

# Morphological knowledge and dyslexia

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**Kristina Bulić**

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Morphological knowledge and dyslexia

Završni rad

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Zadar, 2024.



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Zadar, 16. travnja 2024.

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## **1. Introduction**

The subject of this paper is morphological knowledge and dyslexia. The term morphological knowledge is broad and some scholars (e.g., Bowers et al., 2010) do use it in rather general manner. For example, morphological awareness and morphological processing can therefore both be used in this category. These two are also some of the terms that the paper will be dealing with in the aim of examining the idea that strengthening morphological knowledge – more specifically morphological awareness – in persons with dyslexia can result in a positive outcome which benefits their literacy skills.

In the second chapter, I will provide definition and some additional information for dyslexia that could be useful for the reader, who is not already familiar with it, to better understand it. In addition to morphology that the paper will be dealing with, I will also have to make mention of phonology, that is phonological deficit theory, which is majorly accepted as the theory for difficulties in dyslexia. In the third chapter, I will define the terms aforementioned – morphological knowledge, morphological awareness and morphological processing. Moreover, I will provide evidence from some studies in which typically developing children and adults were tested to observe the role of morphological skills in the development of literacy. Lastly, in the fourth chapter, an overview of studies including persons with dyslexia will be done.

## **2. Defining dyslexia**

Even though the research on dyslexia started back in the 19<sup>th</sup> century and a considerable amount of progress has been made since then, the subject is still nevertheless relevant in the science world and its different fields and therefore open to many questions and possible future studies. The starting belief about the cause for dyslexia differs from what modern studies suggest and what they have (in some way) proven to be true, however it is still possible to encounter misconceptions about dyslexia of people thinking or stating that the primary cause for it are visual impairments. Crucial words here are ‘primary cause’ because, although there are some visual processes proven to be deficient in persons with dyslexia, it has not been established that they are also causally connected (Vellutino et al., 2004, p.10).

It is not actually that difficult to understand why a person not familiar enough with such a disability would think like that. Some of the first theories in the 19<sup>th</sup> century also proposed the same opinion, which can be more closely demonstrated by the term “word-blindness”. The term was at first used to describe the type of dyslexia known today as an acquired dyslexia or alexia, which can occur later in life “as a result of brain injury, neurological conditions, or diseases” and involves “a loss of previously intact skills” (Molfese et al., 2006, p.485). The sole term dyslexia was coined by one of the physicians at the time, Rudolf Berlin, in order to describe the aforementioned type of difficulty. Since similar or same symptoms were later also found in another type of dyslexia, earlier known as “congenital word-blindness”, this enabled to identify it more easily and make further research in this area. Physician called W. Pringle Morgan was the first to make note and describe this type of dyslexia, which is today known as developmental (Beaton, 2004, p.3).

In 2003, the International Dyslexia Association published an official definition of dyslexia which goes as follows:

Dyslexia is a specific learning disability that is neurobiological in origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge (Lyon et al., 2003, p.2).

According to Molfese et al. (2006, p.485), ‘developmental’ in relation to the term ‘dyslexia’ serves to differentiate “this subtype of the disabilities” (developmental dyslexia and dysgraphia)

“as occurring as a result of abnormal learning during the normal course of development despite adequate learning and instructional opportunities and normal intelligence”. “The main symptom of dyslexia”, as Altarelli & Ramus (2014, pp.139-140) claim “is a difficulty in learning the reciprocal mapping between phonemes and graphemes, which in turn significantly impairs written word decoding and also spelling”. Nearly all instances of poor reading abilities recognized in the early childhood have been proven to have developmental dyslexia as the primary root of the problem (Molfese et al., 2006, p.485). It is possible to ameliorate one’s reading abilities, however symptoms are most likely to continue (Altarelli & Ramus, 2014, pp.139-140).

The term frequently linked with dyslexia is comorbidity. Dyslexia often appears together with other learning disabilities such as dysgraphia, dyscalculia, dyspraxia and attention deficit disorder (Molfese et al., 2006, p.485). The shared brain processes of the two difficulties or the presence of risk factors could be the basis of such comorbidity (Snowling & Stackhouse, 2006, p.8). Having dyslexia alone is challenging and can affect one’s academic achievement therefore early assessment is crucial and promises more successful outcome (Barkley, 1997, as cited in Gooch et al., 2014). It is essential to familiarize oneself more closely with developmental disorders by seeking to recognize the source of comorbidities. One step in doing this should be recognizing the frequency of one disorder being present with another one (Moll et al., 2020). Denton et al. (2020) conducted three interventions on children who have both reading disorder and ADHD. They wanted to examine whether their reading skills would improve by conducting the treatment of ADHD and the intervention for reading separately and also by incorporating both into one intervention. One of the findings of these interventions is that, for reading comprehension, ADHD treatment produced more positive outcome. It should be noted that it is not necessary that dyslexia or any other developmental disorder always appears as a comorbidity. That being said, Moll et al. (2020, p.4) also raise an interesting question regarding “reading interventions, which are known to be effective for children with pure disorders” and if they are “as effective for those with comorbid disorders”.

One other factor is believed to influence dyslexia and that is genetics, which is also often observed together with the environmental factors, “given that a number of environmental factors are also shared within families” (Altarelli & Ramus, 2014, p.144). Molfese et al. (2006) report findings from other research such as those about discovery of genes related to different deficiencies in dyslexia.

