

THE EFFECTS OF SYLLABLE SEGMENTATION ON READING ON CHILDREN  
WITH READING DIFFICULTY: A HELPFUL TECHNIQUE FOR POOR READERS

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## **ABSTRACT**

### **EFFECTS OF SYLLABLE SEGMENTATION ON READING ON CHILDREN WITH READING DIFFICULTY: A HELPFUL TECHNIQUE FOR POOR READERS**

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There is a growing body of evidence supporting the idea that dyslexia exhibits itself differently in different languages. Based on how reading is taught in Turkish Language, the symptoms exhibited by students with reading difficulties may be different than the ones exhibited by English speaking students. Even though there is no support for the role of reading syllables as a reading unit in the literature, it is clear that the students in Turkey are taught how to read syllables and are actively using the strategy of reading a word syllable by syllable in their early reading development. Decoding words syllable by syllable, naturally, requires segmentation of the words into their subunits, namely syllables.

During the slow and struggling serial decoding of syllables, which is also based on serial decoding of phonemes to corresponding graphemes, the problem is transformed into bringing the correct number of phonemes together since the syllable length is not constant. It entails an increase in the number of the mistakes while reading a word in relation to its complexity in terms of the number and the variability of the syllables it includes. Deciding how many phonemes are supposed to be brought together and isolating them from the other graphemes in the word until the decoding of the syllable finishes is of critical importance during this process. The current study tested and found significant effects of segmenting the words into its syllables on behalf of the learner. The results suggest that aiding the segmentation process significantly improved the pronunciation of the syllables and words and decreased the number of mistakes during reading. It is hoped the results will help a better understanding of reading difficulties in Turkish, which in turn might help the development of more effective intervention techniques to the problem at hand.

Keywords: Dyslexia, Reading Difficulty, Problem Solving, Syllables, Specific Learning Difficulty

## ÖZ

KELİMELERİ HECELERİNE BÖLMENİN OKUMA GÜÇLÜĞÜ ÇEKEN ÇOCUKLARIN OKUMA PERFORMANSI ÜZERİNE ETKİLERİ: OKUMA BECERİLERİ GERİ KALMIŞ ÇOCUKLAR İÇİN YARDIMCI BİR TEKNİK

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Disleksinin farklı dillerde kendini farklı şekillerde gösterdiğine dair kanıtlar gittikçe artmaktadır. Okumanın öğretiliş şeklinde dayalı olarak, Türkçede okuma güçlüğü çeken öğrencilerin sergiledikleri güçlükler İngilizce konuşan öğrencilerin yaşadığı güçlüklerden farklı olabilir. Okuma sürecinde hecenin bir okuma birimi olarak yer aldığına dair literatürde destek bulunmasa da Türkiye’de öğrencilere hecelerin nasıl okunduğunun öğretildiği ve öğrencilerinde bu stratejiyi özellikle erken dönemde aktif bir biçimde kullandıkları açıktır. Kelimelerin hece hece çözümlenmesi doğal olarak sözcüğün alt birimleri olan hecelerine bölünmesini gerektirir. Hece uzunlukları değişken olduğu için, kendisi de harflere karşılık gelen seslerin çözümlenmesine dayalı olan hecelerin çözümlenmesi sürecinde problem belirli bir heceyi oluşturmak için hangi harflerin bir araya getirileceğine karar verilmesine dönüşür. Bu durum kelime okuma sürecindeki yapılabilecek hataların da kelimeyi oluşturan hecelerin sayısı ve karmaşıklığının artmasına bağlı olarak artacağı varsayımını gerektirir. Kaç harfin bir hece oluşturmak için bir araya getirilmesi gerektiğine karar vermek ve o harflerin kelimenin kalanını oluşturan harflerden izole edilerek seslendirilmesi bu süreçte belirleyicidir. Mevcut çalışma kelimenin hecelerine bölünmesi probleminin öğrencinin adına çözülmüş olmasının etkilerini sınamış ve bunun anlamlı bir şekilde etkili olduğu sonucuna varmıştır. Yardımlı okuma durumunda, deneklerin hece ve kelime okuma performansları istatistiksel olarak anlamlı bir şekilde artarken, hata sayıları düşmüştür. Sonuçların Türkçede okuma güçlüklerine farklı bir anlayış getirmesi ve mevcut problemin çözümünde daha etkin müdahale yöntemlerinin oluşturulmasına yardımcı olması umulmaktadır.

Anahtar Sözcükler: Disleksi, Problem Çözümü, Heceleme, Okuma Güçlüğü Özel Öğrenme Bozukluğu

To My Mother

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## LIST OF ABBREVIATIONS

<b>APA</b>	American Psychiatric Association
<b>SLD</b>	Specific Learning Disorders
<b>DSM 5</b>	Diagnostic and Statistical Manual of Mental Disorders 5
<b>GPC</b>	Grapheme Phoneme Correspondence
<b>CVC</b>	Consonant Vowel Consonant
<b>VCC</b>	Vowel Consonant Consonant
<b>VC</b>	Vowel Consonant
<b>CV</b>	Consonant Vowel
<b>ANOVA</b>	Analysis of Variances
<b>WISC-R</b>	Wechsler Intelligence Scale for Children-Revised
<b>SCL 90-R</b>	Symptom Check List Revised
<b>RAM</b>	Educational Counseling and Research Center (Rehberlik ve Araştırma Merkezi)

## CHAPTER 1

### INTRODUCTION

Reading is one of the basic skills any modern society is built on. Almost every individual goes through an education process and it is almost impossible to find any activity which does not involve some reading related component in it. Therefore, reading is not only a critical but also a survival skill in modern societies. It is an easy, reflex like activity for most people and skillful readers hardly remember how they acquired it. They take it for granted as a natural skill that everyone has. In terms of ease and automaticity, it is very much like any other automatic activity like tying shoe laces or driving. We do it without being consciously aware of how and sometimes even when we do it. We tie our shoe laces at a blink while thinking about something else or sometimes we drive to work as if we are teleported to our destination. Reading, for skilled readers at least, is in the same category with these skills and skilled readers do it automatically. They just have some kind of rough idea about how they, as experienced readers, do it and it is very difficult for them to understand, even imagine how someone cannot read.

Unfortunately, being an easy activity for an experienced reader does not mean that it is a skill to be acquired easily. Even though skilled readers have already forgotten that, it takes quite a lot of time and effort to become a skillful reader, months of schooling for most of the time. It is almost never remembered how much effort was put in that, how hard it was learned during the first years of the school and how frustrating that process was. For most children it takes about two years to be a skillful reader. What we see when we look at the performance of a reader with an experience of about two years is the performance of an expert, which is the result of hundreds of hours spent on reading. It is very much like watching any other expert, like a virtuoso violinist or an elite athlete, even if we are not aware of that.

Performance seems surprisingly easy and watching the performance is almost fascinating. However, it tells us very little about how the expertise is gained. Studying the performance of expert readers is undoubtedly important and gives us invaluable information about many things like how the mind works, what brain regions are active during reading, how they are coordinated to provide the performance etc. Nevertheless, it is not very useful in terms of understanding how the expertise is gained and what kind of obstacles are overcome to get at that level of expertise and what kind of factors lead to individual differences, which can be huge, among readers (Persky & Robinson, 2017)

While reading is so easy and so natural for most people, it is extraordinarily difficult for some others. They keep struggling to read after the first two years of school and never reach the mastery level of the others. The term used to define the people with difficulty in reading is dyslexia and it simply means difficulty in reading. Dyslexia has a surprisingly high prevalence rate and affects a significant percentage of the population. It is estimated that it is seen in 5 to 17 % of all children, making it one of the most prevalent neurobehavioral disorders (Shaywitz, 1998).

In spite of its high prevalence there is a big confusion about dyslexia, which also shows itself on prevalence figures. The range is surprisingly wide and this might be seen as an indication of lack of consensus on the subject. On the other hand, the width of it can be explained by the severity of dyslexia cases and the chosen statistical cut off points. The percentage of severe dyslexia is about 3-6 %, the figure becomes about 10 % with the addition of mild dyslexics, and depending on cut off point criteria the figure may be calculated as high as 15-17 % in the United States of America and Canada (Shaywitz, 1998). Even if only about 5 % of children could be categorized as severely dyslexic, the number is frighteningly high in a modern society in which survival is practically based on reading skills. The confusion keeps showing itself in other areas about dyslexia, as well. Astonishingly, it is still not clearly understood what exactly Dyslexia is, how it develops, how it could be treated or even whether it is possible to treat it (Rayner, Pollatsek, Ashby, & Clifton, 2012). To illustrate, the common image about a dyslexic reader is someone who cannot read because he sees words and letters backwards is not supported by evidence (Lyle, 1973). Contrary to the common belief, dyslexic readers do not make these kinds of mistakes and confuse the direction or orientation of words and letters more frequently on average than other beginning readers (Lieberman, Shankweiler, Orlando, Harris, & Bell Bertib, 1971). Dyslexia is surrounded by uncertainties and this common false impression is an example of the misleading ideas and the prejudgments surrounding it.

Dyslexia is classified under two different categories in the literature; acquired dyslexia and developmental dyslexia (Rayner, Pollatsek, Ashby, & Clifton, 2012). In the case of acquired dyslexia the problem is a result of brain damage in a person who could read properly before the damage. In developmental dyslexia, on the other hand, the person cannot learn reading as well as s/he is supposed to or as well as his or her peers do. Both categories have their own subtypes, which are similar to each other in terms of the symptoms exhibited, in spite of the fact that how they develop is totally different.

