Understanding metaphors in developmental dyslexia

From eye tracking to academic text comprehension

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Abstract

The ability to understand metaphors has often been investigated in neurodevelopmental disorders, but studies devoted to adults with dyslexia are still few and present mixed results: in Griffith (2007) and Cappelli et al. (2018) participants with dyslexia show difficulties in metaphor comprehension tasks, while in Kasirer and Mashal (2017) the group with dyslexia does not differ from controls. The current research project is aimed at providing further insights into how adults with dyslexia understand metaphors. Three psycholinguistic experiments were conducted. In a first eye tracking study based on the Visual Word Paradigm, novel metaphors and corresponding literal sentences were aurally presented in isolation, and participants were asked to select the picture that best corresponded to what they heard. Findings indicated that those with dyslexia are as accurate as controls in interpreting metaphors but need significantly more time to process the figurative meaning (i.e., present longer fixations to the target picture and reaction times). The second study was then aimed at determining whether the identified slowness arises from early stages of metaphor processing, in which the figurative meaning is generated, and the literal components are inhibited. In a task based on the Metaphor Interference Effect paradigm, high and low familiar metaphors and their scrambled counterparts were aurally presented to participants, who were asked to judge whether sentences were literally true or literally false. Findings suggest that individuals with dyslexia are comparable to participants without dyslexia in the early stages of generating and inhibiting the metaphorical meaning, irrespectively of the metaphor familiarity. Thus, difficulties in metaphor comprehension might depend on meaning construction in context rather than online semantic processing. A third study was designed to verify this hypothesis in the case of academic texts, which typically contain a high number of metaphors. A multiple-choice comprehension task revealed that, when reading ability was used as covariate, university students with dyslexia presented significantly lower comprehension scores in texts in the metaphorical condition but not in those in the literal condition. As a conclusion, we suggest that metaphor might not be detrimental *per se* for individuals with dyslexia, but that inferencing its meaning and integrating it in complex contexts could add a layer of difficulty. Possible alternative ways to use metaphors in the education field are then proposed as future areas of research, building on the strengths of people with dyslexia.

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Introduction

> Easy learning is naturally pleasant to all, and words mean something, so that all words which make us learn something are most pleasant. Now we do not know the meaning of strange words, and proper terms we know already. It is metaphor, therefore, that above all produces this effect; for when Homer calls old age stubble, he teaches and informs us through the genus; for both have lost their bloom.
>
> (Aristotle, Rhetoric, III, 10, 1410)

From time immemorial, metaphor has been regarded as an instrument of discovery, as it allows a more vivid access to abstract concepts. For this reason, a large body of literature on the implications of using metaphor in education is available, but few research studies considered the peculiarities of those with specific learning differences, such as dyslexia, when dealing with figurative language.

Until relatively recently, developmental dyslexia has been described as a neurodevelopmental disorder that results in difficulties with decoding and spelling words, but it is now clear that most people with dyslexia present difficulties that extend to cognitive and linguistic abilities. New models of dyslexia emphasize the need for a multifactorial approach, suggesting that each person has a distinct profile. However, while maintaining an individual difference approach, some common traits can be identified. On the one hand, adults with dyslexia tend to show persisting weaknesses in decoding and executive functions; on the other, their semantic skills seem comparable to that of people without dyslexia, and their creative abilities appear to be particularly strong. These are all features that may play a role in metaphor comprehension, either enhancing or inhibiting the process.

The aim of our contribution is to shed light on how people with dyslexia, and specifically adults, understand metaphor. While research on children with dyslexia seems to agree on the fact that figurative language is a source of difficulty, previous studies on adults present inconsistent results. Understanding

whether adults with dyslexia have difficulties with metaphors becomes of paramount importance, since this type of figurative language is pervasive in everyday language: research estimates that it comprises around 7.7% of everyday conversations, 11.7% of fiction, 16.4% of news, and 18.5% of academic texts. Hence, our primary objective in this research is to delineate the process of metaphor comprehension in individuals with dyslexia, taking into account individual differences. This aims to provide insights for those who communicate, narrate, and particularly teach using metaphors, ensuring they are well-informed about the accessibility of this form of figurative language.

Chapter 1 provides an overview of theories of developmental dyslexia, with a specific focus on the cognitive and linguistic profiles identified in prior research. Emphasis is placed on how dyslexia evolves across the lifespan, considering that compensation processes often modulate the characteristics of the disorder from development to adulthood.

Chapter 2 is dedicated to theories of metaphor comprehension, and to the individual cognitive abilities that might impact this process. These are then linked to the cognitive and linguistic profile of dyslexia, allowing the formulation of hypotheses on metaphor processing in this population. A comprehensive review of the few previous studies concerning this topic is also provided.

Chapter 3 presents the first experimental study. To the best of our knowledge, prior research has only used behavioral offline tasks to investigate metaphor comprehension in dyslexia, while in this study we also combined eye-movements to offer a more fine-grained analysis on the online patterns of processing. Assessments of reading abilities, working memory, vocabulary and Theory of Mind are reported to consider any possible correlation with the measures of metaphor comprehension. This research study was carried out at the University of East Anglia with native speakers of English.

Chapter 4 includes the second study, which was based on the Metaphor Interference Effect. This paradigm was originally created by Glucksberg and colleagues (1982) to demonstrate that when we encounter a metaphor, its literal meaning is not necessarily generated first and then rejected, and the figurative meaning is immediately available. While this task has been replicated in numerous research studies, including investigations into metaphor processing within populations with autism, it has not been

explored with individuals with dyslexia until now. The value of this paradigm is that it can be used to examine the earliest stages of metaphor comprehension and to distinguish the phase in which the metaphorical meaning is generated from that in which the unintended meanings are suppressed. The generation of the metaphorical meaning, in fact, might happen independently from the process of understanding the metaphor in conversation, which requires the subsequent step of inhibiting the literal meaning and integrating the metaphoric utterance within discourse and social contexts. This research study was carried out at the Laboratory of Language and Cognition of the University of Genoa with native speakers of Italian.

Chapter 5 reports the third study, which considered the effects of the presence of metaphors in academic texts. Academic texts are characterized by distinct linguistic elements, often perceived as problematic for university students, particularly those with dyslexia. Among them is metaphor, which has long been used by scholars to make concepts more comprehensible. However, this use of metaphors has never been investigated in relation to the way students learn from these texts, nor with specific reference to adults with dyslexia, who are more and more present in university contexts. This study aims to assess the impact of metaphors on overall academic text comprehension in university students with and without dyslexia. It was carried out at the Laboratory of Language and Cognition of the University of Genoa with native speakers of Italian.

Chapter 6 outlines the findings from the three studies conducted, each involving different participants. Given the variability of dyslexia among individuals, deriving definitive conclusions is challenging. However, standardized assessments of cognitive abilities were employed, revealing relatively consistent cognitive profiles. This enabled the identification of common trends in how metaphors are comprehended in dyslexia.

The last chapter also includes the application of our findings to the field of education, which was that of interest to this dissertation. Specifically, alternative ways of using metaphor to understand or to recall concepts based on the strengths of people with dyslexia are suggested, opening the possibility for future research on the topic.

We conclude this introduction with few terminological remarks. Throughout this dissertation, the term "dyslexia" is used to refer to developmental dyslexia as a comprehensive and inclusive category, distinguishing it from acquired dyslexia. Unfortunately, diagnosis provided by participants both in Italy and in the UK do not allow to identify different sub-types.

To address our target population, we have chosen to employ person-first language. Following thoughtful consideration, we consulted our participants to determine their language preference, and the majority expressed a preference for person-first language. We recognize that some individuals in the community may prefer identity-first language, as they perceive the trait as a fundamental aspect of their inner self. We express our apologies to those who hold this preference.

CHAPTER 1

A multidimensional approach to developmental dyslexia

ABSTRACT

This chapter briefly outlines the main theories on developmental dyslexia. Until relatively recently, dyslexia has been described as a deficit that involves reading and decoding, but it is now becoming evident that the majority of people with dyslexia have more global cognitive and linguistic issues. New multifactorial models describe a primary involvement of phonological deficits, together with weaknesses in processing speed, executive functions, and linguistic skills. Given that the focus of this dissertation lies primarily on the linguistic abilities of people with dyslexia, the main part of the chapter will be dedicated to cognitive and linguistic profiles that characterize this population, as well as to implications of dyslexia in adulthood.

1. DEFINITIONS OF DEVELOPMENTAL DYSLEXIA

In 1896, the British ophthalmic surgeon W. Pringle Morgan documented the case of Percy, a 14-year-old youth described as "bright and intelligent, adept in various activities, and comparable to peers of his age" (Pringle Morgan, 1896). Nevertheless, when tasked with reading, Percy exhibited a peculiar challenge:

> He seems to have no power of preserving and storing up the visual impression produced by words - hence the words, though seen, have no significance for him. His visual memory for words is defective or absent; which is equivalent to saying that he is what Kussmaul has termed "word blind" (*cæcitas syllabaris et verbalis*). (p. 378)

This historical account represents one of the initial documented instances of developmental dyslexia, a neurobiological learning difference broadly characterized by lower reading proficiency despite adequate cognitive capacity.