One of the first persons to hypothesize the possibility of dyslexia having a cerebral basis is thought to have been Samuel Orton. Although his theory was proven not to be completely true,



it did set the ground for valuable future research. His ideas were related to the cerebral or hemispheric dominance which he assumed could have something to do with reading difficulties (Beaton, 2004, p.202). By observing the errors that frequently occur in children with dyslexia – letter and word reversal – Orton suspected that the hemispheric dominance failure was the cause of the visual problem (Peterson & Pennington, 2015, p.288). Significant breakthrough was made when postmortem studies started to be conducted, one of them being by Albert Galaburda and colleagues at the beginning of the 1980s which revealed some anomalies in subjects with dyslexia. To be specific, some changes were discovered in the left hemisphere – which, in majority of people, is in control of the language – and also other parts of the brain specialized for language (Altarelli & Ramus, 2014; Snowling & Stackhouse, 2006). However, Rice & Brooks (2004, p.26) highlight that one should not fully rely on evidence from such research and they provide some arguments saying that “the post-mortem research involves few brains” and “it is unclear whether the brains in the post-mortem studies are representative of dyslexic brains in general“. More recent studies make use of the up-to-date techniques like positron emission tomography (PET) and functional magnetic resonance imaging (fMRI) which allow researchers to observe different patterns of “brain activation in impaired and unimpaired readers” (Rice & Brooks, 2004, p.28).

## **2.1 Theories of etiology**

The cause for dyslexia has long time been disputed over and consequently it has also produced various theories. There are some theories proposed by the researchers that are usually considered to be somewhat more credible than the others and for which, over the years, studies have proven – at least in some way – to be in relation with dyslexia. Only some of them will be mentioned here.

### **2.1.1 Visual deficit theory**

The visual deficit theory, which was already briefly mentioned, is the first theory to be put forward at the end of the 19<sup>th</sup> century by W. Pringle Morgan (Altarelli & Ramus, 2014, p.141). Even though a great number of physicians and researchers at the time was in favour of the theory, it still did not have enough empirical evidence (Vellutino et al., 2004, p.8). The hypothesis of a deficit in the magnocellular visual system is what later developed from the visual deficit one. In short, the magnocellular visual system is “a specific part of the visual system devoted to the coarse analysis of visual stimuli as well as detection of movement and of rapid changes” (Altarelli & Ramus, 2014, p.141). However, according to Vellutino et al. (2004,

p.9), it has not been proven that the deficits in the aforementioned system are the cause for the reading difficulties.

### **2.1.2 Theory of the temporal auditory processing deficits**

Molfese et al. (2006, p.486) report different studies, such as that by Tallal (1980), that suggest that children with dyslexia struggle when they process complex auditory tones “presented in quick succession but not when presented at slower rates”. Although there exists some evidence to support the relationship between deficits in auditory temporal processing and dyslexia (Molfese et al., 2006, p.486), Rice & Brooks (2004, p.65) claim that it is “unlikely that dyslexia is characterised by impaired processing of rapidly-changing auditory stimuli”.

### **2.1.3 Phonological deficit theory**

In spite of there still being some points that not all studies agree upon and further research can be conducted, the phonological deficit theory is the one that has been most widely acknowledged by the research community.

Abilities to link spoken language and written language are essential for word decoding, which is the crucial skill one needs to be able to read (Molfese et al., 2006, p.485). According to Rice & Brooks (2004), people with dyslexia have a diminished ability for detecting and processing speech sounds. Problems related to phonological processing can arise at the level of phonological awareness, phonological retrieval<sup>1</sup> and phonological memory<sup>2</sup> (Molfese et al., 2006, pp.485-486). Altarelli & Ramus (2014, p.140) report that games which include rhyming or demand “representation and manipulation of phonemes” can be an indicator of deficient performance in the areas concerning phonological skills – already before reading has been acquired. Considerable amount of evidence has been brought to light over the years in support of phonological skills as pivotal for learning to read and in support of difficulties in acquiring those skills being causally related to dyslexia (Reid, 2009, p.20).

Phonological decoding refers to “translating printed words into their spoken counterparts on the basis of grapheme–phoneme connections”. For a person to acquire reading skills – in the alphabetic writing system – it is essential to learn the relationship between the grapheme-phoneme system (Cardoso-Martins & Ehri, 2014, p.511).

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<sup>1</sup> Phonological retrieval is “the ability to quickly and automatically name letters, objects, numbers, or colors” (Molfese et al., 2006, p.486).

<sup>2</sup> Phonological memory is “the ability to code phonological information [e. g., a string of words or nonwords] into working or shortterm memory” (Molfese et al., 2006, p.486).

A person's capacity to analyse content using the sound of language is known as phonological processing, furthermore, one aspect of phonological processing is phonological awareness (Simpson, 2000) which, according to Cabbage & Hogan (2014, p.451), is "the explicit understanding that spoken language comprises discrete linguistic units of sound structure, such as words, syllables, and phonemes". Phonological awareness is the term one can very often encounter when discussing the importance of acquiring the reading skills. It is regarded as one of the most telling indicators for success in achieving those skills. Phonological awareness refers to different types of skills which show an understanding that the language that we speak "can be analyzed and manipulated based on the sound structure of words alone, independent of word meaning" (Cabbage & Hogan, 2014, p.451). However, Beaton (2004) argues that it is also important to know what features of phonological skills are connected to what features of reading (and spelling) and therefore, claiming that the ability to be aware of and manipulate the structure of sounds of words can predict the success of reading (or spelling) performance is just not enough. All in all, a general agreement on how exactly phonological awareness brings about successful outcome in the process of learning to read still does not exist. Nevertheless, there is an opinion shared by many claiming that phonological awareness is crucial for one's understanding that there is a relation between graphemes and phonemes (Beaton, 2004).