Acquired dyslexia has three sub-types classified according to the mistakes done by the patients as surface dyslexia, deep dyslexia and phonological dyslexia. In the case of Surface Dyslexia reading is normal except for the difficulty in reading low-frequency exception words with regularization errors. In phonological dyslexia patients suffer from a selective impairment in reading non-words compared with words, without suffering from accompanying semantic errors (Beauvois & Derouesne, 1979) while in deep dyslexia patients read almost entirely through semantics (Coltheart, Patterson, & Marshall, 1980).

In the case of developmental dyslexia, on the other hand, the situation is quite complicated. Due to the inconsistencies and the variety of the symptoms exhibited by children, there are not clearly agreed upon sub-types of developmental dyslexia. There are two lines of classification efforts; one of which is trying to adapt the classifications in acquired dyslexia. They are called as acquired dyslexia subtypes (Denckla & Rudela, 1974). The other line is Rapid-naming subtypes which are based on the conception of factors contributing to dyslexia. They are called Double Deficit and Phonological Deficit subtypes (Rayner, Pollatsek, Ashby, & Clifton, 2012).

While developmental dyslexia affects millions of people, it is usually very difficult to find cases for acquired dyslexia, someone with a brain damage on particular locations of the left hemisphere of the brain showing reading difficulties without prior reading difficulties. Even though the number of the cases is very small, practically just a handful, the data about it is abundant once a case is found. The cases can be studied extensively and experimental studies are easier to conduct since the cases themselves are experimental. The symptoms exhibited by both types of dyslexia apparently match, but this match might be misleading, when sources of the data is considered, in terms of understanding how developmental dyslexia develops.

There is literally a chaos in the field of developmental dyslexia. Within this chaotic environment a better understanding of what regular reading is, how it is achieved and how the skill is acquired might provide insight for how come some children cannot learn reading properly? Reading can be defined as a problem solving activity in which the basic challenge is to convert written symbols to oral, acoustic symbols. It is assumed that the reader has the capacity to decode the acoustic symbol as long as symbols are not supposed to be transformed from written ones. Therefore, the problems with understanding spoken messages, like ones caused by a hearing problem or mental retardation, are not within the definition of dyslexia.

When reading is defined as a case of problem solving, decoding written symbols can be divided into of a group of sub-problems to be solved as it can in many other complex problem solving activities. The first problem to be solved is to know what the written basic symbol units correspond to what oral basic sub-units, which means we need to know letter to phoneme correspondences. In order to decode a written symbol, its components must be decoded individually first. On the other hand there are some caveats making the problem harder than it seems. For example the some lexical knowledge may be necessary because some letters might be there just because of historical, legacy reasons and this requires the knowledge that not every letter must be spelled out.

The next problem to be solved is bringing together all the written symbols in a word to spell it out. This may be done either by dividing the word into sub parts like syllables and joining each syllable after each other after decoding it or the word might be treated as an atomic unit and it might be tried spelling out at once. In the first case, therefore, the next sub-problem to be solved is to decide what letters to include in the process of

construction syllables. Syllables might not be meaningful units in the reading literature but they are a basic part of how reading is taught, at least in today's Turkish education system. It is the student's task to read the word syllable by syllable and to decide which letters belong to the current syllable being read at the moment. Once the syllable spelled out correctly the same task is repeated until the end of the word repetitively (Civelek, Gündüz, & Karafilik, 2019). Since this task requires taking many decisions and keeping the decoded syllables in the working memory till the end of decoding the whole word, it is also harder than it seems and difficulty shows itself more as the word gets longer.

As presented above, spelling out written words correctly can be defined as a spectrum of problems and whenever we see a fast and successful performance of reading, this spectrum of problems have been solved successfully by the reader. An inexperienced reader might have problems at different stages of the continuum and depending on where the problem is the severity of dyslexia changes. It can roughly be said that a person with difficulty in defining the letters and joining them into syllables and a person with difficulty in joining syllables each other and spelling out the whole word are both called dyslexics where the former is with severe dyslexia and the latter is with mild dyslexia.

The current thesis focuses on mild dyslexic students who mainly have difficulty with decoding syllables, not particularly having problems with single phoneme level difficulties. It is believed that the problem dyslexic students at this stage have is in segmentation of the words into proper syllables that could be pronounced more easily. This hypothesis designates that the students make less mistakes when segmentation problem is solved on behalf of them. In order to study this possibility a simple experiment where students read sentences with and without segmentation is designed and applied on students with mild dyslexia. Moreover, to test if the students have the concept of syllable a simple phonological awareness task including dividing words into its syllables is given to the same students.

Chapter 2 of this thesis will provide a literature review on dyslexia, single word reading, how skillful reading is achieved, how dyslexia is diagnosed and the problems with dyslexia diagnosis in practice.

Chapter 3 will provide a thesis to explain how reading disorders might be developing because of the processes during the learning while chapter 4 will provide the methodology we employed in this thesis, how the experiment is designed and the data is collected and processed.

Chapter 5 will discuss the results of the study conducted for this thesis and analysis of the data obtained. Finally, chapter 6 will provide a discussion about the findings and limitations of the current study and additionally directions for future work will be evaluated here.

It is hoped that the results of the current study might provide further knowledge about how dyslexia is developed in young readers and why it is only developed in some readers. Furthermore, it is also hoped that the results might help devise some methods to intervene and improve dyslexic readers' reading skills.



## CHAPTER 2

### LITERATURE REVIEW

The first part of this section covers dyslexia as a paradigm and reviews single word reading literature. The second part covers how dyslexia is diagnosed and the problems with the dyslexia diagnosis in practice.

#### 2.1. Dyslexia

The first part of this section covers dyslexia as a paradigm and reviews single word reading literature. The second part covers how dyslexia is diagnosed and the problems with the dyslexia diagnosis in practice.

##### 2.1.1. *What is Dyslexia*

Dyslexia is an umbrella term which covers a situation showing a wide range of variety. There are basically two types of dyslexia; developmental and acquired dyslexia. In cases of acquired dyslexia, the reading problems result from brain damage caused by a stroke or an accident on an individual who reads normally prior to the incident. Developmental dyslexia, on the other hand, occurs in childhood, with the child usually experiencing severe decoding problems when he or she begins learning reading.

In spite of the surface similarity these two types of dyslexia are quite different from each other. Acquired dyslexia as the name indicates is acquired by people who can read well before a brain injury to the left hemisphere where language processing areas or modules are localized to. Three major types of acquired dyslexia syndromes are surface dyslexia, phonological dyslexia and deep dyslexia. In the case of Surface Dyslexia patients read regular words with normal accuracy and latency. They also have no problems with non-words similar to regular words but they experience difficulty in reading low-frequency exception words. They often make regularization errors and read exceptional words as if they are regular words. They pronounce words consistent with more standard spelling sound correspondences. The other two acquired types; Deep and Phonological Dyslexia are similar to each other. In phonological dyslexia patients suffer from a selective impairment in reading non-words compared with words, without suffering from

accompanying semantic errors (Beauvois & Derouesne, 1979). Phonological dyslexic patients can read familiar words but have problems with non-word reading. People with deep dyslexia make semantic substitution errors as well as struggling with decoding. Deep dyslexic patients read almost entirely through semantics (Coltheart, Patterson, & Marshall, 1980).

Even though acquired dyslexia is important on its own aspects, the focus of this thesis will be on developmental dyslexia. The term “developmental dyslexia” implies that a child does not acquire reading very easily and that the problem is in the beginning of learning. Studies indicate that children with dyslexia range from being severely impaired in their reading to only slightly damaged. Sometimes the problem is not simply reading, spelling, writing and problems with other aspects of language accompany to the problem as well as behavioral problems.

### *2.1.2. Developmental Dyslexia*

According to the National Institutes of Health’s current definition of dyslexia, which reflects the dominant understanding of dyslexia, it is a neurobiological disorder that results in particular pattern of reading difficulties (Lyon, Shaywitz, & Shaywitz, 2003). In other words, dyslexia is a specific learning disability which is neurobiological in origin and it only affects reading. It is characterized by difficulties with correct and/or effortless word recognition and poor spelling and decoding abilities. It is believed that these difficulties result from a deficiency in the phonological constituent of language and they are often unexpected with respect to other cognitive abilities of the reader. According to the definition above, which is widely accepted in the U.S. currently, deficits in the phonological language system lie at the core of reading difficulties (Morton & Frith, 1995). The three keys points in the definition are first; reading difficulties mainly result from phonological processing problems, not because of visual or auditory perceptual deficits (Fletcher, Lyon, Fuchs, & Barnes, 2007), second; the symptoms of dyslexia are behavioral, although the bases of these symptoms may be neurological or genetic and third; problems in reading comprehension and vocabulary are secondary results caused by a main impairment in single-word reading (Stanovich K. E., 1986).

Explanation of dyslexia based on the definition above is called as phonological deficit theory and it proposes that dyslexic readers’ difficulty with reading and spelling words is caused directly by a deficit in processing of the abstract speech sound or phonemes that make up words (Lieberman I. , 1973; Murhpy, Pollatsek, & Well, 1988; Stanovich K. , 1988). Problems with storage, access and conscious manipulation of spoken phonemes create a deficit in phonemic awareness and in order to read, in alphabetic writing systems this is the kind of phonological awareness necessary for learning to read. While they are spoken, phonemes are co-articulated with accompanying phonemes and thus acoustic properties of phonemes might change depending on the environments they

exist. They are, in other words, not only abstract entities that must be learned, but also psychophysically defined acoustic objects. Dyslexic readers have problems with distinction of cognitive representations of the phonemes and phoneme sequences that make up a spoken word form. Although they typically understand speech adequately, they have difficulty in consciously processing and manipulating its segments.