Defining dyslexia poses considerable challenges due to its involvement across multiple dimensions (Frith, 1999). On a behavioral level, this condition manifests primarily as a difficulty in reading. However, relying solely on reading difficulties as a diagnostic criterion is insufficient, given that various factors beyond dyslexia can contribute to reading disorders. Furthermore, individuals with dyslexia often witness improvements in their reading skills over time and with practice; yet, persisting challenges, such as spelling difficulties, remain (see Section 5 of this Chapter). Another dimension involves the cognitive functioning of individuals with dyslexia and their learning mechanisms. A third dimension delves into the biological realm, investigating the neurological and genetic underpinnings of dyslexia. Additionally, environmental factors play a role in influencing the severity of the disorder, encompassing elements like exposure to print, family attitudes toward literacy, and the efficacy of instructional methods (Samuelsson, 2003). Morton and Frith (1995) present a systematic framework known as the "causal modelling framework", outlining the interconnectedness between behavioral, cognitive, biological, and environmental levels that contribute to the characterization of dyslexia features (Figure 1). The arrows in the framework signify its fluidity, flexibility, and incorporation of overlapping dimensions.

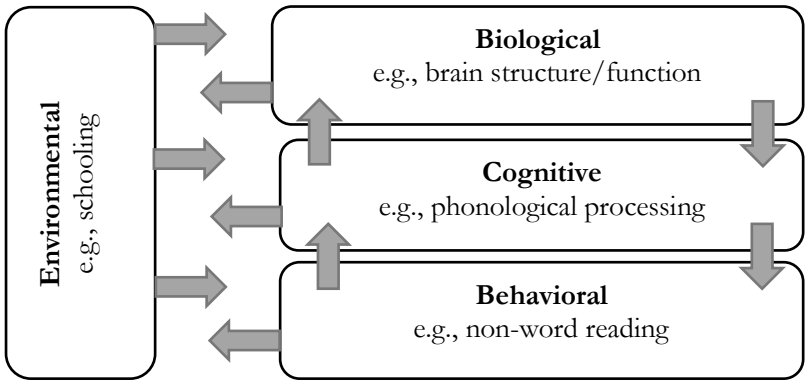

Figure 1 - Key factors in dyslexia across different levels of analysis (adapted from Frith, 1999)

A frequently used definition of dyslexia is an attempt of taking into account all levels. It is the one used by the International Dyslexia Association, proposed by Lyon et al. (2003):

> 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. (p. 1)

It is important to note that this definition still categorizes dyslexia as a disability rather than framing it as a Specific Learning Disorder, an overarching term that is now present in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5; American Psychiatric Association, 2013), which better describes this neurodevelopmental condition. Within the DSM-5, Specific Learning Disorders are characterized by challenges in acquiring and applying academic skills, resulting in performance below the expected level for an individual's age. Specifically, dyslexia entails difficulties in accurate and/or fluent word recognition, coupled with deficient spelling and decoding abilities. Individuals with dyslexia may

also encounter hurdles in reading comprehension and exhibit diminished reading experience, potentially hindering the expansion of vocabulary and background knowledge (American Psychiatric Association, 2013).

Among thirty eminent scholars in the dyslexia field, however, the definition put forth by Lyon et al. (2003) was deemed the most comprehensive (Dickman, 2017). Despite potential incompleteness and underspecification in certain aspects (Wagner et al., 2022), this definition proves valuable in capturing the fundamental characteristics of dyslexia by incorporating all levels of description. Primarily, dyslexia is of a neurobiological nature, indicating that external factors like inadequate exposure to effective instruction are not its root causes. Similar to other neurodevelopmental disorders, dyslexia is likely to have a heritable component (Pennington, 1990; Becker et al., 2017). Family and twin studies consistently reveal a genetic basis for dyslexia. Snowling (2013)'s research suggests a significantly elevated risk of dyslexia in children with a family history of the disorder. Furthermore, twin studies indicate a higher concordance rate among monozygotic twins compared to dizygotic twins, reinforcing the genetic influence on dyslexia (Pennington, 2006). Collectively, these findings point to a substantial hereditary role in dyslexia aetiology, although interactions between genetic factors and environmental influences likely contribute to its development.

At the behavioral level, challenges predominantly manifest in word reading, spelling, and decoding. Nevertheless, the degree of dyslexia is contingent upon the characteristics of the underlying cognitive skills, particularly phonological processing. The definition highlights the unexpected nature of these deficits when considered in relation to other cognitive capacities. Historically, initial dyslexia definitions relied on the "discrepancy" between reading skills and IQ (Intelligence Quotient). However, these definitions faced significant criticism, not only due to the biased nature of certain IQ tests favoring specific social groups, but also because they tended to under-identify individuals with dyslexia (Fletcher et al., 2007; Siegel, 1988). This was attributed to the anticipation of a substantial gap between the IQ score and reading proficiency, potentially resulting in the oversight of individuals with dyslexia whose IQ

fell within lower ranges. The concept of unexpectedness was introduced during this phase as an effort to move beyond discrepancy-based definitions while considering individual cognitive abilities.

Furthermore, Lyon's definition incorporates the "provision of effective classroom instruction" to add the environmental level to this complex picture. It should be acknowledged that quality of education, remedial instruction, and supportive school and home environments might contribute to devising strategies to mitigate the impacts of dyslexia.

Lastly, challenges may extend to reading comprehension and other related linguistic tasks. Whether these are primary or secondary deficits of dyslexia remains a topic of debate, and multifactorial approaches to dyslexia have been proposed (Pennington et al., 2012; Perry et al., 2019; see Section 2.5 of this Chapter).

It is evident that crafting a universally valid, accepted, and comprehensive definition for dyslexia is exceptionally challenging (Vender, 2017) due to the multifaceted nature of this learning disorder, where deficits are not uniform across the population.

Additionally, definitions of dyslexia should also consider positive aspects. The prevailing compensatory cognitive benefit theory (Chakravarty, 2009) suggests that creative abilities may emerge as adaptive responses to the challenges posed by language-related difficulties inherent in dyslexia (for a review on dyslexia and creativity, see Cancer & Antonietti, 2020). For instance, individuals with dyslexia often demonstrate a preference for visual representations and visual processing (West, 2009), along with intuitive strategies linked to cognitive traits that support creativity (Ingesson, 2006). Another perspective proposes that individuals with dyslexia tend to prioritize global information processing over local processing (Schneps et al., 2012), a factor that should be considered, for example, in foreign language teaching. Furthermore, given that the verbal code is the primary conduit for conventional thinking (Shepard, 1978), difficulties in this area may foster unconventional modes of thought (Vail, 1990; Yewchuk, 1983).

Examining dyslexia from a behavioral perspective is crucial for developing effective support strategies for individuals with dyslexia in educational and rehabilitation contexts. However, neuropsychological research has sought to identify the root causes of dyslexia, offering various theoretical frameworks.

The following section will provide a concise overview of the primary theories regarding the aetiology of dyslexia. Subsequent sections will delineate the cognitive and linguistic profiles of individuals with dyslexia, aiming to underscore the pertinent features that will be explored in the upcoming chapters.

2. THEORIES OF DEVELOPMENTAL DYSLEXIA

Several theories have been proposed to elucidate the origins of developmental dyslexia. In the following paragraphs, we have categorized these theories based on the core deficit(s) identified by their proponents.

2.1 Phonological deficits

2.1.1 Phonological theory

The phonological theory is the historically dominant one, and posits that reading difficulties arise from impaired phonological skills (Vellutino, 1979). According to this theory, the inefficiency of individuals with dyslexia in processing written language stems from limited phonological awareness (Catts et al., 2017; Costenaro & Pesce, 2012; Goswami, 2002; Goswami, 2014; Hulme & Snowling, 2014; Ramus et al., 2003; Snowling, 2000). Phonological awareness directly influences word reading, which necessitates intact knowledge of grapheme-phoneme correspondence. If sounds are poorly represented, stored, or retrieved, then reading becomes more difficult. Phonological awareness includes two levels: syllabic and phonemic knowledge. Syllabic knowledge involves the ability to segment and manipulate word syllables, while phonemic knowledge encompasses the ability to discriminate and manipulate speech sounds. Figure 2 visually illustrates the phonological processing issues leading to reading difficulties.

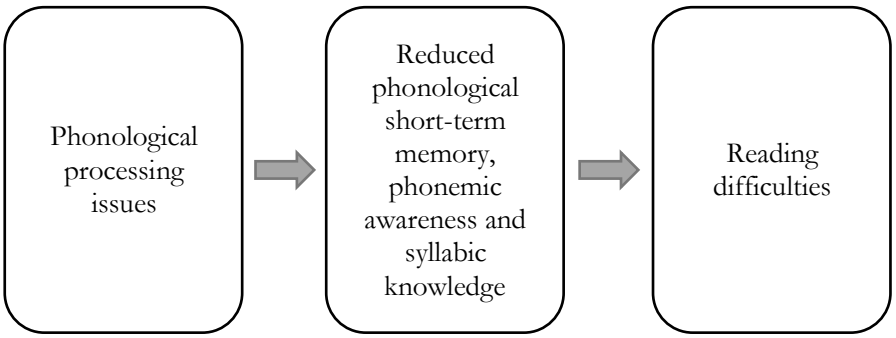

Figure 2 - An illustration of the Phonological Theory (adapted from Kormos & Smith, 2012)

In summary, according to this theory, individuals with dyslexia struggle to accurately represent, store, manipulate, and retrieve speech sounds. This theory holds significant recognition because it offers a robust explanation for challenges in reading and spelling of words and non-words, as well as for the presence of poor phonological awareness across individuals with dyslexia. Furthermore, targeted interventions aimed at strengthening phonological awareness have demonstrated a noteworthy improvement in reading skills (Vellutino et al., 2004; Vender et al., 2022). There is a consensus among researchers that a phonological processing deficit constitutes one of the fundamental cognitive challenges in dyslexia. However, the ongoing debate revolves around whether other cognitive or neurological factors contribute to the elucidation of reading difficulties.

