. Understand the impact of the environment
4. Understand the nature of scientific debate

## But why do we need to know, and who cares?

In order to help the dyslexic individual, we do not need to know the cause, in the same way that a medical doctor does not need to know the cause of a broken leg. What they need to know is the exact nature of the issues, and apply their professional knowledge to overcome difficulties to the best of their skills.

However, for many years there was much heated debate about the very existence of dyslexia. Unfortunately teachers and psychologists found many things to blame rather than accept their lack of understanding of the complexities and diversity of the brain. So even at this level, if we can scientifically prove the cause(s) of dyslexia, then we should be able to overcome the lack of understanding of the difficulties, and ensure that every dyslexic individual is appropriately supported.

Even the most simple representation of human anatomy will demonstrate that everybody is different, and just because we can accept difference that we see (e.g. eye colour) does not mean there is not just as much diversity hidden in the brain. Furthermore, language is a relatively new development in evolutionary terms. There is no single function for it, and indeed it calls on many underlying cognitive skills. (See Module 4 for more details.) And if there are many underlying skills, and each skill calls upon millions of neurons, it is clear that any small failure in the network will have an impact on the development of those skills, e.g. reading. However, the location of that failure (or sub-optimal functioning) will determine the nature and severity of that problem.

So all science has to do is to show that the reading difficulties are caused by cognitive difficulties, the cognitive difficulties are due to wiring differences, and that consistently those wiring differences cause those difficulties. And we may also like to know what causes those wiring differences.

If only science was that simple!

## Diverse definitions lead to uncertainty

How can you have agreement in an area where there is more than one definition, and each stakeholder can provide their own?

## Introduction

The causes of dyslexia may be seen as falling into one of two categories: a) those which have implications on the “learning” process, and b) those that do not. Although simplistic in nature, this categorisation is an attempt to differentiate those “causes” that should be considered in the support process, such as phonological segmentation skills, as opposed to those which cannot be changed, such as brain symmetry. In the future our improved understanding of such biological theories may lead to improved teaching. But not today.

The issue faced by those working in the field of dyslexia is that there is a chicken and egg situation. That is:

It is difficult to have a clear definition until you understand the cause

It is difficult to determine the cause if you do not have a clear definition.

The problem is that dyslexia is a construct that describes a condition (difficulty in the acquisition of reading) which may be caused by many underlying causes. If reading (and writing) involves a whole series of cognitive processes, then it is logical to assume that if any of those processes is less than optimal, then reading will not be as efficient as it would otherwise be.

In turn, the efficiency of those cognitive processes is determined to a large extent by the neurological make-up of those areas impacting upon that particular function. And that make-up is determined by the biology.

And the final outcome (behaviour) will not only be affected by cognitive processes, but also the way one is taught (environmental).

## No such thing as a dyslexia gene

Dyslexia is about more than reading and writing difficulties.

It is a lifelong issue.

There are often strengths that can be utilised.

## Introduction

The simple model below helps us to understand the relationship between the different levels.

### Biological

This may be considered to be the biological make-up of the individual, the physical structure, and its determinants.

### Cognitive

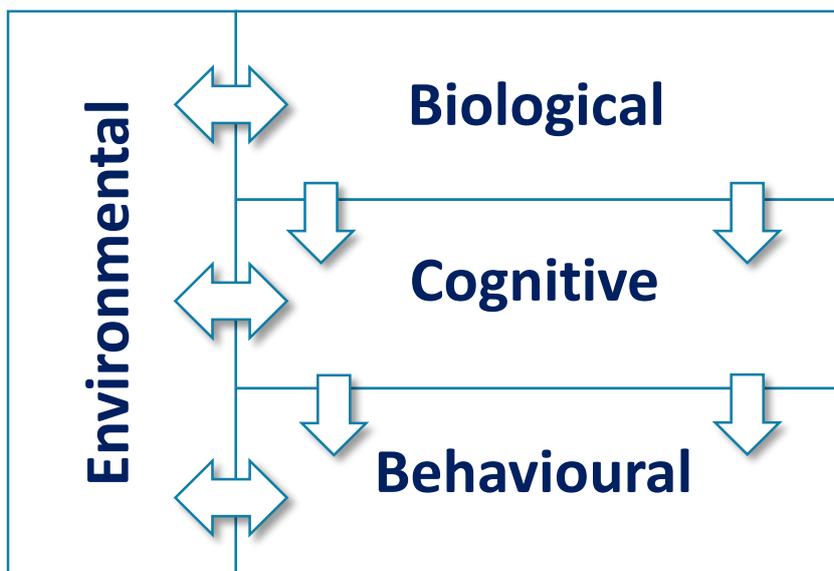
Cognition is about processes, and the ability to function effectively.