A phonological deficit in speech processing makes the individual phonemes difficult to separate from each other and prevents or slows down the learning of letter-sound correspondences. There is considerable evidence supporting that the word-level reading problems in dyslexia can be explained in terms of phonological deficits principally (Brady, 1997; Fowler, 1991; Ramus, Stuart, & Steven, 2003). However, the direct contribution of phonological deficits to word recognition disorders does not imply that phonological deficits always lead to reading problems. In other words, a phonological deficit is a necessary but not sufficient contributor to dyslexia. This theory proposes that early educational interventions can be effective in helping dyslexic children become better readers because of the behavioral nature of dyslexia symptoms. The problem with single word decoding leads to secondary consequences including problems in reading comprehension and lack of reading experience that can hinder the growth of vocabulary and background knowledge, as well.

Even though the current accepted definition of dyslexia refers to some neurobiological origin, decades of research into possible neuro-anatomical differences between dyslexic and normal readers has produced very few consistent findings (Rayner, Pollatsek, Ashby, & Clifton, 2012). Diversity of the problems exhibited by dyslexic readers leads to different theories trying to explain the diversity. Although, according to phonological deficit theories, most dyslexic children have an underlying phonological deficit, no one child has quite the same needs or abilities as another. Another group of theories which can be called as sensory-motor deficit theories, therefore, propose that problems with processing speed underlie the learning difficulties of people with dyslexia (Ramus, Stuart, & Steven, 2003). They essentially claim that processing problems in dyslexia are caused by basic deficits in the visual system, auditory system and cerebellum. (White, 2006). These theories are also called as double deficit theories because they have the idea of a deficit in one or more perceptual/motor system besides phonological deficits (Ramus, Stuart, & Steven, 2003).

### *2.1.3. Problems with the Definition of Dyslexia*

The biggest problem that most children with reading difficulties must solve involves word decoding and dyslexia can operationally be defined as “a substantial deficit in word recognition and/or spelling”. Evidence suggests that for most children with dyslexia this word recognition deficit stems from difficulty in learning letter-sound mappings that allow the accurate identification of unfamiliar words (Fletcher, Forman, & Franchis, 1994). It appears that most children who perform poorly on reading comprehension tests struggle with the alphabetic component of learning to read, which includes phonemic awareness and phonic skills. There is abundant evidence that training

in phonological awareness and letter sound correspondence improves word recognition skills (Blachman, 2000).

Studies identifying single-word decoding as the major deficit exhibited by dyslexic readers propose that the term to be used to describe dyslexic readers should be word-level reading disability (Olson, 1994; Perfetti C. A., 1985). According to word level reading disability approach, phonological and orthographic awareness coordinate in learning orthographic patterns, therefore deficits in one, especially, phonological, often result in lower performance and knowledge on the other as well (Bruck, 1990).

#### *2.1.4. Problems Surrounding Dyslexia*

The literature about developmental dyslexia is very rich but quite confusing. It is still not possible, based on the literature, to conclude what exactly it is, what the criteria for diagnosis is, if it is treatable or not, and, how it should be treated, if it is. Dyslexia occurs along a continuum from mild, maybe only affecting spelling, to severe, extreme difficulties in both reading and writing tasks. Severity of dyslexia is not uniform and it is often accompanied by other non-linguistic impairments such as attention-deficit disorder, which is just another name without stigma for hyperactivity disorder or motor sequencing problems.

Part of the problem for some children with reading difficulties may be coupled with cognitive skills in general or level of IQ. Even though low verbal IQ has an inclination to be associated with deficits in comprehension and vocabulary, most of the children with difficulty learning to decode words have also problems with reading speed and have comprehension score in the average range or better on IQ measurements. Another source of confusion is that the correlation between IQ and reading difficulties shows itself later in elementary school. In addition to the complexity of the concept because of the continuous nature of dyslexia, there is no absolute list of symptoms except for a significant difficulty with decoding and encoding written language.

Words are the fundamental units of meaning, and identifying words accurately is fundamental for understanding a text. In the lower grades, children with poor word recognition skills may be able to comprehend predictable texts by compensation with guessing, using picture cues, memorizing, or applying background knowledge. By the middle of elementary school, however, comprehension may weaken as texts become more abstract and deliver new information. This might be the explanation of why the correlation between IQ and reading difficulties tends to appear later in elementary school.

To be able to use reading to get new information, readers need to rely on strong word recognition skill. Dyslexic children continue to read in a struggling way and spend a quite a lot of cognitive resources to decoding, which leaves less resources available for comprehending text (Curtis, 1980; Perfetti C. A., 1985). Even though, strong word

recognition skills are not sufficient for comprehension, word recognition and decoding provide a necessary foundation for growth in reading comprehension.

Supplemental decoding instruction seems help most children with early reading problems if they are diagnosed as dyslexic or not. In most of the cases, children do not fall behind in reading, due to a transitory delay in their cognitive development. If word-level reading problems are not dealt with, they persist and keep on interfering with reading fluency and comprehension (Perfetti C. A., 1975; Perfetti C. A., 1985; Stanovich K. E., 1986). Children with reading difficulties do not seem to get better in their reading difficulties just by letting time to solve the problem and their chance of catching up peers is very small without effective intervention.

Finally, the biggest challenge to neurobiological origin assumption in dyslexia comes from different prevalence rates of it in different countries. If the problem has just caused by a neurological deficit it would be expected to occur at similar prevalence rates without nationality or language difference. The huge difference of prevalence among different languages, in the data provided by (Bingöl, 2003) shows that it is not the case and implies that the prevalence of dyslexia increase as the opaqueness of the language increase.

Table 1: Prevalence of Dyslexia in Different Countries Based On Orthographical Transparency (Bingöl 2003)

Country	Dyslexia Prevalence
Türkiye	0.6-1
Spain	3-4
Great Britain	5
Scandinavian countries	10
U.S.A	4-15
Canada	10-16

The problem in dyslexia, as mentioned above, is at word level. Thus, a review of single word reading literature will be helpful to put the things into perspective.

## 2.2. Single Word Recognition: How is word reading achieved?

### 2.2.1. *Word Recognition in Skillful and Novice Readers*

It is obvious that bringing the words which are read together and comprehending the messages in phrases or sentences or paragraphs requires quite more than word recognition. Nevertheless, at a lower level reading is based on word recognition and identification of words is not only a necessary condition but also the very first barrier to overcome for being a skillful reader.

For skilled readers who have overcome the challenges of identifying and recognizing just the words themselves, reading, not comprehending the message, is an automatic like process. Even though the performance of skilled readers makes the observers think as if it is a very easy task, for the novice reader recognition of isolated single words is a big challenge. It is known that some children experience great difficulties to overcome that and some are not able to overcome this at all through all their adult life. For the novice readers, recognizing the printed word is the central problem of reading and it is assumed that any person who is able to understand spoken language can also understand the same thing when it is written as well, as long as the message on the paper gets into his or her system. In spite of sometimes having extreme difficulties in decoding of written words beginning readers can process more complex speech very easily and effortlessly.

How decoding is achieved and much of what is known about word identification in skilled readers is summarized as below by Rayner, Pollatsek, Ashby and Clifton (2012, p. 50),

1. Even though, letter to sound conversion plays a role in the identification of words, word recognition is more than converting letters to sounds and then sounds to meaning.
2. Word recognition time in skilled readers is about quarter of second per word and it is automatic like. What is difficult and takes time is higher-order processes like constructing the correct syntactic structure, relating word meaning and fitting the text into the reader's world-knowledge.
3. Words are neither processed serially letter by letter nor learned as visual templates or gestalts. The letters in common short words appear to be processed in parallel. Longer words on the other hand, processed as a combination of serial letter recognition groups, and often not processed as one unit at once.
4. Being a part of a text or being isolated does not make a difference in terms of recognition. They are processed in a very similar way in both cases and the context's help to processing speed is often very small.

Besides identification of the meaning of a printed word, skilled reading includes higher order processes which bring the words together to grasp the structure and meaning of the sentences and this makes it possible to understand paragraphs or texts.

Word recognition, therefore, is a relatively automatic process and it is not the part of reading that requires the most effort in skillful reading. Whereas the word “automatic” means something that is quick, spontaneous and natural at first sight, adopting Posner and Snyder’s (1975) three criteria for automaticity will help to formalize this insight and will help decide if word recognition is automatic. The three criteria are as follows (Posner & Synder, 1975);

- a. the person may be unaware of the process;
- b. the course of action is not controlled consciously by the reader, in other words the readers intention does not have an effect on the execution of the process.
- c. the process takes no processing capacity – that is, it uses no resources that other mental operations might also use.

The recognition of visual words is automatic according to the first criteria given above. The word’s meaning is processed even though the participant is unaware of that fact. The Stroop effect demonstrates that both the name and meaning of a word are processed by skilled readers even when they are trying hard not to process them. So, identifying a word appears to be automatic according to the first two criteria for the skilled readers, even if some readers cannot ever reach at that level.