2.1.2 Auditory theory

The auditory theory posits that phonological deficits observed in dyslexia result from impaired perception of speech sounds (Tallal, 1984). Tallal identified subpar performance in auditory tasks involving short sounds and rapid transitions, such as sound discrimination, temporal order judgment, and backward masking. Consequently, she attributed these processing deficits to impairments in the temporal lobe, formulating the Auditory Temporal Processing Deficit Hypothesis. However, subsequent studies revealed that only a subset of individuals with dyslexia exhibit auditory deficits (Georgiou et al., 2012; Snowling, 2001; Ramus et al., 2003).

2.1.3 Double deficit theory

The Double Deficit Theory, formulated by Wolf and Bowers (1999), was devised to explain the presence of both phonological and rapid automatized naming (RAN) difficulties in individuals with dyslexia. RAN is typically assessed using tasks that gauge the speed of name retrieval for letters, digits, colors, and objects. Research indicates that individuals with dyslexia exhibit significantly slower RAN compared to those without dyslexia (Denckla & Rudel, 1976). Consequently, Wolf and Bowers (1999) argued that the phonological deficit is not the sole core disorder; rather, there is an additional deficit in naming speed — independent of the phonological deficit — that serves as another reliable predictor of dyslexia (see Figure 3).

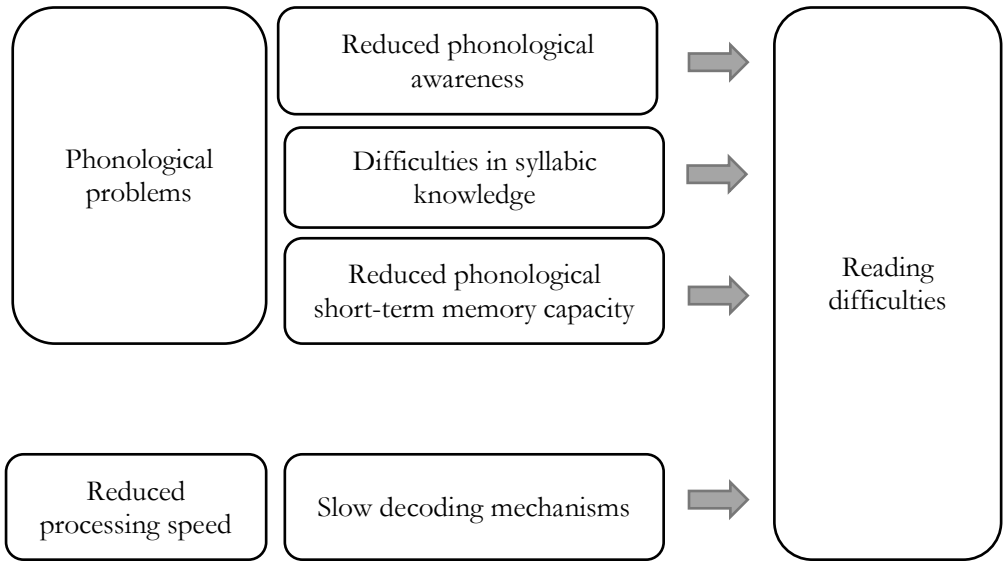

Figure 3 - An illustration of the Double Deficit Hypothesis (adapted from Kormos & Smith, 2012)

The two scholars demonstrated that their participants could be categorized into three groups: those with phonological deficits, those with naming speed issues, and those with both, with the latter being the most severely impaired. However, attempts to replicate their findings realized that the vast majority of individuals with dyslexia exhibit both speed and phonological processing issues (Lovett et al., 2000;

Pennington et al., 2001), thus not substantiating the Double Deficit Theory. Despite this, the theory had a positive impact on remedial interventions, prompting the inclusion of exercises focused on fluent reading and word recognition in addition to phonemic tasks.

Furthermore, Wolf and Bowers (1999) posited that the naming speed deficit extends beyond simple phonological processing, involving more intricate processes (attentional, visual, memory, lexical, articulatory). They hypothesized that this reflects a broader systemic timing deficit, acknowledging the need for further research to corroborate this conclusion.

2.2 Processing Speed deficits

2.2.1 Cerebellar theory

This theory posits that dyslexia-related issues extend beyond reading, indicating a more generalized deficit in executing tasks automatically. Nicolson & Fawcett (1990) conducted a comparison between individuals with dyslexia and age-matched controls across various response time (RT) tasks. In these tasks, participants were required to push a button in response to hearing a tone (simple RT task), specific tones (selective RT task), or words (lexical decision RT task). Individuals with dyslexia exhibited significant delays in all tasks except the simple RT task, indicating a deficit in processing speed and a linguistic timing deficit. This domain-general processing speed deficit has been corroborated by other research studies (e.g., Catts et al., 2002).

Nicolson and Fawcett attributed this processing slowness to the cerebellum, a brain region dedicated to motor control and speech articulation, crucial for automating over-learned tasks like typing, reading, and driving. Automatization is pivotal in reading; its efficiency reduces cognitive load, enhancing word processing speed. According to this theory, dyslexia is linked to reduced left cerebellar activity. However, this specificity has been scrutinized, as differences in the cerebellum might indicate alterations in other brain areas, such as the visual cortex (Zeffiro & Eden, 2000). Additionally, structural and functional brain differences in dyslexia extend beyond the cerebellum (Brunswick et al., 1999). Subsequent studies

highlighted that motor impairments in dyslexia are not universal (Ramus et al., 2003) and are likely linked to frequent comorbidities between dyslexia and ADHD (Rochelle et al., 2009; see Section 2.6 of this Chapter).

2.3 Visual deficits

2.3.1 Visual theory

The visual theory, while acknowledging a potential phonological deficit, attributes difficulties in processing letters and words to visual impairments (Lovegrove et al., 1980; Stein & Walsh, 1997). In this view, dyslexia is primarily conceptualized as a deficit in visuo-spatial processing. Eden and colleagues (1996) proposed that reading difficulties stem from visuospatial scanning errors and inadequate visual-linguistic integration. Scholars have explored the underlying reasons for this visual processing slowness (Goswami, 2014; Hairston et al., 2005; Johnston et al., 2008; Laasonen et al., 2001; Livingstone et al., 1991; Provazza et al., 2019) and identified low-level visual deficits such as oculomotor deficiencies and visual-tracking problems. Consequently, it has been suggested that individuals with dyslexia may have a restricted "visual attention span" (Valdois, 2022). Saksida and colleagues (2016), after examining a large sample of children with dyslexia, affirmed the significance of phonological deficits (present in 92.1% of the sample) and identified impairments in visual attention span in 28.1% of the sample. They concluded that while visual attention span may play a role in dyslexia, it is likely a secondary factor.

2.3.2 Magnocellular theory

The magnocellular theory posits that the core impairments of dyslexia originate in the magnocellular system (Stein, 2001). Magnocells are specialized cells responsible for sensory and motor events (Doyle & McDowall, 2015). This theory integrates aspects of others and appears to account for the principal manifestations of dyslexia across visual, auditory, tactile, and motor domains. According to Stein (2001), a deficiency in the magnocellular system may lead to poor control of ocular movements, affecting the

transmission of information from the eyes to the brain. Unstable ocular control during reading could explain the moving and blurry images perceived by some individuals with dyslexia, along with subsequent difficulties in visually recognizing words. Auditory and phonological deficits observed in people with dyslexia can also be elucidated within the framework of this theory. Magnocells contribute to the processing of acoustic transitions, essential for segmenting letters and sounds to meet the phonological demands of reading (Stein, 2001). Additionally, deficits in motor tasks requiring automatization can be explained by magnocells' involvement in inputs to the cerebellum.

On initial examination, the magnocellular theory appears to be a comprehensive etiological framework. However, some scholars have highlighted inconsistencies between theoretical predictions and empirical findings. Indeed, specific magnocellular deficits have been only identified in subsets of individuals with dyslexia. A seminal study by Ramus and colleagues (2003), while limited in participant number, employed psychometric, phonological, auditory, visual, and cerebellar tests to assess the validity of the magnocellular, cerebellar, and phonological theories. Their results indicated the presence of a phonological deficit across all participants, but only a minority displayed a clear visual magnocellular deficit. Furthermore, not all participants exhibited auditory or motor deficits, contradicting theories positing that dyslexia is solely caused by sensory-motor dysfunctions.

2.5 Multiple deficits models

The theories discussed thus far highlight phonological deficits as distinctive features of individuals with dyslexia. However, other functions, including visual and auditory perception and automatization, have been shown to be specifically impaired in dyslexia. Currently, no theory has offered a thorough and comprehensive explanation for all the deficits associated with dyslexia. The most widely supported theory remains the phonological theory, accounting for the poor phonological awareness observed in all individuals with dyslexia. However, it does not encompass motor-sensory deficits present in some cases. Simultaneously, the auditory theory struggles to explain difficulties in word recognition, and its findings

have faced challenges in replication (Fostick & Revah, 2018; McArthur et al., 2000). The same limitations apply to the cerebellar theory, which does not account for sensory deficits.