### **3. Morphological knowledge and dyslexia**

Morphology is considered to be one of the crucial steps in successfully achieving literacy, especially in case of dyslexia (Henry, 2019; Wolter & Collins, 2017). Research into the morphological aspect and the way morphology could possibly influence and benefit the development of literacy began not long ago. Phonological knowledge always took the advantage as being the primary step, however more and more studies are being conducted in this area and morphological awareness – to be more precise – is being observed as equally important in reaching one’s proficient level of literacy. This is even more so when we are talking about dyslexia, since the most common theory is that of the phonological deficit. Nagy et al. (2014) report about researchers who believe that developing morphological awareness can be used as a compensatory strategy for those who struggle with reading difficulties, in particular those with phonological deficits. For example, persons with reading difficulties have trouble “isolating, manipulating, and blending phonemes”, but “morphological units are larger than phonemes, and they link to meaning” (Fowler & Liberman, 1995, as cited in Nagy et al., 2014, pp.6-7) and “meaning (comprehension) is the goal of reading” (Henry, 2019, p.23). Morphology has been part of the educational program, but what these studies are also questioning is whether it should be of any benefit to perhaps introduce it much earlier.

#### **3.1 Morphological knowledge**

Although they differentiate between morphological awareness and morphological processing, certain scholars such as Bowers et al. (2010), apply the term ‘morphological knowledge’ in a more general manner, including both morphological awareness and processing in it.

When defining the term ‘morphological awareness’ some authors (e.g., Apel & Werfel, 2014; Apel, 2017; Nagy et al., 2014) point out that one should distinguish between morphological production and morphological awareness. As stated by Nagy et al. (2014, p.4) “Morphological awareness is the ability to reflect on and manipulate morphemes—in other words, the ability to analyze words into smaller meaningful parts such as prefixes, roots, and suffixes”. On the other hand, person takes part in the morphological production whenever he/she is using spoken or written language without giving any notice to the morphemes that are being used (Apel & Werfel, 2014, p.254). Nagy et al. (2014, p.4) also speak of overregularization which can be observed in children who have acquired some command over the inflectional morphology – for instance “goed”. Apel (2017, p.11) says that it is “sometime around the age of 5” that morphological awareness can be seen occurring in children. Bowers et al. (2010) also report some research evidence of children having morphological knowledge already at the age of 4

(e.g., Berko, 1958, as cited in Bowers et al., 2010). Nagy et al. (2014, p.5) do not specifically state around what age morphological awareness occurs, however they claim that apart from overregularization, young children “also routinely generate past tenses of regular verbs that they may not have heard before”. What they are saying is that the knowledge that allows them to do so is most likely ‘tacit’, just like the majority of knowledge used in general by the people when using their own language. For this tacit use of morphology they employ the term morphological ‘processing’ and, taking an example of Bowers et al. (2010), they include it – together with morphological awareness – to refer to morphological knowledge (Nagy et al., 2014, p.5).

Different authors suggest multiple reasons why morphological knowledge might be beneficial. For example, Nagy et al. (2014, p.10) do not deny that phonics undoubtedly contributes to the development of one’s reading skills. However, they argue that to make further progress – if the phonics has been properly acquired – it is not necessary to sound out the word (familiar to us from before and already established in our memory) every time we encounter it. Therefore, the role of the morphological knowledge would perhaps be to “lead to higher quality lexical representations by strengthening the links between the orthographic, phonological, and meaning representations of words and morphemes”. This view is also shared by Nagy et al. (2006, as cited in Nagy et al., 2014, p.3) who claim that the importance of the phonological awareness decreases after early elementary years and then the morphological knowledge keeps progressing (Berninger, Abbott, Nagy & Carlisle, 2010, as cited in Nagy et al., 2014, p.3).

Nagy et al. (2014, p.4) differentiate two ways in which they believe morphological knowledge possibly contributes to literacy. Firstly, they distinguish between “the strategic and conscious application of morphological awareness to new words” and “the largely tacit contribution of morphological processing”. Secondly, they distinguish between different language dimensions – word form, meaning of the word and syntax. Like Nagy et al. (2014), Apel (2017, p.11) also argues that “The focus on morphological awareness to improve literacy skills makes sense intuitively, given written English is morphophonemic system”. This is visible throughout numerous irregularities that the English spelling offers in which the morphological principle is reflected – “spelling of a morpheme is often preserved even when its pronunciation has changed” (Chomsky, 1970, as cited in Nagy et al., 2014, p.5). When it comes to the word meaning of morphologically complex words, morphological knowledge should enable one to work it out and store it in their memory with much less difficulty. As for the influence at the syntax level, coming to conclusion about which part of the speech does the newly encountered (morphologically complex) word belong to and in which syntactic patterns it takes part should

be less demanding with morphological knowledge. For instance, “words ending in *-ion* will tend to function as nouns and be modified by adjectives, whereas words ending in *-ize* function as verbs and are modified by adverbs” (Nagy et al., 2014, p.5).

In this paper, studies that will be included in the overview will be dealing with inflectional (see section 4.2 and 4.3) and derivational morphology (see section 3.2.2, 4.1, 4.3 and 4.4) and some of them with compounds (see section 4.2 and 4.3). Inflection refers to a type of word-formation process where suffixes indicate grammatical categories such as number, possession and tense. Derivation entails changing of the word class with the addition of a prefix or a suffix (to a word that already exists). Inflectional morphemes present themselves in the earlier stages of development. Furthermore, awareness of these morphemes has been observed already in the first grade. On the other hand, derivational morphology comes about later, around second or third grade (Wolter & Gibson, 2015, p.32).