### *2.2.2. The relationship between processing the letters and the processing of words.*

Decoding of a written word is basically based on a match between printed letters and a lexical representation. It is argued that there are two routes to the lexicon; a direct route which goes directly from the printed letters to the lexicon and an indirect route which involves initial transformation of the printed letters into a sound representation and then accessing the lexicon through the sound representation (Rayner, Pollatsek, Ashby, & Clifton, 2012). It is indicated that longer words with more than one morpheme are perceived in a more complex way in which at least some of the morphemes are distinct units. Although it seems obvious that letters must be natural units in the perception of words, this is not necessarily the case especially for the languages with deep orthography.

Alphabetical languages can be put on a continuum in terms of depth of their orthographies. While shallow orthography means very good match between the phonemes and the graphemes, deep orthography means the opposite. This distinction can be seen with a comparison of the English and Serbo-Croatian orthographies, which would also likely be true for Turkish orthography, as well. The Serbo-Croatian writing system, which has a shallow orthography, directly represents the phonology of the word; each grapheme unambiguously represents a single phoneme, and each phoneme is represented by only one grapheme. On the other hand, the English spelling system, which has a deeper orthography, simultaneously represents both the phonology and

morphology. In addition to that, these representations are mixed variably, even erratically at first sight, from word to word (Katz & Frost, 1992).

As a result, phonemic codes can be more easily produced from a written form in languages with a shallow orthography like Serbo-Croatian than in English (Frost, 1987). Several studies shows that lexical access in English is mediated by both orthographic and phonemic codes, whereas native readers of Serbo-Croatian are biased toward using phonemic codes in word recognition (Feldman, 1980; Feldman, 1983; Lukatela, 1980). Therefore, as solution to conflict created by the depth of orthography, orthographical depth hypothesis suggest that phonology is generated directly from print in shallow orthographies, whereas it is derived from the internal lexicon in deep orthographies. Even though the data on which these suggestions have been based were provided primarily by studies conducted in English, research outside of the English language with Serbo-Croatian and Hebrew supports the findings. Which one of these ways will be preferred and more likely to be used seems to be determined by the depth of the language's orthography.

The Hebrew language, which has a deeper orthography than English, provides a third point on the continuum of orthographic depth. Therefore, including Hebrew in a study helps to identify that the results mentioned above are really because of the depth of the orthography but not a function of another factor.

Orthographical depth hypothesis proposes that lexical word recognition in a shallow orthography is achieved primarily by phonemic cues, which are generated pre-lexically by grapheme-to-phoneme translation which is possible because of the nature of the language's orthography (Katz & Frost, 1992). On the other hand lexical access for word recognition in a deep orthography is achieved largely with the help of orthographic cues and phonology is derived from the internal lexicon because grapheme-to-morpheme route is blocked because of the depth of orthography.

Consequently, in a shallow orthography, the major phonological information needed for word pronunciation is expected to be generated without applying to the lexicon, by means of grapheme-to-phoneme translation as the normal strategy for naming. In contrast, in a deep orthography, this kind of pre-lexical information for naming is either absent or too complex to be used efficiently. Therefore, pronunciation is based on information stored in the lexicon.

Another explanation might be that at the extreme shallow end of the orthographic depth continuum, a sufficient portion of the phonological code can accumulate before the orthographic analysis can help word recognition. In contrast, in deep orthographies generation of the phonemic code is more complex. It is frequently dependent on units larger than the single grapheme, and is therefore slower. Moreover, in a deeper orthography, simple grapheme-to-phoneme translation is not only difficult but may frequently lead to incorrect responses (Frost, 1987).

At the study where Frost, Katz and Bentin (1987), compared skilled readers of three orthographically different languages, skilled readers of Hebrew, which has the deepest orthography, uses orthographic cues more than skilled readers of English, which has the mild orthography among the languages compared, and English readers use orthographic cues more than readers of Serbo-Croatian, which has the shallowest orthography of all three. These results seem to support the orthographical depth hypothesis.

Another study by Wimmer and Goswamib (1993), which compares the influence of orthographic consistency on reading development with word recognition skills in English and German children, also supports the orthographical depth hypothesis. The study compares the initial difference in reading strategy between the two orthographies, and shows that English children, who are more dependent on direct access strategies, have difficulty in reading the nonsense words (Wimmer & Goswamib, 1994). The German children, on the other hand, have little difficulty with the nonsense word reading task, as they are used to assembling pronunciations of letters.

It can be speculated, in the light of the result of the studies mentioned above, the orthography of the language determines the extent to which the reader will rely on one route or the other more. The regularity of the grapheme-phoneme correspondence in shallow orthography like Serbo-Croatian may simply lead readers to depend more profoundly on the route through sound to the lexicon whereas depth of orthography lead the readers to access the lexicon through an indirect route.

The present evidence suggests that both routes are used in all languages. Once readers have acquired the ability to decipher the written symbols, reading may be a relatively culture-free cognitive activity (Gibson, 1975) in the sense that the writing system may have little effect on the process of reading. In skilled readers, the letters within words are processed in parallel, and parallel letter recognition leads to word identification (Rayner, Pollatsek, Ashby, & Clifton, 2012). On the other hand, it seems as if novice readers start reading the letters serially and it turns into parallel processing with mastery over time. It seems as if there is no data about at what stage and how novice readers get to the mastery level of parallel processing and if all learners of reading are able to do it.

Even though word recognition is automatic for skilled readers, it is not the same for the novice readers. Skilled readers are all ex-novice readers and go through similar processes while being an expert on reading. It might be helpful to remember that what we see when we look at their performance is the expression of mastery more than something natural. In other words, what the experts and novices do might be different from each other and to study the transformation process might help us to understand it better.

### 2.3. Dyslexia Diagnosis and DSM 5

How dyslexia is diagnosed shares similar problems with the definition of dyslexia. It is quite problematic as well. Dyslexia is officially diagnosed by psychiatrists or psychologists and their diagnosis is based on Diagnostic and Statistical Manual of Mental Disorders 5 (DSM 5).

According to the DSM-5 of the American Psychiatric Association (APA) Dyslexia is classified under Specific Learning Disorders (SLD). It is the most common SLD, accounting for about 80 per cent of all SLD cases and affects between 3–12 per cent of the population (Pavlidis, 1981). Among the many definitions made by different researchers and institutions the one made by APA would be the most reliable one and the best starting point because Dyslexia diagnosis is based on this definition in Turkey. Any child with reading difficulties is directed to the local educational Counseling and Research Center (RAM, Rehberlik ve Araştırma Merkezi) through the referral of the teacher and the school psychological counselor. After the first evaluations in the RAM the student is directed to a child psychiatrist where the final and official diagnosis for SLD with reading difficulty is given.

Diagnosis is based on the DSM-5 and the DSM-5 diagnostic criteria for Specific Learning Disability define an umbrella category of SLD. The definition has specifiers to characterize the specific manifestations of learning difficulties at the time of assessment in three major academic domains, namely reading, writing, mathematics. Therefore, dyslexia in DSM-5 is called as SLD with impairment in reading. The diagnosis of dyslexia or SLD with impairment in reading is based on four criteria (A – D), all of which must be met.

Criterion A refers to the key characteristics of SLD and at least one of six symptoms of learning difficulties that have persisted for at least 6 months despite the provision of extra help or targeted instruction must be present. Criterion B refers to measurement of those characteristics. The affected academic skills are substantially and quantifiably below those expected for age and cause impairment in academic, occupational, or everyday activities, as confirmed by individually administered standardized achievement measures and comprehensive clinical assessment.

Criterion C refers to age at onset of problems during the school-age years, although may not fully manifest until young adulthood in some individuals. Therefore, schooling is important to diagnose dyslexia. Finally, criterion D specifies the disorders and situations that must be eliminated before the diagnosis. Intellectual Disabilities, uncorrected auditory or visual acuity problems, other mental or neurological disorders or adverse conditions, psychosocial adversity, lack of proficiency in the language of instruction, inadequate instruction must all be ruled out before a diagnosis of SLD can be confirmed. Criterion B, which is in fact a compound criterion of three different but related criterion is hardly met in practice. The definition chains tree criteria with each

other with the logical operator “and” requiring that all three criteria must be met at the same time. These are

- it must be determined that the affected academic skills are substantially and quantifiably below those expected for age and
- lack of skills must cause the impairment in academic, occupational, or everyday activities, and
- it must be confirmed by individually administered standardized achievement measures and comprehensive clinical assessment.

Academic skills expected at a certain age are not clearly identified and determined in our country. Since standardized achievement measures do not exist in Turkey, an unknown reference is supposed to be used as a major reference point in diagnosis of dyslexia. In the absence of the reference points, it is impossible to decide how much academic skills are affected and diagnose dyslexia objectively. This absence indirectly affects the second part of the criteria requiring that how much the student is below than the expected level is measured with standardized achievement measures. In the absence of reference points, which is also not set or simply do not exist in Turkey currently, it is impossible to have standardized measurement of achievement. As a result, with all missing elements above, comprehensive clinical assessment and objective dyslexia diagnosis in Turkey, in practice, is something random and inconsistent.

Because of the reasons I list below, I think that it is not possible to use DSM-5 correctly to diagnose dyslexia in Turkey. Moreover, it is a very long and difficult process. Without having a diagnosis students cannot access the individual education sponsored by the Ministry of Education. Dyslexia which is already confusing enough becomes more confusing with the problems related with proper diagnosis and intervention.