Lorusso and Toraldo (2023) propose three potential interpretations for the heterogeneous pattern of findings in dyslexia research: (i) a single core deficit might be accountable for the reading impairment, with other observed deficits being associated disorders; (ii) distinct factors could serve as core deficits, leading to the existence of multiple subtypes of dyslexia; (iii) various deficits may represent manifestations of a higher-order (functional) system. However, as of now, none of these interpretations has succeeded in fully explaining the complexity and heterogeneity observed in developmental dyslexia.

Recent perspectives propose that dyslexia is characterized by diverse impairments, which may vary across individuals. These viewpoints are commonly categorized as multiple-deficit models (MDM) of dyslexia (Pennington, 2006; Pennington et al., 2012). They move away from a categorical approach and embrace a probabilistic one, acknowledging the multitude of functions influencing reading processes. MDM models emerge from the necessity for behavioral diagnoses that provide a nuanced understanding of the reading and spelling performance of individuals with dyslexia. This nuanced understanding can then inform more targeted interventions addressing not only the presumed "core" issue (e.g., phonological or visual abilities) but also other functions that appear to be impaired in each specific case. MDM models have garnered varied reactions, ranging from support (McGrath et al., 2011; Moll et al., 2020) to attempts at reconciliation with previous core-deficit models (Ozernov-Palchik et al., 2016; Catts et al., 2017) to outright rejection (Stein, 2023).

2.6 Comorbidities

In contemporary perspectives, there is a broad consensus that dyslexia often coexists with other neurodevelopmental disorders, a phenomenon known as comorbidity, i.e., the simultaneous occurrence of two or more disorders in an individual. Recent research studies indicate that half of the children with dyslexia meet the diagnostic criteria for other developmental disorders (Moll et al., 2020). Comorbidity can manifest as homotypic, involving disorders within the same diagnostic grouping. For instance,

different disorders of learning may affect reading, writing, and mathematics. While earlier classifications identified dyslexia, dysgraphia (writing disorder), and dyscalculia (mathematics disorder) as distinct entities, the most recent edition of the DSM-5 (American Psychiatric Association, 2013) introduced the term Specific Learning Disorder as the overarching diagnosis for difficulties in these domains (see Section 1 of this Chapter).

Nevertheless, comorbidity can also manifest in a heterotypic manner, involving disorders from different diagnostic categories with distinct symptomatology. Among the most prevalent conditions that co-occur with dyslexia are developmental language disorder (DLD) and attention deficit hyperactivity disorder (ADHD). Additionally, emotional disorders like depression and anxiety are commonly found in conjunction with dyslexia (Angold, Costello, & Erkanli, 1999).

In the literature on comorbidities, there is substantial variability in rates. This variability arises from the absence of clear definitions and cut-off criteria to precisely delineate the disorders (Dirks et al., 2008; Landerl & Moll, 2010). Additionally, the overlap between disorders is age-dependent and likely to evolve over development. This is particularly pertinent in the comorbidity between dyslexia and developmental language disorder (DLD), as these conditions are typically diagnosed at different developmental stages (Adlof et al., 2022). While dyslexia is reliably diagnosed in the early years of primary school, DLD is often identified in the preschool phase (kindergarten). In a comprehensive study involving a sample of over 500 children, Catts and colleagues (2005) investigated the overlap of DLD during kindergarten and the subsequent occurrence of dyslexia in grades two, four, and eight. Using a deficit criterion that considered IQ, they observed co-occurrence rates ranging from 17% to 29%. Without accounting for IQ, the percentage increased to 33-36%.

Comorbidity between dyslexia and ADHD is also prevalent, although somewhat unexpected given that each disorder impacts different domains (Moll, 2022). Notably, ADHD comprises two dimensions, namely inattention and hyperactivity-impulsivity, with several subtypes identified (DSM-5, American Psychiatric Association, 2013). For instance, consistent findings indicate that dyslexia is more commonly associated with the inattentive subtype rather than the hyperactive-impulsive subtype of ADHD

(Pennington et al., 2019). Numerous research studies have included groups with dyslexia-only, ADHD-only, and dyslexia with ADHD, revealing that the comorbid group exhibits a combination of deficits reported in the single deficit groups, along with shared genetic risk factors (Greven et al., 2012; Wadsworth et al., 2015). These risk factors give rise to shared cognitive risk factors, encompassing "processing speed, language skills, working memory, inhibition, and sustained attention" (Moll, 2022, p. 451), with processing speed being particularly prominent. However, further research is needed to clarify the connections between risk factors and deficits in attention and literacy.

In conclusion, the prevalence of comorbidities challenges the perspective that each disorder is defined by a distinct and specific core deficit (Moll, 2022). This underscores the need for multifactorial models and additional research studies to unravel how particular cognitive deficits or neurobiological correlates can be ascribed to one disorder while excluding another.

3. EXECUTIVE FUNCTIONING IN DYSLEXIA

Executive functions (EFs) constitute a collection of general-purpose control mechanisms that facilitate self-regulation and the execution of goal-oriented behavior (Miyake & Friedman, 2012). These encompass skills like planning, problem solving, sequencing, inhibiting verbal and motor responses, managing dual tasks, and accessing and retaining pertinent information. EFs are typically associated with the frontal regions of the brain (Alvarez & Emory, 2006), and the ongoing debate centers on whether they should be conceptualized as a unified construct or as a set of distinct functions (Duncan et al., 1997; Miyake et al., 2001; Stuss & Alexander, 2000; Teuber, 1972). Contemporary perspectives lean toward considering EFs as distinct yet interconnected functions (Banich, 2009; Friedman et al., 2008; Garon, Bryson, & Smith, 2008).

Indeed, the examination of individual differences in EFs has demonstrated both a degree of correlation, indicating shared underlying abilities (i.e., "unity"), and "diversity", as each identified EF

exhibits distinct relationships with other neuropsychological measures (Miyake et al., 2000). In the framework proposed by Miyake and colleagues, three primary EFs are outlined: inhibition (the intentional suppression of dominant responses), shifting (the flexible transition between tasks), and updating (the continuous monitoring of working-memory contents). Although there are additional EFs (e.g., dual-tasking) and multiple levels of analysis within this intricate domain, these three "have provided useful insights into the nature and organization of individual differences in EFs" (Miyake & Friedman, 2012, p. 2). Consequently, several other researchers have adopted this approach in their investigations (Garon et al., 2008; Hull et al., 2008; Van der Sluis et al., 2007).

Regarding dyslexia, diverse executive impairments have been documented in the existing literature, encompassing challenges with inhibition, problem solving, set maintenance, and selective and sustained attention (e.g., Brosnan et al., 2002; Everatt et al., 1997; Jeffries & Everatt, 2004; Reiter et al., 2005; van der Schoot et al., 2000). To align with our research focus, and comparably to other research studies (e.g., Smith-Spark et al., 2016) we will employ the framework proposed by Miyake, Friedman and colleagues to delineate executive functions in dyslexia.

3.2.1 Inhibition

Inhibition pertains to the capacity to restrain automatic and dominant responses to stimuli, opting instead for more context-specific and task-appropriate responses (Diamond, 2012). Developments of Miyake and Friedman's framework (refer to Miyake & Friedman, 2012) further deconstructed each of the three executive functions (EF) into what is shared among them, termed Common EF. This analytical approach revealed that no unique variance was left exclusively for inhibition (Friedman et al., 2008, 2011), indicating that inhibition might be a shared aspect of both shifting and updating. A schematic depiction of the "unity" and "diversity" of these three EF is presented in Fig. 4.

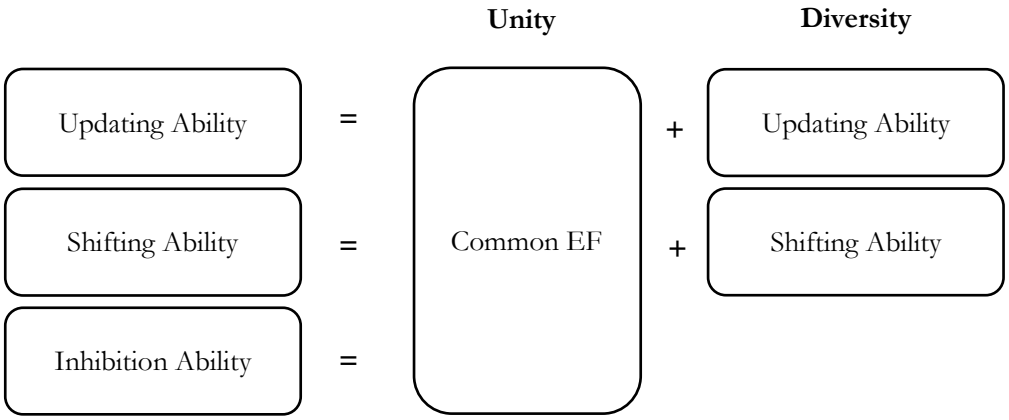

Figure 4 - A schematic representation of the "unity" and "diversity" of EF (Miyake & Friedman, 2012)

Deficits in inhibitory processes associated with dyslexia have been investigated across various cognitive tasks. For instance, impairments related to inhibition have been noted in dyslexia through the Stroop test (Everatt et al., 1997; Kapoula et al., 2010; Protopapas et al., 2007; Reiter et al., 2005). Similarly, evidence of such deficits has been reported in tasks like the Go/No Go task (McLean, Stuart, Coltheart, & Castles, 2011; although not in Reiter et al., 2005) and the Wisconsin Card Sorting Test (Kelly et al., 1989; McCabe et al., 2010). Brosnan et al. (2002) employed the Group-Embedded Figures Test as an indicator of inhibition, revealing diminished performance in a limited sample of adults with dyslexia. This inhibition-related impairment was further confirmed through assessments with the Children's Embedded Figures Test in children with dyslexia, indicating deficits in inhibition (Brosnan et al., 2002). Wang and colleagues (2012) used a battery of six distinct inhibition measures on children with dyslexia, comparing their performance with control groups and children diagnosed with dyscalculia. Their comprehensive factor analysis revealed a categorization of inhibition tasks into three distinct factors: word, number, and graphical inhibition. The study showed that children with dyslexia exhibited significantly poorer performance than control groups in word and graphical inhibition tasks, while their performance in the domain of number inhibition was comparable. These findings suggest that inhibitory impairments are likely to be part of the profile of individuals with dyslexia.