### **3.1.1 Morphological awareness assessment**

The reason why one’s morphological awareness should be assessed is so that the educator gets better insight into the morphological knowledge that he/she possesses and is able to apply (Apel, 2017, p.12). In order to measure morphological awareness different tasks can be used – those requiring implicit or explicit awareness (Apel & Werfel, 2014, p.254).

Implicit awareness refers to the morphological production. The term ‘tacit knowledge’ that they employed also fits here, given that these tasks demand “only a low level of morphological analysis” (Apel & Werfel, 2014, p.254). Since they also offer some contextual guidance, these tasks call for “less conscious analysis of a word’s morphological structure” (Apel & Werfel, 2014, p.255). Example of this type of an assessment would be by Carlisle (1988, as cited in Apel & Werfel, 2014, p.255) which covers two parts – derivation and decomposition. In the former, one is presented with a base word and it is expected of him/her to affix a bound morpheme to that base word (e.g., “Farm. My uncle is a \_\_\_\_\_” [farmer]). On the other hand, in the latter one, he/she is expected to detach the bound morpheme when presented with a multimorphemic word, ending up with a monomorphemic base word (e.g., “Improvement. My teacher wants my spelling to \_\_\_\_\_ [improve]”).

Tasks that entail explicit morphological awareness differ from the aforementioned ones as they demand from an individual to demonstrate a higher level of understanding of morphological analysis. Tasks put emphasis on the “conscious analysis of the morphological structure of words” with less guidance from the context. For instance, tasks such as those where he/she should determine if the two words presented are in any relation morphologically. Moreover, the

tasks in which he/she has to complete the presented sentence by choosing a word from a given closed set of words according to the appropriate affix (Apel & Werfel, 2014, p.255).

### **3.1.2 Morphological awareness and the development of literacy**

Different research that have been carried out regarding this subject have confirmed the connection of morphology and morphological skills to the development of literacy. As an example, I will present evidence from some studies, but conducted on the sample of typically developing children and adults.

For instance, Levesque et al. (2019) wanted to find out which morphological skill is responsible for the development of reading comprehension in students from grade 3 to 4<sup>3</sup> – morphological awareness, morphological analysis or maybe both. They defined morphological awareness as “the awareness of and ability to manipulate the minimal units of meaning, or morphemes, in oral language” (Carlisle, 1995, as cited in Levesque et al., 2019, p.64). On the other hand, morphological analysis was defined as “the ability to infer the meaning of unfamiliar morphologically complex words on the spot based on their morpheme constituents” (Anglin, 1993; Baumann et al., 2002; Deacon, Tong, & Francis, 2017, as cited in Levesque et al., 2019, p.64). The morphological analysis task focused on derived words. The study found that the morphological analysis can help improve one’s level of reading comprehension, while the morphological awareness enhances morphological analysis. Furthermore, the study also indicates that the more advanced morphological awareness in children enables them to achieve “more progress in learning to infer the meanings of unfamiliar morphologically complex words” (Levesque et al., 2019, p.74).

In their study, which included students in grade 4 through 9, Nagy et al. (2006, p.143) report that morphological awareness “made significant unique contribution at all grade levels to reading comprehension, reading vocabulary, and spelling”. The fourth/fifth-grade level and the eight/ninth-grade level both demonstrated gains from morphological awareness in decoding accuracy, while at the eight/ninth-grade level it contributed significantly to decoding rate (Nagy et al., 2006, p.144). ‘Accuracy’ and ‘rate’ are – together with prosody – elements of fluent reading (Hudson et al., 2005, pp.702-704). Reading accuracy is “the ability to recognize or decode words correctly”, while reading rate includes “word-level automaticity and the speed and fluidity” used to progress through the text. Similarly to Levesque et al. (2019), Nagy et al. (2006, p.144) suggest that as morphological awareness progresses and increases so does

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<sup>3</sup> Students were on average 8 years 10 months old in grade 3.

“accuracy and fluency in decoding morphologically complex words, which then leads to improved comprehension”.

Singson et al. (2000) carried out two experiments in which students from grades 3 through 6 were tested. They sought to replicate previous evidence provided by Mahony (1994, p.223) that suggest “that knowledge of the syntactic categories of suffixes relates to reading ability”. Furthermore, they also wanted to investigate whether knowledge of derivational morphology contributes independently to reading ability. It was discovered in both experiments that the children’s results on the derivational suffix test were improved concurrently with a notable difference in their decoding abilities. Both experiments showed considerable connection between performance on the test and reading ability, moreover Mahony’s (1994) evidence was replicated. Singson et al. (2000, p.245) also observed the importance of phonological awareness in the third grade, however according to the study, its contribution “gradually fades away, leaving in its wake a steady role of morpheme skill that persists as the reader progresses through the upper elementary grades”. All in all, they highlight the significance of development of derivational morphology in later elementary grades, for which their study provides evidence.

The main objective of the study carried out by McCutchen & Stull (2014) was to find out in what way can children’s morphological awareness influence their spelling, as well as their ability to produce words that are morphologically complex. The study included students from grade 5 (ages 10-11) for which they argued is “because by this age children’s vocabularies are rapidly expanding (Anglin, 1993, as cited in McCutchen & Stull, 2014, p.275) and they are expected to read and write more complex text” (Lawrence, White & Snow, 2010, as cited in McCutchen & Stull, 2014, p.275). The results revealed that the students’ morphological awareness is correlated with the ability to accurately produce morphologically complex forms, and it can aid with word construction as well. McCutchen & Stull (2014, p.285) refer to Tyler & Nagy (1989) according to whom there are at least three aspects of morphological knowledge – relational, syntactic and distributional – which are needed in order for derivational morphology to be understood. Relational knowledge is the one that allows us to recognize the possibility of words sharing a common morpheme. Syntactic knowledge is the one that provides us with understanding that a certain grammatical category is designated by a particular derivational suffix, and lastly, distributional knowledge implies “an understanding of rules governing allowable pairings of stems and suffixes”. According to Tyler and Nagy (1989, as cited in McCutchen & Stull, 2014, p.285) distributional knowledge develops last. McCutchen & Stull’s (2014) study produced evidence which is in agreement with what Tyler & Nagy (1989) suggested. According to their findings, children whose derivational knowledge is more