### Behavioural

Behavioural, may consider the literacy outcomes discussed here.

### Environmental

Environmental, primarily here refers to the teaching and learning environment, but may also be related to, for example, the outcomes of exposure to chemical toxins.



*Frith (1999), (Morton and Frith, 1995)*

## Key Points

Dyslexia is about more than reading and writing difficulties.

It is a lifelong issue.

There are often strengths that can be utilised.

---

## Links

<http://onlinelibrary.wiley.com/doi/10.1111/j.1444-0938.2006.00052.x/full>

## Biological basis

The research into the biological basis of dyslexia has in recent years looked at the genetic origins, and to date has identified nine potential chromosomes that may be implicated.

However, the quality of the research is variable, in particular because of the nature of the identification of the dyslexic participants in the studies. Since dyslexia (and reading) involves many cognitive processes, it may be assumed that a series of chromosomes may be implicated, each of which may impact upon one of more of the underlying processes.

This genetic heritability influence has been confirmed through a series of twin studies. However, the high levels of correlation reported in early studies has been questioned as more potential influencing factors in gene studies have come under scrutiny. The influences include home environment and teacher influence. In 2010 Petrill and his team suggested that "our interpretation is that educational studies overestimate the importance of the environment by ignoring genetically sensitive designs but that rejecting the possibility of teacher effects is unfounded."

### Other potential biological causes

The lack of consensus on the definition of dyslexia makes it difficult to be sure what to include or exclude from causes of dyslexia. In particular, some people suggest that you are born with dyslexia (and die with it). This would exclude some medical conditions that have been cited as a biological cause of dyslexia.

For example, otitis media, a common problem in infants can inhibit hearing at a crucial developmental age, and may influence development of those phonological skills important in development of fluent and accurate reading and writing.

Other potential "biological" influences include drug use (abuse and pharmaceutical) during pregnancy.

### The brain scan debate

A recent publication suggests that up to 90% of all brain scan research was wrong (New Scientist, Oct 2013). Of course it does not mean that research in dyslexia is flawed. But it does lead to some questions.

For example, in 1996 scans were published that demonstrated the difference between dyslexic and non-dyslexic brains in reading related tasks who had been diagnosed at least 10 years before.

In 2003 brain scans showed a difference after just 12 weeks of intensive training.

So the question is where the original scans showing real difference or just the impact of 10 years of specialist teaching?

---

### Links

Hensler BS, Schatschneider C, Taylor J, and Wagner RK (2010) Behavioral Genetic Approach to the Study of Dyslexia. *J Dev Behav Pediatr.* 2010 September; 31(7): 525–532.

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2952936/>

## Other biological causes

### **Magnocellular deficit theory**

Although given wide publicity, the scientific support for this theory is mixed. This is because the related studies offer conflicting results, and problems in experimental design (sample size, methods of choosing the subjects, and the presence of confounding issues) makes replication of results problematic.

### **Cerebellar deficit theory**

The hypothesis is based on the cerebellum controlling many areas related to the reading process, such as visual, auditory, tactile and motion processing. The lack of consistency in results makes acceptance as a major contributor problematic.

The fact that many individuals may have these deficits and yet not be dyslexic, and that many dyslexics do not show these deficits highlights the multiplicity of underlying causes, and the difficulties in choosing a representative sample for research purposes. While there is little doubt that some individuals do have these specific impairments, there is little to suggest that these are nothing more than the extremes of a normal population.