3.2.2 Set shifting

Set shifting, also known as task switching, pertains to the ability to seamlessly transition between different tasks or operations, adjusting to changes in task requirements or environmental context (Monsell, 2003). The cost incurred during the transition between cognitive operations or sets, compared to performance within a stable context, serves as a measure of cognitive flexibility, typically assessed through accuracy or reaction time. Investigations into set shifting within the context of dyslexia have yielded mixed outcomes.

Meltzer (1991) postulated that a deficiency in cognitive flexibility might impede individuals with dyslexia from effectively accessing metacognitive insights during problem-solving. Additionally, Poljac et al. (2010) asserted the existence of a task-switching impairment in children with dyslexia, alongside a broader challenge in information processing speed. Specifically, when participants with dyslexia were tasked with matching stimuli to a reference figure based on either color or shape, they exhibited a significantly larger cost when shifting between matching color and shape criteria compared to their typically developing peers.

In contrast, Stoet and colleagues (2007) found no evidence of a task-shifting deficit in undergraduate students with dyslexia, using randomly interleaved color and shape discrimination trials. Their conclusion suggested that any identified task-related impairments were localized to perceptual levels rather than central cognitive processes. However, Poljac et al. (2010) raised methodological concerns surrounding stimulus congruence, potentially explaining the absence of a switch cost in Stoet and colleagues's study.

Nevertheless, several studies reported neither differences in task switching nor set shifting associated with dyslexia (e.g., Kapoula et al., 2010; Närhi et al., 1997; Smith-Spark, 2000). Based on the variable findings outlined, the presence of deficits in set shifting among individuals with dyslexia remains a possibility but not an absolute certainty.

3.2.3 Updating (Working Memory)

Updating is defined as the "constant monitoring and rapid addition/deletion of working-memory contents" (Miyake & Friedman, 2012; p. 2). Working memory (WM) is a limited-capacity memory system that enables the temporary storage and processing of information. The multi-component perspective proposed by Baddeley (1986; Baddeley & Hitch, 1974) identifies two modality-specific systems: the phonological loop (processing phonologically based information) and the visuospatial sketchpad (handling visual and spatial information). In addition, there is the central executive, a modality-free attentional controller, and the episodic buffer, a temporary storage component that integrates information from the other subsystems, controlled by the central executive (Baddeley, 2000).

In dyslexia research, impairment in WM has emerged as one of the most challenging aspects of executive function, observed in both children (Booth et al., 2010) and adults (McLoughlin et al., 1994). Notably, deficits in verbal memory spans, where the phonological loop assumes a prominent role, have been extensively documented in the literature (e.g., Ackerman & Dykman, 1993; Cohen, Netley, & Clarke, 1984; Helland & Asbjørnsen, 2004; Jorm, 1983; Palmer, 2000; Roodenrys & Stokes, 2001; Smith-Spark, Fisk, Fawcett, & Nicolson, 2003). However, given that phonological processing deficits are a core feature of dyslexia, the source of these difficulties – whether stemming from phonological or memory processes – is not definitively established (e.g., Gathercole, 1994; Gathercole, Willis, Emslie, & Baddeley, 1991; Snowling, Chiat, & Hulme, 1991).

Discrepancies between individuals with and without dyslexia have also been observed in WM span tasks (e.g., Ransby & Swanson, 2004; Swanson, Ashbaker, & Lee, 1996; Wolff & Lundberg, 2003), which require the simultaneous processing of multiple pieces of information. Both the phonological loop and strategy selection from the central executive are essential for successfully completing these tasks (Baddeley, 1990). Experimental studies have provided evidence supporting impairments that involve the central executive in dyslexia (e.g., Bacon et al., 2013; Jeffries & Everatt, 2004; Palmer, 2000; Smith-Spark et al., 2003; Swanson, 1999; Swanson & Sachse-Lee, 2001).

Tasks that involve the visuospatial sketchpad have yielded varied outcomes when examining participants with dyslexia. While certain studies have not identified any significant differences between individuals with and without dyslexia on a range of spatial working memory tasks (e.g., Jeffries & Everatt, 2003, 2004; Kibby et al., 2004), there is also supporting evidence for a deficit in this domain (e.g., Bacon et al., 2013; Menghini et al., 2011; Smith-Spark et al., 2003; Smith-Spark & Fisk, 2007; Swanson, 1992; Varvara et al., 2014).

In summary, the literature on WM in dyslexia is extensive and characterized by diverse methods and frameworks of reference. Given the substantial deficits observed in the phonological domain (Vellutino, 1979), much of the research on working memory in dyslexia has focused on elucidating impairments in the phonological loop (Ackerman & Dykman, 1993; Cohen et al., 1984; Gould & Glencross, 1990; Helland & Asbjørnsen, 2003; Jorm, 1983; Palmer, 2000; Roodenrys & Stokes, 2001). However, an argument has been put forth suggesting that dyslexia also involves impairments within the central executive, although these deficits in the central executive have been proposed to be confined to tasks relying on phonological processing (Brosnan et al., 2002; Jeffries & Everatt, 2003, 2004; Kibby et al., 2004; Schuchardt et al., 2008). While issues within the central executive domain might be most pronounced when tasks tap into phonological loop functions, several studies suggest that central executive challenges can also manifest within visuospatial working memory tasks, particularly under cognitively demanding or novel conditions (Smith-Spark et al., 2003; Smith-Spark & Fisk, 2007). Hence, it is plausible that deficits associated with executive-loaded working memory would be evident across both phonological and visuospatial domains.

4. LINGUISTIC PROFILE OF PEOPLE WITH DYSLEXIA

4.1 Phonology

Phonological processing is a cognitive and linguistic skill that plays a pivotal role in reading development (Wagner et al., 2022). As already mentioned, dyslexia is frequently associated with deficits in this domain, regarded as a primary cause of the disorder. In this section, we will provide a concise examination of the three fundamental phonological processes relevant to dyslexia: phonological awareness, phonological memory, and rapid naming (Wagner and Torgesen, 1987).

Phonological awareness (PA) denotes the capacity to discern individual sounds within words, undergoing continuous refinement from early childhood to the initial school years. During this period, children progressively learn the association between graphemes and phonemes (Melloni & Vender, 2020). Given its status as a robust predictor of reading proficiency, PA has been extensively scrutinized concerning dyslexia. The body of research in this domain reveals impaired PA skills in individuals with dyslexia, reflecting challenges in tasks such as phoneme manipulation, rhyme detection, and spoonerisms (Bradley & Bryant, 1978; Joanisse et al., 2000; Ramus et al., 2013). These difficulties, however, stem not solely from inaccurate phonological representations (Elbro, 1996) but also from the processes involved in accessing and manipulating these representations (Ramus & Ahissar, 2012; Ramus & Szenkovits, 2008).

Phonological memory pertains to the capacity to temporarily retain and manipulate auditory information associated with the sounds of language, encompassing individual phonemes or syllables. This cognitive process involves retaining phonological representations in working memory for brief durations, enabling individuals to execute tasks like reproducing a sequence of spoken numbers or syllables. Individuals with dyslexia consistently exhibit impairments in this domain (Melby-Lervåg et al., 2012; Snowling & Melby-Lervåg, 2016), and these difficulties appear to extend to broader linguistic skills, including grammatical abilities (Robertson & Joanisse, 2010). In a recent investigation, van Witteloostuijn et al. (2021) assessed children with and without dyslexia using measures of phonological memory (digit

span, nonword repetition) and revealed that both measures contribute to individual differences in grammatical performance.

Rapid naming is a cognitive ability that necessitates the retrieval of phonological codes stored in long-term memory. Individuals with dyslexia frequently demonstrate slower and less fluent naming speed in rapid naming tasks when compared to typical readers. Denckla and Rudel (1976) and Wolf and Bowers (1999) emphasized the correlation between deficits in rapid naming and dyslexia, proposing that impaired automatization of naming skills may impede the efficient retrieval of phonological representations essential for fluent reading.

When considering the three cognitive abilities in relation to reading skills, phonological awareness and rapid naming exhibit stronger correlations with reading compared to phonological memory (Melby-Lervåg et al., 2012; Kudo et al., 2015). In fact, tasks involving phonological awareness and the rapid naming of digits and letters show a greater resemblance to reading tasks compared to tasks assessing phonological memory (Wagner et al., 2022). Consequently, deficits in these abilities can be interpreted as correlates, rather than causes, of poor reading. To address this, family risk studies have been conducted, allowing for the measurement of phonological processing before the onset of literacy. A review by Snowling & Melby-Lervåg (2016) covering 95 studies examining children at family risk of dyslexia revealed that these children experience delays in language acquisition and the development of phonological awareness.