basic are perhaps not yet capable of applying it in their production and therefore do not tackle very often the usage of complex derivational forms (Carlisle, 1996; Green et al., 2003, as cited in McCutchen & Stull, 2014, p.285). On the contrary, those who have a certain level of relational and syntactic knowledge – and are just gaining distributional knowledge – are in all likelihood to resort to overgeneralization and invention of derivational forms while writing. Upon deepening their morphological knowledge, children’s “understanding of distributional constraints become more complete” (p.285).

The last study to be presented is by Kotzer et al. (2021, pp.305-306) and the only one among them whose participants are university students. The objective of this study was to discover whether there is a unique contribution to reading comprehension created by morphological awareness in the group previously mentioned. One element that the authors of the study saw as crucial is including the controlling of the predictors of reading comprehension. They claim that this is the one thing which they did not see in some other previously conducted studies or at least not a lot of measures was included. It is important to have a wide range of controls in order to be able to determine that the result is not caused by some other component. Kotzer et al. (2021, pp.314-315) claim that morphological awareness is connected with word reading and also with language comprehension, “but that it should have an effect on reading comprehension and speed of text reading after the control of typical measures of word reading (...) and language comprehension”. The study found that the word reading and language comprehension both predict morphological awareness. Furthermore, word and comprehension measures both “made significant contributions when added to the model”, however “none remained significant once morphological awareness was added”.

Overall, acquiring morphological knowledge is gaining more and more recognition and being understood as one of the crucial steps towards achieving proficiency in literacy. This is supported by different research evidence some of them also stating that persons with reading difficulties can use morphological awareness as a compensatory strategy. Some scholars believe that the significance of the phonological awareness diminishes throughout elementary school while morphological knowledge is the one that continues to grow. Morphological assessment is an important part because by evaluating one’s morphological knowledge it is possible to better understand what the person already knows and can use. Some of the research conducted provided evidence that children that demonstrate a higher level of morphological awareness are more likely to identify the meanings of unfamiliar and morphologically complex words.

#### **4. Morphological awareness in developmental dyslexia**

Presented studies of contribution of morphological awareness to literacy were all conducted in English, however studies that I will be presenting in the continuation of this paper – in relation to dyslexia – were also carried out in one other language. Since this is the case, I believe some things related to reading in different orthographies – that are often brought up when dealing with this subject – should also be mentioned and taken into consideration.

The orthographic depth hypothesis claims “that reading can be affected by the orthographic nature of the script in which a language is written” (Beaton, 2004, p.97). According to this hypothesis there are deep (or opaque) and shallow (or transparent) orthographies. English orthography, where “the same sound can be represented in different ways” and “a given letter string can be pronounced in different ways”, is considered as a deep orthography. Shallow orthographies would be those of German and Italian, for example, where there is more consistency and regularities (Beaton, 2004, p.97). Elbro & Arnbak (1996, p.210) note that “orthographies like English and to some extent Danish and French” are “notoriously ‘irregular’” since they are “not entirely transparent at the grapheme-phoneme level because they are governed not only by phonology, but also by morphology”.

The first study (Berninger et al., 2008) and the last study (Law et al., 2015) that will be presented were carried out in English while the second one (Elbro & Arnbak, 1996) and the third one (Arnbak & Elbro, 2000) were carried out in Danish.

##### **4.1 Writing instructions for dyslexic students (Berninger et al., 2008)**

In their studies, Berninger et al. (2008, p.96) used a three-tier model designed specifically for teaching students who have dyslexia. These kinds of models are used in education, as well as for treating writing problems. During Tier 1 it is determined which persons will be needing further preventive measures. During Tier 2, another smaller group is formed to go through additional intervention. And lastly, during Tier 3, it is determined which persons “with unusual conditions” will be going to specialized treatment (Berninger et al., 2008, p.96).

Berninger et al. (2008) conducted two studies in both of which they put emphasis on instructing writing skills. As they claim, “Spelling is typically impaired” (Bruck, 1993; Lefly, & Pennington, 1991, as cited in Berninger et al., 2008, p.97) in individuals with dyslexia, “which in turn interferes with development of written composition” (Berninger, Nielsen, Abbott, Wijsman, & Raskind, 2008, as cited in Berninger et al., 2008, p.97). Given that students with dyslexia, together with spelling, often also have handwriting issues, “impaired executive functions may also impair composing skills” (Hooper et al., 2002, as cited in Berninger et al.,

2008, p.97). Because of this Berninger et al. (2008) argue that persons with dyslexia can profit from explicit writing instruction.

Study 1 involved 22 children with dyslexia who were in grades 4 to 6 as well as 17 children with dyslexia in grades 7 to 9. In the first study Berninger et al. (2008) divided students at random into two types of spelling treatments – either orthographic or morphologic. The reason they did this is because they were wondering if this type of explicit training might help children in spelling longer and more complex words. They report of stages of spelling development, which according to some theorists, consist of three parts – phonological, orthographic and morphological (e.g., Templeton & Bear, 1992, as cited in Berninger et al., 2008, p.97). Moreover, training in phonological awareness was also incorporated since this is the area believed to be lacking in individuals with dyslexia. As well as spelling instruction, composing instruction was also included in lessons.