#### **2.4. Hypothesis**

The basic idea about language and alphabetic principle is that the mapping between written and spoken forms of language is regular and therefore they can be expressed and learned in terms of a set of rules, even if the languages with opaque orthography are quasi-regular and input-output relationship has many exceptions. The idea of mapping does not only determine how reading is taught to children but also lets us define reading as a problem solving activity.

Based on the basic idea presented above the basic challenge in reading is to pronounce a word from a group of letters written on a medium. At the lowest level this challenge is dealt with, for the beginning readers at least, by matching all the graphemes in the word to phonemes serially. This model is called as the Grapheme Phoneme Correspondence (GPC) model of reading (Plaut, McClelland, Seidenberg, & Patterson, 1996). Writing, on the other hand, is just the opposite, encoding a word from the mental lexicon to a

writable medium. When decoding of the written word is finished through the GPC, it is matched with the words in the mental lexicon of the reader, which is the way to make sure that pronunciation is correct. For example, when a reader finishes pronouncing or decoding the word “cat”, the pronounced word is matched with a semantically meaningful word “cat” in the mental lexicon of the reader. Accuracy of this matching is obviously critical since pronunciation of the symbol as “cas” will not match with a word while pronunciation of word as “car” will match a totally different word from the mental lexicon or the person’s knowledge about that language’s vocabulary.

When they are learning how to read, the instruction given to the students on how to do it is that reading is based on the alphabetic principle and GPC rules and they have to employ strategy until the end of the word. Any observation, like the ones I did for this study, of the effort of a child struggling to decode a word shows that children actively use this strategy and even the fluent readers return to it when they come across a word that they cannot decode automatically. While decoding a word letter by letter, another problem arises in the pronunciation of words consisting of more than one syllable; serial GPC becomes harder or even impossible as the word to be decoded gets longer because of working memory capacity, which is about two seconds in terms of time. Under the working memory constraints, while pronunciation of a word like “symbol” is difficult, pronunciation of a word like “pronunciation” is impossible solely with GPC strategy. The solution is chunking the GPC’s into syllables and using syllables as base unit of at the early phases of learning reading.

This solution brings its own problems to be solved; how to decide when to convert GPC into a syllable. Is it supposed to be sy-mbol or sym-bol or symb-ol? Since syllable is natural sub-unit of words, people are naturally able to divide a word into its spoken syllables (Gambell & Yang, 2005). In other words, the signal flag is already there when needed. With the existence of flag variable, the problem is converted into pronunciation of syllables and adding them to each other consecutively to pronounce the whole word at the end. To illustrate, a child decoding the word “pro-nun-ci-a-tion” must start with a successful GPC of the first syllable “pro”, store it temporarily in the working memory while the next syllable is being decoded and then join the two syllables into each other. Any problem with decoding of the syllables will affect the final result of word reading. Correct decoding of the syllables is a prerequisite for the later stages of the word decoding. A child decoding a word with three syllables like the word “symbolic” must decide where to stop the first syllable. The first syllable may be sy, sym or symb. What is more the decision here affects the course of development of the second syllable as well. If the child mistakenly decides that the first syllable is “sy” then the second syllable may be “mbol”, “mbo” and if there are no correction the third syllable will be harder to decode.

Anything interfering during the solution of this problem will affect the performance of decoding. Interference might be caused by incorrect determination of syllable boundary, decoding the syllable incorrectly or lack of knowledge to be able to decode the word correctly or consuming too much time to decode a syllable and decaying the syllables

decoded before from the working memory. Any one or combination of these problems might result in reading mistakes. In the data collected for this thesis the word length and complexity effect is observable. While the readers with poorer skills read complex words effortfully or cannot read them at all, the skilled readers read them more slowly with respect to simple words or they make returns during the reading.

As mentioned above the idea of reading as a problem solving activity also determines how reading is taught at schools as well. The current approach adopted in Turkey now is bottom up in which the students are taught single phoneme to grapheme correspondences and are expected to decode words through serial decoding. A quick look at the course book which is distributed by the Ministry of education freely and has to be used nationwide will approve the current approach. The book starts with teaching 8 most common letters and teaches reading simple short words which only include these letters. Before teaching reading the words, the book teaches how to bring letters together to form syllables and explicitly teaches that words are made up of syllables and divides words into syllables. (Civelek, Gündüz, & Karafilik, 2019)

The problem of decoding a written word in the form presented above consists of combination of two different problems; spelling out single letters and bringing them together in a syllable and deciding how many letters to bring together to build a syllable. There are four basic types of syllables used during reading in Turkish. They are single Vowel (“e”, as in the word edirne), Consonant Vowel (“an”, as in the word anne), VC (“ne”, as in the word anne), and CVC (“son”, as in the word sonra) syllables. VCC (“üst”, as in the word üst) is another kind of syllable but it is almost always converted into VC (üs) + CV (tü) during reading unless it is used as a single word as in the word üs-tü-nüz-de. The most common one among the four basic types is two letter Consonant-vowel (CV) syllables and it is the first kind of syllable that is taught how to read in the school book. Vowel-Consonant (VC) syllables are less common in Turkish and they are very similar to CV syllables in terms of reading difficulty. These types of syllables are the kind of syllables that the students come across and are trained on most. As a result they have a tendency to try to divide words into these kinds of syllables first as long as it works.

The word “sarmalanıp” (CVC+CV+CV+CVC) is not only longer than the word “günü” (CV+CV), but also contains transitions between different kind of syllables. Single word reading is a problem solving activity including dividing the problem at hand into sub segments and the performance on the problem is related with the problem difficulty. Longer words with transitions among different kinds of syllables present more complex problems to be solved and are expected to be read with more effortfully than less complex words. Therefore, the hypothesis to be tested in this study is that problem difficulty is a factor affecting reading performance and assistance which decrease problem difficulty will improve the performance in reading. In other words, the students are expected to read faster and make lesser mistakes in reading words when they are presented in syllables with respect to presenting the same words as a whole. In addition to this, word complexity itself as presented in the example above is a factor affecting the

problem difficulty, as the word gets more complex, the problem gets more difficult. Therefore, it is expected that both the time it takes and the number of mistakes made will increase as the complexity of the word itself increases and they will decrease under assisted condition in which syllable boundaries are determined behalf of the student.

Moreover, the formulation of single word reading as a problem solving activity also requires the notion of phonetic awareness on syllable level. In order to use syllables as a subunit of a word during reading a notion of syllable must exist and decoded syllables must be matched with the syllables recalled from the mental lexicon. This assumption is also tested in the current thesis.

Even though problems with syllable segmentation are not certainly the only problem to be solved to read accurately, it is one of the important problems the children with reading difficulties must solve. There is a range of problems before and after this stage and in order to proceed to the next level to the problems located after this problem on the spectrum understanding the problems at this level is thought to be helpful.

The next chapter provides the details of the data collection and experiment to support the ideas presented in this theses.

## **CHAPTER 3**

### **MATERIALS & METHODOLOGY**

In order to test the hypothesis presented in the previous chapter, some reading data from students with severe to mild reading difficulties has been collected. The students are asked to read words with different complexity levels, 10 low, 10 medium and 10 high complexity words, under regular and assisted reading conditions. The words are taken from age appropriate school text books (Çeltik, 2018). Between the sessions a simple phonetic awareness measurement is applied to see if the students have a firm syllable idea and if they are able to divide words into their syllables on their own and if word length affects segmentation ability.

A group of 10 students with regular reading skills and another group of 10 students with reading difficulties are recorded while reading age appropriate words with different difficulty levels taken from school books. The children in each group read a set of 30 words with three complexity levels twice. In the first round they read the words as they normally read and in the second round they read the same words syllable by syllable with highlighted syllables changed by the experimenter manually. Between the rounds the students are tested with their phonological awareness ability in terms of syllable segmentation.

#### **3.1. Participants**

All of the twenty participants of the current study are second grade students from Çağrı Bey İlkokulu, in Ataşehir İstanbul. The participants tested have been divided into two groups as an experimental group and a control group. Both groups had ten students. All the students in the control group have average or above average reading skill in their class. The students in this group are directed by their class teachers. The experimental

group also had ten students, three of whom with reading difficulty and have had SLD diagnosis while seven of them do not. Because of stigmatization and labeling some parents do not want their children to be diagnosed as Dyslexic. Therefore, even though their reading levels are parallel some students do not have an official diagnosis. The students are directed by the coordination of their class teacher and the school psychological counselor both of whom know and are aware of the problems of the students. Three students are excluded from the study because they mainly experience difficulty on recognition of single letters and were not able to pronounce syllables by joining letters to each other. The students took part in the study with the written approval of their parents which obtained by the school psychological counselor and their class teachers and ethics approval was obtained from METU Human Subjects Ethics Committee before the experiments were conducted.

### **3.2. Stimuli**

The stimuli consist of 30 words, chosen from students' text book which is studied at school. The words equally divided into three groups based on their difficulty levels which are assumed to be a function of word length, the longer the words the more difficult they are, and variability of syllables in the word, the more the variability the more difficult the word to be read. The first group with the least difficulty consisted of words with three syllables, the second group with medium difficulty consisted of words with four syllables and the difficult words group consisted of five syllable words. All sentences consisted of consonant vocal consonant (CVC), consonant vocal (CV), vocal consonant (VC). Since single word syllables (V) are always vocal phonemes and are always the first syllable of the words and therefore easier to read they are not employed in the study.