In summary, individuals with dyslexia consistently demonstrate significant and pervasive challenges in the realm of phonology. These challenges extend to their phonological awareness, phonological memory, and rapid naming – essential skills for the acquisition of reading. Importantly, these difficulties persist consistently across various age groups, languages, and orthographies (Caravolas, 2022).

4.2 Morphological awareness

Morphological awareness, as defined by Carlisle (1995), pertains to the capacity to comprehend and manipulate the smallest units of meaning, namely morphemes. The initiation of this process generally occurs around 18 months of age; however, its complete mastery necessitates a protracted and gradual developmental trajectory (Clark, 1982). Different morpheme functions are assimilated at disparate rates and developmental stages (Nagy et al., 1993). Gender and number represent the initial inflectional features acquired, with derivational forms following suit at a later developmental stage. Notably, in the initial years of life, this knowledge is spontaneous and lacks organization, constituting what is termed epilinguistic knowledge. Only in subsequent years, particularly during formal education and literacy acquisition, does this knowledge transform into actual "awareness" (Diamanti et al., 2018; Duncan et al., 2000). The acquisition of inflectional morphology typically transpires within the initial years of formal instruction, while derivational morphology tends to emerge around the fourth grade (or an extensive review refer to Diamanti et al., 2018).

When it comes to dyslexia, morphological awareness has frequently been identified as an element of difficulty besides the main phonological deficit. Impairments in morphological awareness have been documented in dyslexia across languages with different levels of transparency, such as Italian (e.g., Melloni & Vender, 2022), Greek (e.g., Giazitzidou & Padeliadu, 2022), French (e.g., Casalis et al., 2004) and English (e.g., Breadmore & Carroll, 2016). More particularly, research has indicated that children with dyslexia have poorer performance than their typically developing peers on inflectional, derivational, and compounding morphology (Breadmore & Carroll, 2016; Casalis et al., 2004; Rothou, 2012; Vender et al., 2017; Melloni & Vender, 2022).

Jimenez et al. (2004) conducted a sentence completion task focusing on gender and number agreement, revealing that children with dyslexia performed significantly worse compared to controls matched for both age and reading age. Additionally, Joanisse et al. (2000) identified weaknesses in dyslexic children's application of past tense agreement and pluralization rules when compared to controls. Vender

et al. (2017) observed difficulties in applying pluralization rules to nonwords within the morphologically complex context of Italian nominal inflection. A recent investigation by Vender and Melloni (2022) further substantiated the general impairment of morphological skills in children with dyslexia. They employed Berko's Wug test, which includes tasks requiring the manipulation of nonwords to replicate precise morphological rules, such as generating plurals, verb inflections, deverbal forms, and evaluative nouns. This approach using nonwords effectively isolates morphological skills from vocabulary, offering a measure of the ability to apply morphological rules.

Concerning adults, the available findings are mixed and primarily pertain to university students. In a study by Martin et al. (2014), the performance of university students with dyslexia in tasks related to both phonological and morphological awareness was compared with controls matched for chronological age and reading level. Despite exhibiting impairments in phonological skills, individuals with dyslexia outperformed controls at the same reading level in morphological awareness tasks and nearly reached the proficiency of their chronological age controls. This dissociation between phonemic and morphemic abilities in university students with dyslexia is also noted by Cavalli et al. (2017), where no significant between-group differences were found in morphological knowledge. Furthermore, in a study by Vender & Delfitto (*in prep.*)[1], 45 adults with dyslexia and a control group were assessed on tasks involving nonword pluralization, past participle production, and suffix choice. While no between-group differences emerged in the pluralization task, students with dyslexia performed significantly lower in the other two tasks. Hence, challenges in verbal and derivational morphological domains appear to endure into adulthood.

A recent study by Redolfi et al. (*in prep.*)[2] suggests that adults with dyslexia may derive greater advantages from the presence of derivational suffixes compared to typically developing controls. The study employed eye tracking methodology to observe participants reading a text that incorporated nonwords containing coherent derivational suffixes. The group with dyslexia exhibited briefer and less

[1, 2] The preliminary results of this study have been presented at the XXXI Airipa Conference, Università di Foggia, September 2023.

frequent fixations on these target nonwords, indicating a heightened reliance on morphological information. In another investigation, Law et al. (2015) underscored the significance of morphology in the reading process of individuals with dyslexia by revealing a more pronounced interaction between word reading skills and morphological awareness in the group with dyslexia than in typically developing controls.

The impact of morphological awareness on reading fluency is widely recognized and operates through various pathways (Levesque et al., 2021). Firstly, morphemes encompass multidimensional information, including phonological, orthographic, syntactic, and semantic aspects (Kirby & Bowers, 2017). According to Perfetti (2007), the linkage of these diverse layers of information enhances lexical quality, storage, and retrieval. Secondly, the semantic content and visual similarity of morphemes can facilitate reading, eliciting top-down processes (Nation, 2009). Additionally, the presence of morphemes reduces the number of reading units that need processing, thereby accelerating lexical access (Deacon, 2008). This phenomenon appears to be particularly pronounced in languages with transparent orthographies, such as Italian (Burani et al., 2002), Greek (Grigorakis & Manolitsis, 2019), Portuguese (Freitas et al., 2018), Spanish (Suárez-Coalla et al., 2017), Dutch (Rispens et al., 2008), German (Görgen et al., 2021), and Hebrew (Shechter et al., 2018). The facilitation of morphological skills in reading fluency was experimentally demonstrated by Arnbak & Elbro (2010), who implemented a morphological awareness training that proved beneficial for a group of reading-impaired young adults in spelling skills and in reading words and texts.

For these many reasons, despite evidence indicating challenges in morphological skills among individuals with dyslexia, several studies have proposed that morphological awareness could serve as a strength for individuals with dyslexia (Burani, 2010; Casalis et al., 2004; Deacon et al., 2019), potentially mitigating the reliance on phonological skills. Notably, Vender and Melloni (2022) pointed out that morphological difficulties in dyslexia are sensibly more evident when dealing with nonwords, supporting the role of morphological and lexical knowledge as a compensation mechanism (see also Section 4.3 of this Chapter). In fact, people who lack strong phonological abilities, as in the case of dyslexia, are more

inclined to use morphemic awareness as a compensatory technique to address their difficulties in reading and spelling (Vender & Melloni, 2022).

Burani et al. (2008) discovered that a group of 6th graders with dyslexia relied on morphological cues in reading words and pseudowords in a manner akin to a group of younger children (2nd-3rd graders). Consequently, the authors suggest that those who had not fully developed whole-word processing mastery (i.e., young children and children with dyslexia) lean more on morphological parsing during reading. Arnbak & Elbro (2010) identified positive effects on morphological awareness tasks, reading comprehension, and spelling in 4th and 5th graders with dyslexia who underwent morphological awareness training. The aforementioned study by Redolfi et al. (*in prep.*) suggests a similar pattern in adults with dyslexia, representing the first to offer online measures. Participants with dyslexia exhibited facilitation, characterized by fewer and shorter fixations on nonwords containing morphological information via meaningful suffixes, compared to the control group.

While this body of research points to challenges in morphological awareness tasks for individuals with dyslexia, it is noteworthy that, in contrast to phonological skills, morphological skills follow a more protracted developmental trajectory. Moreover, individuals with dyslexia seem to employ morphological abilities as a compensatory mechanism to navigate their more prominent reading difficulties (Melloni & Vender, 2022).

4.3 Lexico-semantic skills

Lexico-semantic skills in individuals with dyslexia have been extensively investigated due to their close connection to literacy (Cain & Oakhill, 2011). In fact, comprehension necessitates the understanding of words and the integration of their meanings into a coherent mental model (Stafura & Perfetti, 2017). The Simple View of Reading (Gough and Tunmer, 1986) posits that text comprehension involves two distinct yet interconnected processes: word reading (decoding) and language comprehension. In dyslexia, the decoding component is compromised, resulting in less fluent and

accurate reading compared to age-matched typically developing peers. According to the Simple View of Reading, decoding and comprehension are largely distinct, and their synergy is indispensable for proficient reading. More recently, this model has been extended to comprehend reading difficulties (Oakhill et al., 2014). It posits a "double dissociation" between word decoding and language comprehension, suggesting that each component can manifest independently. In dyslexia, word reading is typically characterized as "poor", while language comprehension is deemed "good". Challenges in reading comprehension are often viewed as secondary consequences of deficient decoding. Conversely, individuals identified as "poor comprehenders" struggle with reading comprehension despite possessing robust word reading skills and no apparent language or cognitive impairments (Oakhill et al., 2014, p. 6). Thus, both individuals with dyslexia and poor comprehenders display deficiencies in language comprehension, albeit for different reasons (Table 1).

	Language comprehension	
Word reading	Poor	Good
Poor	Generally poor reader	Dyslexic
Good	Poor comprehender	Good reader

Table 1. Simple View of Reading as schematized in Oakhill et al. (2014).

Some scholars argue that these difficulties may cause diminished reading experience, subsequently hindering lexico-semantic abilities. The International Dyslexia Association used to define dyslexia by stating that spelling and decoding issues may lead to reduced reading experience, impacting vocabulary growth and reading comprehension. In line with this view, Huettig et al. (2018) compared individuals with dyslexia to illiterate people, finding similar cognitive impairments, suggesting a shared factor – potentially, a lack of reading experience. However, contrasting views emerged, with scholars identifying early issues in lexico-semantic abilities in children at familial risk of dyslexia (Song et al., 2015; van Viersen et al., 2017), indicating differences in lexical system development that challenge the "reduced reading experience" perspective.