The lesson started with the “common alphabet principle training for both spelling treatments” and after that, what was left of the spelling treatment was reserved for the treatment to which the student was appointed (p.103). The objective of the morphological one “was to create precise representations of base words and affixes and learn morphological spelling rules that affect the spelling of words” (p.105). Both orthographical and morphological treatments had more than one strategy; some of the morphological strategies included word-building, word-dissecting and spelling-rule activities.

Assessment measures in this study included spelling, composition, reading, orthographic and morphological measures. The last one was assessing the knowledge of derivational morphology. In the test, students were expected to choose the correct suffix, out of four that were given.

The first study in Berninger et al. (2008) found that the group that was assigned the morphological treatment – in comparison to the one that was assigned the orthographic treatment – became better at spelling pseudowords that were dictated to students. Berninger et al. (2008) report that this is in accordance with what was discovered earlier about reading. Morphological and phonological training were put to comparison and the former one resulted in considerably better benefits (Berninger et al., 2003, as cited in Berninger et al., 2008, p.108). As for the difference between age groups/grade levels, the findings suggest that the younger group was still not at the morphological stage of spelling, since it is only the older group of students whose morphological awareness ameliorated considerably.

Study 2 in Berninger et al. (2008) included 24 children with dyslexia who recently finished grades 4 to 6 and also 12 ‘normal’ controls. Once again, children were at random assigned to a

certain treatment – language or nonverbal. The language treatment – called John Muir<sup>4</sup> – included “teacher-led phonological, oral reading, spelling, and listening-note taking activities (...), computer-assisted reading/listening-note taking by pen activities (...), and computer-assisted science report writing activities” (p.111). The nonverbal treatment – named Finding Luna nonverbal treatment – used computer-based activities and a VR technology. Berninger et al.’s (2008, p.113) hypothesis was that children’s “control of these actions, combined with students’ own exploration and measurement of parameters (...) would enable them to develop accurate mental models (...), and become both present and engaged in the learning activity”. Some of the measures that were used for the assessment are phonological measures, spelling, reading, “sentence and narrative text writing by pen and keyboard” and integration of writing and reading (pp.113-115).

All things considered, the discoveries of the first study which demonstrate that the morphological treatment resulted in the improvement of pseudowords spelling, Berninger et al. (2008) relate with the Triple Word Form theory (Berninger & Richards, 2002; Richards et al, 2006, as cited in Berninger et al. 2008, p.119). This theory suggests that “learning to read and spell words involves learning to coordinate phonological, orthographic and morphological word forms and their parts” (p.123). However, in grades 4 to 6 orthographical treatment was more beneficial for ameliorating real word spelling. Moreover, it was found that students advancement “in silent reading comprehension fluency” was correlated with both treatments (p.120).

Altogether, in their study Berninger et al. (2008) provide support that morphological instruction (as well as orthographic) can be valuable and beneficial for students with dyslexia, more specifically for the improvement of spelling skills.

#### **4.2 Evaluating the significance of morpheme analysis and morphological awareness in dyslexic students (Elbro & Arnbak, 1996)**

Elbro & Arnbak (1996) report of three studies carried out in Danish with an objective to examine the role of morpheme analysis and morphological awareness in students who have dyslexia. One of the studies was also a training in morphological awareness to see what effect this would have on the students’ reading skills.

The first study was originally published by Elbro (1990, p.214) and it examined word decoding strategies in students with dyslexia and students with normal reading skills. The two groups –

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<sup>4</sup>“The common theme across these four sessions was the life of John Muir, father of the National Park System in the United States, and two national parks in the Northwest” (Berninger et al., 2008, p.111).

26 students with dyslexia and 26 “normally achieving readers” – were matched on the reading level. The latter group was younger than the former.

The participants were presented with substantial number of tasks concerning reading and language. Nineteen semantically transparent<sup>5</sup> words matched with another nineteen non-transparent ones were randomly presented to the students to read them aloud.

The findings of this first study show that the students with dyslexia benefited more from the transparent morphological structure of the word. The control group did not use the help of the transparent semantic structure – perhaps because they did not have any need to do so. This suggests that the students with dyslexia used their morphological analysis strategy as “a compensatory strategy developed in the context of their poor phonological recoding skills” (p.217).

Both groups were also evaluated on tasks involving morphological awareness where the students with dyslexia were considerably surpassed in their performance by the control group. Altogether there were five tasks that included: sentence analysis, “a task requiring inflection and compounding of new words, adapted from Berko's (1958) Wug test”, morphological reversal, morpheme synthesis and a morphological completion task (p.224).

The second study was first reported by Elbro & Petersen (1993) in Danish and then by Elbro & Arnbak (1996) in English. Participants were a group of 16 students with dyslexia and a group of normally achieving students. The control group was again younger than the experimental group.

The objective of this study was to examine the way that the morphological structure impacts text reading. Therefore, students were shown a test on a computer. By pressing on the key, they moved through the text (Elbro, 1991, as cited in Elbro & Arnbak, 1996, p.217). However, only one unit at the time was fully seen while the rest was in the form of underscores. When the student pressed the key, another unit was shown. After having finished with the text, students were shown five pictures from which they had to, according to the content, choose one that they believed was the most suitable for the text.