Although it was intended to use 45 words initially, with the same characteristics above, since the test trials showed that it took too long to read that number of words for the poor readers and they started to get tired and bored towards the end of the reading session, the number of the words in the experiment decreased to 30. There are 120 syllables in total and their distribution in terms of syllable variety is consonant vocal consonant (CVC) 66, consonant vocal (CV) 52, vocal consonant (VC) 2.

### **3.3. Procedure**

The students were expected to read the same set of words twice; with and without assistance. In the session with assistance the students were expected to read words which were divided into their syllables by highlighting the syllable to be read. Moreover, the students' phonetic awareness levels in terms of dividing words into syllables naturally is tested in between reading sessions. The performance of the students is recorded in school counselor's office in Çağrı Bey İlkokulu in school days in the presence of the school counselor. The students are informed what the study is about and what they are

expected both by the school counselor who they already know and by the experimenter at the beginning of the session. The words that they are supposed to read are displayed on a laptop screen and their reading performance is recorded with an external microphone with sound editing software, namely Audacity.

The students were first asked to read 30 words with three difficulty levels as if they were reading them in class. After finishing reading non-assisted regular reading session, their word segmentation ability is tested with a simple phonetic awareness task in which they divide orally presented words like “birincilikle” into its syllables like “bi-rin-ci-lik-le” After that the students were asked to read the same words with assistance. The syllables the students were supposed to read were highlighted on the screen with the help of a javascript and html code. The students were not given any feedback about their performance and once the student finishes reading the highlighted syllable, successfully or not, the next syllable is highlighted and reading activity continued in this way for all the words in the list. The words are presented in two different reading sets and screen shots from regular and assisted reading sessions are provided below.

çalışkan, gülümser

Figure 1 Reading without Assistance / Regular Reading Example

çalışkan, gülümser  
çalışkan, gülümser  
çalışkan, gülümser

Figure 2 Reading with Assistance Example

It was, at first, intended to observe the performance of the students with a fixed latency of 1000 milliseconds between syllables to change. However, trial recordings showed that the reading speed of the students is not uniform for all syllables and fixed latency was either too fast or too slow occasionally. Since this is not the natural way the students read and it considerably hindered their reading performance, instead of using a fixed duration syllable highlighting was manually controlled by the experimenter according to the pace of the reader during the study.

### **3.4. Data Preparation and analysis**

The data recorded is annotated and studied word by word with sound editing program, Praat. Reading durations are calculated by using Praat's annotation and textGrid facilities and reading accuracy is calculated as the sum of the mistakes done during reading of a word or a syllable for both conditions. The data about phonetic awareness simply includes counting the errors made by the students in each word they are supposed to divide into its syllables because even the students with poorest reading ability turned out to be quite fast and largely flawless in this task.

Two-way (two-factor) repeated-measures ANOVA is conducted on the data since there are 2 within-subjects factors, assisted reading vs. regular reading, with three different levels, reading low, medium and high difficulty words and each dependent variable measurement is repeatedly conducted with(in) the same subject for all conditions. In brief, reading performances of the students, dependent variable, with and without help at different word difficulty levels, independent variables, are compared.

## CHAPTER 4

### RESULTS

In this chapter, we report the results of the analyses of the participants' reading performance on assisted and non-assisted reading tasks with different difficulty levels. The data collected from students with or without reading difficulty is summarized in terms of reading duration and mistakes made during reading. As well as standard experiment-control group comparison, the performance at different difficulty levels is employed at the current study. Mixed design two-way ANOVA, results of which are explained below, is applied at the data.

#### 4.1. Reading speed (duration) Within Subjects Effects

This section reports the results of the analyses of the participants' reading performances and interpretation of the duration data is as follows.

Duration of the time spent to read words and syllables is measured as an indicator of reading performance. Initial analyses showed that both word difficulty and segmentation of words have significant effects on participants' performance as it can be seen in the graph below.

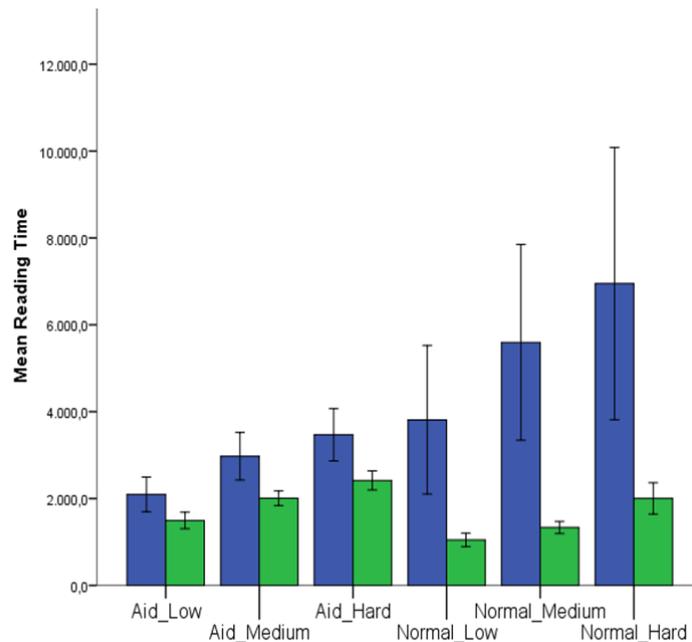


Figure 3 Comparison of Dyslexic and Normal Readers

In the ANOVA, main effects of reading difficulty and type of reading are analyzed first and then interactions between the main effects at different difficulty levels are compared. Since Mauchly's test of sphericity is significant, we do not assume sphericity. Therefore, F values with Greenhouse-Geisser correction is used in the following analysis.

The main effect of difference between whole word reading and reading a word in syllables was statistically significant ( $F(1, 10) = 5.706, p < .05, \eta^2 = .241$ ). This means that there is meaningful performance difference in reading words regularly or in a segmented way when independent of which group the subjects come. This is in line with the initial analysis based on the means. On the other hand, this effect is stronger between groups ( $F(1, 10) = 12.460, p < .05, \eta^2 = .413$ ). The results shows that it is helpful to divide a word into its syllables and it helps to improve all the students' performances while this help is more significant between groups, namely for poorer readers.

The main effect of difficulty of the word read was statistically significant ( $F(2, 18) = 57.354, p < .05, \eta^2 = .761$ ) for both groups. It is clear that difficulty of the word read has a great effect on the performance on both groups. However, this effect is not as strong as the effect of word segmentation between groups ( $F(2, 18) = 10.282, p < .05, \eta^2 = .364$ ). The results shows that effect of difficulty of the word being read is important for both groups but it is more important for the experiment group. Subject in both groups read faster when the words are divided into their syllables. This effect is greater for reading difficulty group. Subjects are more successful in reading less difficult words.

#### 4.1.1. Within Subjects Contrasts

The main effect of word difficulty was statistically significant ( $F(1, 10) = 63,007, p < .05, \eta p^2 = .778$ ). It means that when all other factors are ignored word difficulty is the most important factor affecting reading performance. On the other hand, this effect gets weaker in word difficulty is combined with group. This interaction is also significant. ( $F(1, 10) = 10,710, p < .05, \eta p^2 = .373$ ). The results shows that as the word difficulty increase the students' performance will decrease independent of the group they belong to.

When the interaction of word of difficulty and group is studied based on difficulty level it can be seen that the difference between medium and hard difficulty levels was statistically significant ( $F(1, 10) = 23,250, p < .05, \eta p^2 = .564$ ). This effect is still significant between groups although it gets weaker ( $F(1, 10) = 12.460, p < .05, \eta p^2 = .413$ ). The results show that difficulty word being read is an important factor in performance for both groups.

Additionally, when the interaction between type of reading and word difficulty compared for easy and hard conditions, the effect was statistically significant ( $F(1, 10) = 6,018, p < .05, \eta p^2 = .251$ ). On the other hand, when the same interaction is compared for medium and hard conditions, the effect was statistically significant ( $F(1, 10) = 4,735, p < .05, \eta p^2 = .208$ ). The results shows that how a word is read contributes the performance at all conditions but it effect is greater for harder words.

The interaction between how reading type and word difficulty effects both groups was also statistically significant for easy and hard conditions ( $F(1, 10) = 5,576, p < .05, \eta p^2 = .237$ ). This effect is still significant ( $F(1, 10) = 13,115, p < .05, \eta p^2 = .422$ ) and it gets stronger when medium and hard levels are compared.

Finally, between subjects effects are significant as well, ( $F(1, 10) = 15,993, p < .05, \eta p^2 = .470$ ) which means if ignore all other variables the performances of students are different based on the group they come.

#### 4.2. Accuracy (Success Rate)

Accuracy (Success Rate) is the ratio of correctly read word and syllables to all words and syllables read. Initial analyses showed that the situation in accuracy measurements is quite similar to the measurements in duration and both word difficulty and segmentation of words have significant effects on participants' performance as illustrated in the graph below.

A comparison of means of both groups shows that dyslexic and regular reader groups are from different populations and the difference between them is enormous under both reading conditions. When the students are assisted and word segmentation task is done behalf of them the performance of the students with reading difficulty improves

considerably. It can easily be seen that word difficulty has a considerable effect on both groups on both conditions. The difference between the groups stays mainly under both conditions which might be caused by the number or mistakes made by regular reading group are already very small. It is clear that assistance helps the students with reading difficulty a considerable amount. The analysis of variances supports this interpretation as well.