4.3.1 Vocabulary

A fundamental component of oral language skills and reading performance is vocabulary knowledge (Guo et al., 2011). Vocabulary skills can be assessed using two measures: vocabulary breadth and vocabulary depth (Ouellette & Beers, 2010; Ouellette & Shaw, 2014). Vocabulary breadth quantifies the number of known words, while vocabulary depth provides a qualitative measure, considering the precision of word knowledge and its placement within the lexical network (Read, 2004; Webb, 2013). However, many studies on vocabulary knowledge in individuals with dyslexia have merged these two measures, hindering a clear understanding of the issue (Cavalli, 2016).

Snowling and Melby-Lervåg (2016) conducted a meta-analysis revealing that vocabulary issues in children with dyslexia become more pronounced after entering school. Studies involving children at familial risk of dyslexia identified between-group differences in vocabulary size already at 17-19 months (Chen et al., 2017; Koster et al., 2005), 30 months (Lyytinen et al., 2004), and 6 years of age (Caglar-Ryeng et al., 2019). However, primary impairments were noted in phonological awareness, phonological short-term memory, and rapid retrieval of phonological forms. While it is plausible that phonological skills influence novel word learning, the Lexical Restructuring Theory (Metsala & Walley, 1998) posits that vocabulary growth is crucial for phonological representation development.

The longitudinal investigation conducted by Lyytinen et al. (2001) demonstrated that children at familial risk of dyslexia exhibit a receptive vocabulary comparable to children without familial risk, but deficiencies are evident in expressive language. Consistent findings of specific expressive vocabulary issues have been affirmed by other studies (Caglar-Ryeng et al., 2020; van Viersen et al., 2018). In a more recent longitudinal study, van Viersen et al. (2017) initially compared children without familial risk of dyslexia to a group at familial risk, subsequently dividing the latter into those who developed dyslexia and those who did not. The results indicated no differences in receptive or expressive vocabulary development between the groups without dyslexia, even when one was at familial risk. Within the group with dyslexia, expressive vocabulary lagged at 17 months, while receptive vocabulary was lower at 23 months, revealing distinct developmental trajectories. Consequently, early vocabulary skills do not appear

to reliably predict dyslexia, given their low developmental stability (Duff et al., 2015). The specific challenges with expressive vocabulary may stem from factors such as the age of assessment, familial history of dyslexia (Pennington, 2006), socioeconomic variables (Lyytinen et al., 2001; Tamis-LeMonda et al., 2001), or insufficient early exposure to print materials (Montag et al., 2015).

Several studies reported that differences in vocabulary knowledge between people with dyslexia and typically developing peers increase after school entry and persist in young adulthood (Swanson, 2012; Swanson & Hsieh, 2009). Differences in vocabulary size seem to increase over the school years, but only if age-matched peers are taken as control group. If groups are matched on reading age, then the disparity seems to be reduced (Wolf & Segal, 1999).

When it comes to adulthood, the picture becomes more controversial. Cavalli et al. (2016) assessed both vocabulary depth and breadth in 20 university students with dyslexia, who performed at the same level as controls in the vocabulary breadth task. Interestingly, they were significantly better in the vocabulary depth task. Neither measure correlated with reading habits assessment, thus excluding a role of reading exposure. The authors pointed out to three possible hypotheses. The first is related to the transparency (i.e., grapheme-phoneme correspondence) of French, which may reduce decoding efforts and facilitate vocabulary performance. The second is based on Ramus and Szenkovits' (2008) suggestion that the phonological deficit in dyslexia results from impaired access to phonological forms, rather than from inaccurate phonological representations. The last one relates to the type of assessment, in which university students with dyslexia may have activated particular cognitive strategies, the majority of them having received remedial teaching for more than three years. Some adults with dyslexia may also draw on vocabulary knowledge to compensate for weak decoding (Snowling, 2000). The study by Cavalli et al. (2016) offers insights into the strengths of individuals with dyslexia, although caution is warranted due to the limited number of participants and the exclusive inclusion of university students, representing well-compensated adults with dyslexia.

Despite yielding mixed conclusions, these studies collectively indicate that dyslexia should not unequivocally be linked to vocabulary deficits (Snowling & Hulme, 2012). The lexical profile of

individuals with dyslexia does not seem compromised to the extent of constituting a pervasive and consistent distinctive deficit in their communicative profile. Despite exhibiting a smaller vocabulary size than their typically-developing peers, especially during development, the depth of their vocabulary does not appear to be impaired, potentially exerting a positive influence on word reading (Cappelli, 2022). This would be further explained and expanded when taking semantics into consideration.

4.3.2 Lexical dimension of semantics

It is widely recognized that semantics and phonology hold a reciprocal relationship within the mental lexicon (Li et al., 2004; Savill et al., 2017; van Rijthoven et al., 2018). Consequently, numerous research studies have delved into how semantic knowledge may underpin the development of phonological skills and alleviate working memory demands, especially in the context of dyslexia (Betjemann & Keenan, 2008; Hennessey et al., 2012; Nobre & Salles, 2016; Rasamimanana et al., 2020; Robichon et al., 2002; van der Kleij et al., 2017; van Goch et al., 2014). This notion is encapsulated by the "semantic compensation hypothesis" (Cavalli et al., 2016; Elbro and Arnbak, 1996; Haft et al., 2016), which posits that individuals with dyslexia leverage their semantic abilities to compensate for phonological deficits.

In a word learning task, Savill et al. (2017) observed a reciprocal relationship between the semantic and phonological systems, demonstrating that semantic knowledge aids in the recall of phonological information. Notably, individuals with dyslexia may employ their semantic knowledge in oral reading to enhance fluency (Rose & Rouhani, 2012). Van der Kleij et al. (2019) utilized a picture-word priming task to investigate phonological and semantic priming effects in children with dyslexia. The data revealed that only semantic priming effects were more pronounced in children with dyslexia compared to typically developing peers, and these semantic priming effects predicted word and pseudoword reading efficiency. This finding might explain why some adults with dyslexia attain high levels of reading comprehension despite the persistence of phonological deficits (see Section 4.5 of this Chapter). Interestingly, they appear to allocate greater resources to semantic information than proficient readers (Robichon et al., 2002).

Relying to a greater extent on semantic compensation rather than on phonological skills, however, comes with inherent costs: processing becomes slower, and the cognitive resources available for text comprehension become constrained (Deacon et al., 2019; Breznitz & Meyler, 2003; Schiff et al., 2019). Subtle semantic processing differences have been detected in people with dyslexia through eye tracking and electrophysiological research, both at word (Jednorog et al., 2010; Rüsseler et al., 2007) and at whole sentence (Egan et al., 2023; Schulz et al., 2008) levels. Rasamimanana et al. (2020) employed event related potentials (ERPs) to assess the semantic ability of university students with dyslexia. Data revealed discernible between-group differences in the scalp distribution of the N400 component, a reliable index of semantic processing (Kutas and Hillyard, 1980). At the same time, behavioral data indicated comparable accuracy to the control group. This suggests that participants with dyslexia might necessitate more neural resources to execute semantic tasks, something that points to semantic compensation rather than to semantic deficits (Cappelli, 2022).

Other insights on semantic skills in dyslexia come from research on word learning. In fact, people with dyslexia are as efficient as controls in learning concepts, referents and associations of newly learnt words (Xiao & Ho, 2014), but they need more meaningful encounters to do so. According to the Fuzzy-trace Theory (Reyna, 2012), two distinct memory traces are created while processing a new word: the verbatim trace represents the surface form, while the gist trace represents the semantic properties. Issues with one of the two components may cause inefficient word retrieval. In the case of dyslexia, impairments have been shown in memory of verbatim traces, while gist traces were preserved and well developed, even more than in controls (Miles et al., 2006; Obidziński & Nieznański, 2017). When we learn a word, we store it in semantic networks inside our mental lexicon (Collins & Loftus, 1975), in which clusters of words are created based on semantic relatedness (Hills et al., 2009; Mengisidou et al., 2020).

In assessments of semantic fluency, individuals are tasked with naming as many words as possible within a specific category within a limited time frame (e.g., car brands, fruits, and animals in 3 minutes each, as in the Italian version by Novelli, 1986). The evaluation involves assessing the number of clusters and their size. Results regarding semantic fluency tasks in dyslexia are varied, as noted in Cappelli (2022):

some studies indicated that individuals with dyslexia scored lower than typically developing controls in these tasks (Mengisidou et al., 2020; Reiter et al., 2005; Varvara et al., 2014), while others found no differences (Brosnan et al., 2002; Landerl et al., 2009; Marzocchi et al., 2008). However, an interesting observation arises when the lexical items produced in semantic tasks are qualitatively analyzed. Despite the size of clusters (i.e., the number of words produced) being comparable between groups, individuals with dyslexia exhibited a lower number of clusters (Cappelli, 2019; Mengisidou et al., 2020; Mielnik et al., 2015). This indicates a distinct organization in the semantic network. According to the Retrieval-Slowing Model (Rohrer et al., 1995), lexical retrieval is facilitated by richer semantic connections. Thus, the challenges in lexical retrieval often observed in dyslexia may stem from the presence of fewer semantic clusters rather than a deficient semantic structure (Cappelli, 2022).