The findings showed similar results for both groups on reading comprehension which was measured with fully visible text. As for the word decoding measure, the younger (control) group

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<sup>5</sup> Semantic transparency is “the degree to which the sound and meaning of a complex word is predictable from its constituent morphemes” (Elbro & Arnbak, 1996, pp.212-213).

was better in accuracy<sup>6</sup>, but not in speed. Furthermore, it was found that students with dyslexia were more skilled in reading texts that were divided into morphemes, as opposed to syllables. The last study in the paper by Elbro & Arnbak (1996) was a pilot study, however I will not be presenting that part here. The next subchapter deals with a study by Arnbak & Elbro (2000) conducted on the same subject with the same objective.

#### **4.3 Instructing students with dyslexia in morphological awareness (Arnbak & Elbro, 2000)**

Arnbak & Elbro (2000, p.233) conducted a study in Danish language with which they set themselves multiple goals some of which include examining whether it is possible for students with dyslexia to develop morphological awareness via spoken language exercises; if development of awareness can also have positive influence on students' reading and spelling skills; if the training in morphological awareness would result in increased degree of "general linguistic knowledge".

Participants of the study were 33 students with dyslexia (experimental group) attending 4<sup>th</sup> and 5<sup>th</sup> grades, while the control group consisted of 27 students. Both groups had remedial instruction for the same duration of time. Before the instruction even started, the first author gave a course in morphology to the experimental group's teachers lasting for 12 hours.

Semantic transparency was important factor since the words that were used were arranged according to it. First part of the programme focused on root morphemes, the second on affixes and the third on inflections (Arnbak, 2003, as cited in Arnbak & Elbro, 2000, p.234).

The first part employed three different tasks multiple times; "morphological segmentation of compounds", "analysis of the semantic relation between the roots" and "production of both existing and novel compounds" (p.235). An example of the task from the first part including compounds would be:

A candy factory does not sell enough bonbons. They sell bonbons of four different flavours: orange slices, liquorice bonbons, caramel balls, chocolate chips. Help the candy factory sell more candy: make up more interesting and fun names for the four types of bonbons. The names of the candy should be compounds (Arnbak & Elbro, 2000, p.235).

Second part of the programme was training in affixes, of which prefixes were instructed first. The third part included instruction of inflection but only of nouns, verbs and adjectives. The

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<sup>6</sup> Accuracy is the "number of correctly read passages as indicated by a correct picture choice" (Elbro & Arnbak, 1996, p.119).

students were instructed to first examine what the possible meaning of the inflection could be, after which they did the segmentation part.

Overall, Arnbak & Elbro (2000) report that not all of the initial goals were met at the end of the study. Their expectations that the students with dyslexia would have higher gains in awareness in comparison to the control group was not fully met – it was achieved only in two measures. Arnbak & Elbro (2000, p.246) suggest that it is possible that the failure of measures could be “due to lack of transfer from transparent words to less transparent ones” since students with dyslexia “had primarily been trained in identifying morphemes in semantically and phonetically transparent words”. They also suggest another potential factor which could have influenced the outcome and which, they report, has also been found in some other studies to have had an influence on the training (e.g., Henry, 1989, as cited in Arnbak & Elbro, 2000, p. 246). The issue in question is the possible insufficient knowledge in the area of morphology by the teachers instructing the experimental group. Moreover, another environmental factor that could have had significant influence is the size of the group in which the students participated. It was found that students benefited more when the groups were smaller in size.

Arnbak & Elbro (2000) point out that the reason why the experimental group did not achieve higher results in the reading part is perhaps because they lack in orthographic knowledge. It is also supported by different studies that the orthographic knowledge is of great importance for one to acquire awareness of morphemes in both written and spoken language (Carlise, 1987; Leong, 1987; Fowler & Liberman, 1995, as cited in Arnbak & Elbro, 2000, p.247). Furthermore, the findings suggest that more gains could be observed for the spelling skills in students with dyslexia, as well as that it is possible to train morphological awareness independently. The latter is examined in the finding that the higher results that the experimental group achieved “compared with the controls were not a result of a higher level of linguistic awareness at other levels such as the phonological, or at the word level as one would have expected” (p.248).

All in all, although Arnbak & Elbro (2000) did not meet all of their goals, they still produced some significant findings with this study which can possibly contribute to other future research in this area.

#### **4.4 Examining morphological awareness in adult dyslexics and if it has a compensatory role for them (Law et al., 2015)**

The last study, by Law et al. (2015), examined morphological awareness in adults with dyslexia and whether it can have a compensatory role for them. Law et al. (2015) wanted to observe the

relationship between morphological awareness and literacy skills as well as phonological processing. Moreover, they also looked at the relation of morphological awareness to reading of words, spelling, and the comprehension of the written material without taking phonological awareness and vocabulary into consideration. Participants of the study were 36 adults with dyslexia and 54 without who were all chosen from universities.

Tasks assessing literacy included word reading task where the participants had to read aloud 42 words, spelling task where they had to spell words that were orally dictated to them and lastly, reading comprehension task where they had to read a short passage in silence and then determine the best option for the missing word. Tasks related to phonological skills included assessing phonological awareness which was done with a spoonerism task. Next, rapid automatic naming and verbal short-term memory. For the assessment of the vocabulary participants were presented with a word for whose meaning they had to provide a definition or a description. As for the morphological awareness, tasks used for measuring were “a derivational suffix task and a nonword sentence completion task” (p.261). In the former participants had to “complete a sentence by applying a derivational suffix to a target root word (e.g., act: The secret police arrested the \_\_\_\_\_ before he could give his speech)” (p. 261). In the latter they had to read a sentence which was incomplete and then choose one word out of four given – according to the fitting suffix – to complete the sentence.

Findings showed that the performance in word reading, spelling and reading comprehension of adults without dyslexia was notably better than the other group. On measures for phonological skills adults with dyslexia had scored considerably lower results, as well as for their performance on tasks measuring morphological awareness.