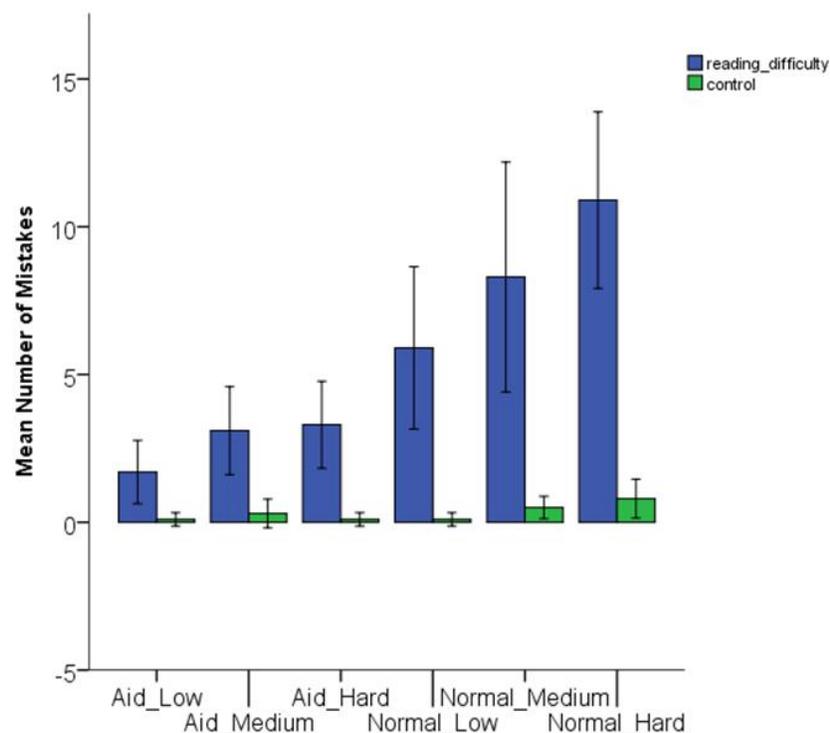


Figure 4 Comparison of Experiment and Control Groups in Terms of Accuracy

In the ANOVA, main effects of reading difficulty and type of reading are analyzed first and then interactions between the main effects at different difficulty levels are compared as in the duration data above. Since Mauchly’s test of sphericity is not significant for difficulty and aid-difficulty condition, we assume sphericity and corresponding F values are used in the analysis of this condition. On the other hand, since Mauchly’s test of sphericity is significant for aided or not group, we do not assume sphericity for these analysis. Therefore, F values with Greenhouse-Geisser correction is used in the for aided group analysis.

The main effect of type of reading was statistically significant ( $F(1, 10) = 35,474, p < .05, \eta p^2 = .663$ ). This means number of words read correctly changes depending how the words are presented. This effect can be seen for both groups. Moreover, this effect is still significant for different groups ( $F(1, 10) = 5.378, p < .05, \eta p^2 = .242$ ) even though it is not as strong as before. The results shows that it is helpful to divide a word into its syllables help all the students while this help is more significant between groups. In other words segmentation of words into its component during reading decreases the number of mistakes made for both groups but it helps reading difficulty group more.

The interaction between type of reading and difficulty was not statistically significant ( $F(2, 18) = 3.026, p > .05, \eta p^2 = .144$ ) for both groups. It shows that type of reading and word difficulty are not dependent to each other. Moreover, the interaction between type of reading and difficulty is not significant for groups as well ( $F(2, 18) = 1.310, p > .05, \eta p^2 = .068$ ). This results show that the effect mentioned above is not true for groups as well.

#### *4.2.1. Within Subjects Contrasts*

The main effect of type of reading is statistically significant ( $F(1, 10) = 35,474, p < .05, \eta p^2 = .663$ ). This effect is still strong for both groups ( $F(1, 10) = 28,698, p < .05, \eta p^2 = .615$ ). The results shows that it is helpful to divide a word into its syllables help all the students while this help is more significant between groups. In other words, the number of mistakes made by the students decrease based on how words to be read are presented. The accuracy of reading increases under assisted condition as it can be seen in the graph above.

The main effect of difficulty, when easy and hard conditions are compared, was statistically significant ( $F(1, 10) = 26,869, p < .05, \eta p^2 = .599$ ) and is quite strong. On the other hand, the same comparison, when it is made between medium and hard levels, is not significant ( $F(1, 10) = 4,250, p > .05, \eta p^2 = .191$ ). The results shows that segmentation help most when the word to be read is difficult while the help it provides is not significant between difficulty levels of medium and hard.

The interaction of difficulty and group, when easy and hard levels are compared, was statistically significant ( $F(1, 10) = 17,551, p < .05, \eta p^2 = .494$ ). The same pattern above follows here and the effect for medium to hard is not significant ( $F(1, 10) = 2,248, p > .05, \eta p^2 = .111$ ) as well.

The interaction of type of reading and difficulty, in comparison of medium to hard vs. easy to hard, was statistically significant ( $F(1, 10) = 5,281, p < .05, \eta p^2 = .227$ ). In a similar way with the analysis above the interaction between type of reading and difficulty, when compared based on medium to hard, is not significant ( $F(1, 10) = .464, p > .05, \eta p^2 = .025$ ) as well.

Finally, between subjects effects are significant as well, ( $F(1, 10) = 55,367, p < .05, \eta p^2 = .755$ ) which means if ignore all other variables the performances of students are

different based on the group they come. In other words how accurately a student reads can be predicted only by based on the group s/he comes.

## CHAPTER 5

### DISCUSSION

Our aim, in this study, was to provide an alternative explanation to the low performance of dyslexic students on reading tasks. We observed the performance of young students in regular reading and syllable-assisted reading tasks in Turkish. We investigated how reading performance improves when some part of the problem is solved on behalf of the reader. In line with our hypothesis, we have found that the performance of poor readers considerably increases when a part of the problem is solved on behalf of them. Poor readers not only read faster but also read more accurately when the words are presented syllable by syllable (i.e. when the task of dividing a word into its parts is done on behalf of them). The performance on reading, both in terms of accuracy and duration was significantly increased with the help of segmentation. While many words which had been read incorrectly before were spelled out correctly, most of the syllables are decoded more accurately when presented as a single syllable instead of being presented as a part of a word.

The reason for the improved performance might be due to the decrease in cognitive load under assisted reading condition. When the student does not have to decide what letters to combine to construct a syllable, s/he has more cognitive capacity to deal with the problem of spelling out the syllable. To illustrate, a child decoding a word with three syllables like the word “symbolic” must decide where to stop for the first syllable. The first syllable may be sy, sym, symb or even just s. What is more, the decision here affects the course of development of the second syllable as well. If the child mistakenly decides that the first syllable is “sy” then the second syllable may be “mbol”, “mbo” and if there is no correction the third syllable will even be harder to decode. More importantly, in this case the student will be deprived of the feedback showing that s/he is on the right track. The self feed-back here is critical for learning because it is the only feedback the student gets most of the time. It is a well-known fact that the cognitive load associated with acquired skills decreases with practice as its automaticity increases over time with learning. One side of the problem with dyslexic readers might be not to be able to reach automaticity since they did not get self feedback from their own performance. In the data collected for this thesis the word length and complexity effects are observable.

While participants experiencing reading difficulty read complex words effortfully or cannot read them at all, skilled readers read complex words more slowly as compared to simpler words or they make corrections / returns during reading. It is certain that problems with syllable segmentation are not the only problem to be solved so as to read accurately. There is a range of problems before and after this stage and in order to proceed to the next level, understanding and overcoming the problems at the current level is of critical importance. The current thesis focuses on mild dyslexic students who mainly have difficulty with decoding syllables, not particularly having problems at the level of voicing single phonemes. The current study does not definitely claim that it is the only problem in dyslexia, but proposes that it is one of the important and distinctive deficiencies in dyslexia. It is believed that the problem dyslexic students at this stage have is related with segmentation of the words into proper syllables that could be pronounced more easily. This hypothesis designates that students will make less mistakes when the segmentation problem is solved on behalf of them by using \*\*\*. Our study showed that this really is the case and mild dyslexic students are able to read segmented words in a way it is predicted in our hypothesis.

It might be speculated that the results are in line with Phonological Deficit theory of dyslexia which proposes that reading and spelling difficulties in dyslexia are directly caused by a deficit in the processing of the abstract speech sounds of phonemes that make up the words, (Liberman I. , 1973). According to this theory phonemes are not psychophysically defined objects but abstract entities that have to be learned and children with reading difficulty have problems in consciously processing and manipulating their segments (Stanovich K. E., 1986). It might be proposed that the help with the segmentation of words into their parts helps since it decreases the abstractness of the entities. Finally, there is another line of theories proposing that difficulty in phonological coding caused by phonological awareness problems (Blachman, 2000, Foorman, Francis, Fletcher, Schatschneider, & Mehta, 1998). There is abundant evidence showing that training in phonological awareness and letter-sound correspondences improves word recognition skills (Hatcher, 1994). The findings in the current study are in line with these theories, since the same kind of improvement is observed. Moreover, even though syllable is not a separate unit in reading of a meaningful part of a word, how reading is taught in Turkey is definitely based on letters and syllables and the method used in the study is largely compatible with the way the students learn reading. This might be another factor which explains why the students' performances are promoted under assisted reading conditions.