### **Modifying behaviour**

In "Is the nature of dyslexia nurtured?" Kathleen M. Lehigh wrote "a plan to modify the dyslexic behaviour would be the most likely method to "treat" the dyslexia. Until there is a way to modify the genes, modifying the behaviour will have to do." However, many dyslexic individuals as well as those working with them would suggest that dyslexia can be a positive advantage. It is just that society has not found a way to harness the strength, and remove the barriers in the learning process that restricts responses to conventional academic teaching.

## Research Design Flaws

Although given wide publicity, the scientific support for these theories is mixed. This is because the related studies offer conflicting results, and problems in experimental design (sample size, methods of choosing the subjects, and the presence of confounding issues) makes replication of results problematic.

Furthermore, in line with most theories, they fail to account for all the difficulties found in dyslexia.

## Cognitive processes

The cognitive processes may be considered to be any of those skills which may underpin the development of reading and writing skills.

These skills are more fully discussed in Module 4, but include:

- Memory
- Sound segmentation (e.g. syllables, rhyming and alliteration)
- Matching sounds and letters
- Distinguishing between sounds.
- Information retrieval

Each of these are important for the development of literacy skills, and whilst most people are adept at compensating for small difficulties and neurological differences, some have more trouble than others.

Fortunately, unlike biological differences, these cognitive difficulties are relatively easy and cheap to detect through the use of traditional paper and computer based testing.

They are also important in the development of support for the dyslexic individual, since they will identify which area needs additional teaching.

### **Biological vs Cognitive identification**

Some people have suggested that all we need for dyslexia identification is a brain or DNA scan. However, dyslexia is caused by a number of underlying difficulties. These are cognitive, even though their root cause may be biological. That biological difference may not have the same outcome in every individual. So the only way to confirm what the scan suggests is through the use of cognitive tests. So why use the scan in the first place?

## Structural differences

A number of researchers have found structural differences between dyslexic individuals and those who do not have reading difficulties.

Differences have been shown through brain scans and through post-mortem studies. But the research has rarely been clear as to how those differences relate to dyslexia.

Furthermore, there are questions about the methodology used, including the impact of additional teaching.

---

### Links

<http://onlinelibrary.wiley.com/doi/10.1111/j.1444-0938.2006.00052.x/full>

## Environment

The three most important environmental considerations are the teaching environment the chemical environment, particularly during pregnancy; and nutrition.

### Teaching environment

If a teacher fails to teach appropriately, the whole class can appear to be dyslexic! But even in those conditions, if you look closely, you will still find a child struggling more than the rest.

### Chemical environment

There is evidence of the impact of brain development from diverse sources including:

- Smoking
- Drugs (illegal)
- Drugs- prescribed
- Chemical exposure (e.g. lead poisoning)
- Alcohol

It is not difficult to see that if these impact upon development, and many areas of the brain are needed for reading, then all of these can have an impact upon reading. If you look deep enough on the internet, you will probably find research that will claim a link between dyslexia and diverse chemical exposures. While few people would doubt that such links exist, scrutiny of the published research often questions that the case is proven due to the questionable methods used.

### Nutrition

As well as exposure to certain chemicals that impact upon development, it is important to consider the lack of exposure to certain chemicals that are part of our dietary needs. There is contradictory research on the expanding supplements industry, particularly the impact of vitamins and fish oils. There is little doubt that they can help the significantly undernourished child. However, it is less likely to help those with a balanced diet.

### Visual stress

While a lot of research concentrates on difficulties related to the auditory side, some has been carried out with respect to the visual components, and in particular the impact of visual stress.

Many individuals have been shown to improve their reading skills when colour papers, colour overlays or special glasses are used. There is little doubt that this does have a positive impact with some individuals. However, it is doubtful that it can help as many as some researchers suggest, as typified by the number of individuals who continue to use these aids.

One aspect science has not answered is, if they suggest the precise colour is important, why users do not need a different colour for each lighting environment.

---

## Links

Use shortener

## Recommended web sites

All web sites are only as good as the person(s) who edits them. And Wikipedia is no different. However, it can be a very good source of links to primary sources of information.

Therefore, provided one appreciates there may be a bias in what is presented, it can be worth looking at the list of links to research papers.

Google Scholar is another useful resource for research papers.

---

### Links

Dysvet reading list – [www.dysvet.eu/resources/reading\\_list](http://www.dysvet.eu/resources/reading_list)