However, it was discovered that morphological awareness had “a positive relationship with reading and PA<sup>7</sup> (measured with the spoonerism task), while these relationships were not found within the normal reading sample” (p.262). Findings also indicate that it contributed to spelling and reading comprehension in both groups, while greater correlation was discovered between morphological awareness and word reading ability in persons who have dyslexia. Law et al. (2015) suggested two different conclusions. The first one – which is less probable – indicates that the reading difficulties that can be examined in adults with dyslexia are partly caused by morphology, however Law et al. (2015, p.266) say that not a lot of researchers would agree with the claim of morphological awareness being causally related to dyslexia. The second

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<sup>7</sup> Phonological awareness



conclusion suggests that there was a change “in the underlying cognitive mechanisms of word reading” in adults with dyslexia which led “to a greater involvement of MA<sup>8</sup>”.

They further divided the group of adults with dyslexia into compensated – “those whose reading scores were no longer found to be deviant” – and noncompensated – “those whose reading scores were still deviant” – in order to examine the role of morphological awareness in assisting certain dyslexics reach normal word reading skills (p.267). Furthermore, they report that “no statistical difference could be observed in MA” between adults without dyslexia and compensated dyslexics (p.267).

All things considered, Law et al.’s (2015) study provided evidence for their initial theory that morphological awareness does have a role in compensation in adults with dyslexia. With the nearly same levels of morphological awareness as in the control group, compensated dyslexics demonstrated unimpaired morphological processing which suggests that this group could possibly be further helped to develop their word reading to the normal level.

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<sup>8</sup> Morphological awareness

## 5. Conclusion

Briefly to conclude, in the second chapter of this paper I defined dyslexia as well as some ideas related to it that I thought would be relevant. One part of that chapter was also dedicated to theories trying to explain the cause of dyslexia – one of which is phonological deficit theory, which tends to be embraced by the vast majority. In the following chapter I defined the terms morphological knowledge, morphological awareness and morphological processing and also looked at the relation between morphological knowledge and dyslexia. Furthermore, I looked at the role of morphological awareness in literacy by presenting some findings from previous studies of tests on typically developing children and adults. In the last chapter I gave an overview of studies that conducted training of morphological awareness in persons with dyslexia.

The two studies conducted by Berninger et al. (2008) found that the group of students who have dyslexia and were given the morphological treatment were better at spelling pseudowords dictated to them. In comparison to phonological training, morphological training showed better results. However, morphological awareness was found to have improved only in older students. The results of the studies by Elbro & Arnbak (1996) showed that students who have dyslexia had more benefit from the structure of the word that is morphologically transparent. Furthermore, the control group significantly outperformed the students with dyslexia in tasks requiring morphological awareness. The results for reading comprehension were similar for both groups, however it was shown that, for dyslexic students, it was less challenging to read texts that were split into morphemes rather than syllables. The study by Arnbak & Elbro (2000) found that the dyslexic students had lower achievement in awareness than the control group and they provided reasoning why this could have happened. The results of their study also indicate that improvement in spelling skills could be seen in dyslexic students as well as that morphological awareness could be taught separately. In their study, Law et al. (2015) report that adults without dyslexia, in comparison to dyslexic adults, achieved better results in word reading, spelling and reading comprehension along with tasks that evaluated phonological skills and morphological awareness. Results of the study suggest that morphological awareness helps enhance spelling and reading comprehension in both adults with and without dyslexia. In addition, it was found that morphological awareness is more significantly related to word reading in dyslexic adults.

All in all, studies carried out on the sample of typically developing children and adults all showed some kind of contribution of morphological skills to the development of literacy. For example, Levesque et al. (2019, p.74) found that as one's morphological awareness strengthens

they are able to make “more progress in learning to infer the meanings of unfamiliar morphologically complex words”. In the studies with the persons with dyslexia most of the presented ones had positive outcomes, although in some cases results happened to be lower than the researchers had expected. Nevertheless, the findings demonstrated that it is possible for children with dyslexia to benefit from deepening their morphological knowledge. What is more, two studies showed that morphological analysis and morphological awareness can have role in developing a compensatory strategy.

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## **7. Morphological knowledge and dyslexia: Abstract and key words**

This paper examines the role of morphological knowledge in the development of literacy skills, especially in relation to persons with dyslexia. The objective was to investigate whether it is possible for persons with dyslexia to improve their literacy skills by improving their morphological awareness. Introductory part provides a definition of and some further facts on dyslexia. In the continuation of the paper are also described some of the theories of etiology of dyslexia. Moreover, terms morphological knowledge, morphological awareness and morphological processing are defined. Lastly, an overview of studies is given.

**Key words:** dyslexia, morphology, morphological knowledge, morphological awareness, morphological processing, phonological awareness, phonological deficit theory



## **8. Morfološko znanje i disleksija: Sažetak i ključne riječi**

U ovom se završnom radu ispituje uloga morfološkog znanja u razvoju pismenosti, posebno u odnosu na osobe s disleksijom. Cilj je bio istražiti mogu li osobe s disleksijom poboljšati svoje vještine pismenosti poboljšanjem morfološke svjesnosti. Uvodni dio pruža definiciju i neke dodatne činjenice o disleksiji dok su u nastavku rada također opisane neke od teorija o etiologiji disleksije. Nadalje, definirani su pojmovi morfološko znanje, morfološka svjesnost i morfološko procesiranje. U zadnjem dijelu izložen je pregled studija.

**Ključne riječi:** disleksija, morfologija, morfološko znanje, morfološka svjesnost, morfološko procesiranje, fonološka svjesnost, teorija fonološkog deficita