### **5.1. Evaluation of Reading Performance Under Regular Reading and Aid Conditions**

Our results show that the reading performance of the subjects under regular reading condition is different for both groups. As expected this is the condition where the differences between both groups is the highest. While normal readers make a few

mistakes, the reading difficulty group makes considerably higher number of mistakes as expected under this condition. The difference between reading times is also highest under this condition. Even though regular readers also have some kind of difficulty as the word complexity gets higher the difficulty experienced by poor readers is still much worse. Our results showed, as we had expected, that participants from both groups were faster and more accurate in the assisted reading condition than they were in regular reading conditions.

When the performance is measured in terms of duration, both word difficulty and segmentation of words affect participants' performance considerably. As the word gets more difficult reading time increases and segmentation of the word reverses that effect. It is clear from both group's error bars that both groups are from different populations. The difference between them is enormous under normal reading conditions. On the other hand, this difference gets smaller when the words are presented in syllables. It can easily be seen that word difficulty has a considerable effect in both groups on both conditions and the level of difficulty has a significant effect as well. However, the big difference between the groups shrinks under the assisted condition. Even though under this condition both groups still look as if they are sampled from different populations, the difference gets smaller, which is highlighted by the significant interaction effect. It is clear that assistance helps the students with reading difficulty in a considerable amount.

It is also clear from analysis of variances dividing a word into its syllables improves the reading performance for both groups. While it is helpful to divide a word into its syllables for both groups, the improvement on the dyslexic students' performances is more significant. The word difficulty is also an important factor which has an effect on the performance of both groups significantly. Both groups' performances are affected negatively as the difficulty of the word increases. Subjects in both groups read faster when the words are divided into their syllables. This effect is greater for reading difficulty group. Subjects are more successful in reading less difficult words. When all other factors are ignored word difficulty is the most important factor affecting reading performance but this effect is not the same for both groups. The results shows that as the word difficulty increase the students' performance will decrease independent of the group they belong to.

When we look at the level of difficulty of the word being read we can see that it is an important factor in performance for both groups and it is harder to read hard words than reading medium words for both groups. The same effect can be observed in comparison of hard and easy conditions. The results show that how a word is read contributes the performance in all conditions, but its effect is greater for harder words.

When the performance is studied in terms of the mistakes made during reading the situation is parallel to the situation where duration is used as a measurement of performance. Both word difficulty and segmentation of words have significant effects on participants' performance as it is the case in duration. Both groups are from different

populations and the difference between groups under different reading conditions is considerably big. Type of reading is important and it clearly affects the performance of the readers. Readers from both groups make lesser mistakes when they are assisted. While segmentation of words into its components during reading decreases the number of mistakes made for both groups but it helps reading difficulty group more. The results show that it is helpful to divide a word into its syllables. It helps all the students while this help is more significant between groups. In other words, the number of mistakes made by the students decrease based on how words to be read are presented. The results shows that segmentation help the most when the word to be read is difficult while the help it provides is not significant between difficulty levels of medium and hard. While there is a significant difference on both groups when the level of difficulty considered, this is only valid for easy and hard levels. The difference between medium and hard is not significant.

## **5.2. Limitations and Future Directions**

The limitations of this study and some suggestions about how they can be addressed in future studies will be pointed out in the following. One limitation of this study is its small sample size. Considering the statistical assumption that larger sample sizes (at least 30 for a group) represent the population better than smaller ones, our sample size (i.e., 20 for each setting) is probably not large enough. The results might be reevaluated with a bigger sample size or with addition of some more data to the current data set. Moreover, we were only able to measure reading time and accuracy as performance indicators. It is clear other factors like prosody, rhythm are important in reading and it is easily recognizable, with an informal superficial observation, that prosody and rhythm of reading improves especially in poor readers when the words are segmented. Some other characteristics of reading which are not mistakes but affecting the quality of reading like returns and repetitions might also be measured and included in further studies. Another study in which these measures are added with a higher number of subjects could be more illuminating and could produce more certain results. Even though the results we obtained in this study are promising because of the reasons mentioned above, caution should be exercised when generalizing these findings to the population of children suffering from reading difficulties. Another limitation of the study is that we were not able to control all possible parameters in terms of word difficulty. The words we thought as difficult might not be as difficult as we thought for some students and therefore, the word difficulty should better be considered as a random effect in similar studies.

In addition, some other data in the form of self evaluation could be collected and might have provided some idea about where the improvement comes from. Unfortunately, this study did not include a post-survey instrument. However, some poor readers showed their content caused by assisted reading with their remarks like “I would always read if the stimuli presented this way” and “I am not tired and bored at all”. Systematically collecting readers’ reactions to the task and changes in their feelings ex post facto could

have provided additional evidence insights regarding the nature of the dyslexic students' problems.

Another line of future work might be taking the current study one step forward and ask the subjects to employ a combination of syllable reading with regular reading strategies one after another. The subjects might be asked to read a word syllable by syllable first and then the same word may be asked to read without assistance. With such a study how the transition from syllable to word is reinforced might be studied. The probable future works might produce more information about the reading difficulties and may help solve some of the problems experienced by dyslexic individuals.

Finally, dyslexia diagnosis is based mainly on international psychiatric tests like Schedule for Affective Disorders and Schizophrenia for School-Age Children, Wechsler Intelligence Scale for Children-Revised (WISC-R), Symptom Check List, (SCL 90-R) and national diagnostic devices like Specific Learning Difficulty Symptom Scale, (Korkmazlar, 1992) which is also based on SCL 90-R and Reading Writing Mathematics Skills Evaluation List, (Korkmazlar, 1992) known as, Error Analysis, in Turkish, which is an informal test, (Altay, 2018). There is only one subject specific test in the inventory and it is an informal one. It is clear that dyslexia diagnosis is based on qualitative criteria. In the absence of quantitative objective criteria, the objective measures based on syllable reading paradigm, which is used in the current study might provide useful and objective metrics for diagnosis.

### **5.3. Conclusion**

Disadvantages of having reading disability are so dramatic that any help on understanding or solution of the problem is important. Since dyslexia shows itself on a spectrum from severe to mild, in other words, from difficulties on letter recognition and disability in syllable formation to having difficulties on syllable formation and word reading, the help the reader needs depends on where s\he actually is on the spectrum. Our study focused on the problems experienced by mild dyslexics who do not have their main problem in letter recognition but have problems with deciding correct syllables to read the word properly. Therefore, the findings of this study cannot be generalized to all dyslexia cases. It is clear that the mechanisms and problems exhibited may not be the same in severe and mild dyslexics. Even though what can be done about severe dyslexia and how to move severe dyslexics on the continuum is a subject of another study, probably many studies, it can be assumed that severe dyslexic students may move at the continuum, to the mild dyslexia level, with a better understanding of their problems and development of interference devices based on this understanding. It is hoped that the current study is a small step in this way.



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## APPENDICES

### APPENDIX A

#### Word Lists

##### LOW DIFFICULTY

1. alıřkan
2. glmser
3. kırıntı
4. isterse
5. grkemli
6. sormadan
7. kalmadı
8. komřunuz
9. etrafta
10. demektir

##### MEDIUM DIFFICULTY

11. genellikle
12. gkyznn
13. memleketin
14. tartıřmaya
15. kavgacıydı
16. grnmeyen
17. kendisiyle
18. marangozun
19. yanlarında
20. srklerim

##### HIGH DIFFICULTY

21. sylediklerin
22. demiryolları
23. zorundadırlar
24. gereksinimler

25. bırakmamaktır
26. kıyafetlerim
27. penceresinden
28. faydalarından
29. karşılaşmanız
30. parçacıkları

## APPENDIX B

### The sentences divided into syllables

#### LOW DIFFICULTY

1. a-lıř- kan 2+3+3	3
2. g-lm-ser 2+3+3	3
3. k1-r1n-t1 2+3+2	3
4. is-ter-se 2+3+2	3
5. gr-kem-li 3+3+2	3
6. sor-ma-dan 3+2+3	3
7. kal-ma-d1 3+2+2	3
8. kom-řu-nuz 3+2+3	3
9. et-raf-ta 2+3+2	3
10. de-mek-tir 2+3+3	3

#### MEDIUM DIFFICULTY

11. ge-nel-lik-le 2+3+3+2	4
12. gk-y-z-nn 3+2+2+3	4
13. mem-le-ke-tin 3+2+2+3	4
14. tar-tıř-ma-ya 3+3+2+2	4
15. kav-ga-c1y-d1 3+2+3+2	4
16. g-rn-me-yen 2+3+2+3	4
17. ken-di-siy-le 3+2+3+2	4
18. ma-ran-go-zun 2+3+2+3	4
19. yan-la-r1n-da 3+2+3+2	4
20. s-rk-le-rim 2+3+2+3	4

#### HIGH DIFFICULTY

21. sy-le-dik-le-rin 3+2+3+2+3	5
22. de-mir-yol-la-r1 2+3+3+2+2	4
23. zo-run-da-d1r-lar 2+3+2+3+3	5
24. ge-rek-si-nim-ler 2+3+2+3+3	5
25. b1-rak-ma-mak-t1r 2+3+2+3+3	5
26. k1-ya-fet-le-rim 2+2+3+2+3	5
27. pen-ce-re-sin-den 3+2+2+3+3	5

28. fay-da-la-rın-dan 3+2+2+3+3 5
29. kar-şı-laş-ma-nız 3+2+3+2+3 5
30. par-ça-cık-la-rı 3+2+3+2+2 5