In conclusion, people with dyslexia seem to have well-preserved semantic skills. Issues have been observed primarily in the cognitive demands associated with semantic processing. Furthermore, they might lean on the semantic aspect of language to compensate for phonological impairments in reading.

4.4 Sentence processing skills

Investigations into sentence processing in dyslexia are limited (Stella & Engelhardt, 2021) and often intertwined with the overlap of this disorder and specific language impairment (SLI; Bishop & Snowling, 2004; Catts et al., 2005; McArthur et al., 2000). Various studies have indicated challenges in comprehending complex syntactic structures in dyslexia. These difficulties may stem from a general weakness in language processing (Tunmer & Hoover, 1992) or cognitive factors such as limited working memory capacity (de Jong, 1998; Kibby et al., 2004). As discussed in relation to lexico-semantic skills, some scholars also propose that issues with complex syntactic structures could be attributed to reduced reading experience (e.g., Stanovich, 1991).

There is no consensus on whether individuals with dyslexia exhibit impairments in sentence processing and comprehension beyond difficulties in single-word decoding (De Luca et al., 1999; Hyönä

& Olson, 1995). What is certain is that comprehending sentences necessitates the ability to integrate words into meaningful phrases, extracting compositional meaning – a task considerably more intricate than single-word reading (Stella and Engelhardt, 2021). Complex sentence structures impose a working memory load that seems to play a dominant role in comprehension deficits in dyslexia (Wiseheart et al., 2009). Increase in semantic complexity place demands on working memory capacity (Gibson, 1998) especially if the linguistic units are distant. This is the case of certain constructions that are derived by syntactic movement, such as passive or relative clauses (Cardinaletti et al., 2022). Interestingly, these two types of structures are the most frequently studied in relation to dyslexia.

4.4.1 Passive clauses

Ferreira (2003) demonstrated that proficient readers occasionally misinterpret unambiguous sentences featuring noncanonical order, such as passives where the subject and object positions are inverted. The comprehension of passive constructions, requiring the reassignment of thematic roles, imposes a significant cognitive load on working memory. Wiseheart et al. (2009) conducted a study to evaluate the comprehension of both active and passive sentences in a group of adults with dyslexia. Participants were presented with pictures depicting the same two actors in reverse roles and were tasked with determining the image corresponding to the sentence being read. Response time and accuracy were recorded. The group with dyslexia exhibited significantly lower accuracy and marginally slower response times in passive sentences compared to the control group. The disparities in response times were predominantly associated with working memory, which was included as a covariate in the analysis. As suggested by Linderholm et al. (2009), individuals with low working memory capacity demonstrate reduced proficiency in self-monitoring reading comprehension. Consequently, Wiseheart et al. (2009) concluded that the slower reaction times observed in the group with dyslexia may be attributed to the additional time required for self-monitoring.

Another investigation, involving Italian-speaking adults with dyslexia, was conducted by Cardinaletti and Volpato (2015). They evaluated the comprehension of passive sentences using a picture matching

task, where participants selected the correct option (out of three) after hearing the sentence. In this study, the reading component was avoided. Transitive reversible actional and non-actional passives were employed. All ten participants in the study achieved maximum accuracy in comprehending actional passives, with only two participants scoring lower on non-actional passives. Due to the limited number of participants and the absence of a control group, definitive conclusions cannot be drawn. However, it appears that passive sentences do not pose significant comprehension difficulties for adults with dyslexia. Challenges might arise when reading of more complex passive constructions is involved, potentially causing a working memory overload. To the best of our knowledge, data for children with dyslexia without specific SLI are not available. Wiseheart et al. (2009) suggest that studies with adults and age-matched controls can provide a "valid, albeit, stringent, alternative for examining the complex relationship between language processing and literacy disorders" (p. 154), minimizing the possible confounding variables of literacy experience and comorbid language disorders.

4.4.2 Relative clauses

In relative clauses, there is an increased distance between linguistic units that need to be integrated, something that may cause processing load (Gibson, 1998). Parsing sentences with relative clauses requires the subject to be held in working memory until the main verb is encountered (Wiseheart et al., 2009). In the case of sentences with center-embedded object-relative (OR) clauses (e.g., *The man that the woman is pulling pulls the dog*) the canonical order is disrupted by the dual assignment of thematic roles, while in sentences with center-embedded subject-relative (SR) clauses (e.g., *The man that is pulling the woman pulls the dog*) the thematic role of agent is assigned to the subject in both the main sentence and in the relative clause (Just & Carpenter, 1992). Therefore, OR sentences place more demands on working memory than SR ones, because "with two roles, the speaker must maintain two competing thematic assignments for the same noun and determine which thematic role applies within each clause" (Wiseheart et al., 2009, p. 153).

In a sentence repetition task that included relative clauses structures, Mann et al. (1984) found that children with dyslexia had a poorer performance compared to typically developing peers. The authors attributed this weakness to a limited working memory capacity, even if they did not provide a working memory assessment. Smith et al. (1989) followed up on this study using a token test methodology. Differences were not found between the dyslexia and the control group because the presence of toys helped in assigning the thematic roles, and therefore reduced the working memory load. The authors concluded that the difficulties found in previous studies might be more related to working memory capacity than to syntactic processing ability.

Wiseheart et al. (2009) tested young adults with dyslexia also on subject and object relative clauses, both in center-embedded and right branching position (see Table 2).

Relative position	**Relative type**	**Examples**
Center-embedded clauses	Subject relatives	The man that is pulling the woman pulls the dog
	Object relatives	The man that the woman is pulling pulls the dog
Right-branching clauses	Subject relatives	The man is leading the woman that is pulling the dog
	Object relatives	The man is leading the woman that the dog is pulling

Table 2. Examples of relative clause sentences by position and type (Wiseheart et al., 2009).

Participants had to decide which of the two pictures they were presented with corresponded to the sentence they read. The group with dyslexia had a lower comprehension accuracy compared to controls on all sentences containing relative clauses. Interestingly, location (center-embedded, right-branching) had a higher influence on accuracy than type (subject, object). Participants with dyslexia were less accurate on center-embedded clauses than on right-branching ones, irrespectively of the type. Interestingly, after controlling for working memory, group differences were reduced, suggesting a role of this cognitive ability in the process. In fact, thematic role assignment seems not to be an element of difficulty in dyslexia,

since performance on right branching sentences of both types was not significantly different across groups.

Cardinaletti and Volpato (2015) tested ten university students with dyslexia with an agent selection task based on Volpato (2010). Pictures with the two referents performing opposite actions were presented to participants. For example, if the sentence *Touch the rabbit that the mouse hits* was pronounced, two pictures with either the mouse or the rabbit in the action of hitting were showed. Results showed that accuracy in comprehension was comparable with that of a control group of adolescents without dyslexia, and significantly inferior to age-matched controls. No individual differences measures were considered.

A study by Stella and Engelhardt (2021) expanded previous findings by providing online processing measures and a larger experimental group (50 adults with dyslexia). Their aim was also to identify the source (i.e., working memory or verbal intelligence) and the location of processing difficulties. In fact, according to Gibson (1998) difficulties are located at the verb, "as there is a 'storage cost' that slows processing while the long-distance dependency is unresolved" (Stella and Engelhardt, 2021, p. 4); by contrast, expectation-based theories (Hale, 2001; Gennari & MacDonald, 2008) suggest difficulty at the relative noun. Stella and Engelhardt (2021) monitored eye movements of adults with and without dyslexia while reading subject and object relative clauses. They found that people with dyslexia had a comparable comprehension accuracy to controls, despite showing longer first pass reading times, longer total reading times and longer regression path durations. No effects were found in relation to sentence type (subject-object) nor with any of the cognitive measures (verbal intelligence and working memory). Stella and Engelhardt (2021) attribute the difference in findings compared to Wiseheart et al. (2009) to the fact that only well-compensated university students were included in their study. However, eye movements suggested that processing difficulty was related to individual differences in working memory, "in particular holding the extracted constituent in memory rather than retrieving the constituent at the moment the relative verb in encountered" (Stella and Engelhardt, 2021, p. 16). Overall, eye movements analysis supports theories that assume that processing difficulties in relative clauses are linked to memory-

based processing. Thus, syntactic processing seems not to be a specific issue related to dyslexia, while working memory capacity clearly is.

4.5 Text comprehension skills

Reading transcends the mere decoding of words and sentences; it involves the integration of these elements into a coherent text structure, as it was claimed by the Simple View of Reading (Gough and Tunmer, 1986; see Section 4.3 of this Chapter).

Both longitudinal and cross-sectional studies indicate that the roles of decoding and linguistic comprehension in reading comprehension undergo changes over time (Adlof et al., 2006; Foorman et al., 2018; Tilstra et al., 2009; Torppa et al., 2016). Decoding skills tend to exert a more substantial influence during childhood, while linguistic comprehension emerges as a stronger predictor in adulthood. Nevertheless, in the context of dyslexia, adults still demonstrate deficits in single-word recognition (Bruck, 1992; Lefly & Pennington, 1991), phonological processing (Bruck, 1992; Wilson & Lesaux, 2001), and rapid automatized naming (Cancer & Antonietti, 2018; Decker, 1989; Felton et al., 1990).

While these deficits might imply that poor text comprehension results from weak single word reading, consensus on this matter is still elusive. Influential studies on reading comprehension in typical populations (e.g., Baddeley et al., 1985; Bell & Perfetti, 1994) underscore the significant contributions of oral language skills, vocabulary, and general knowledge to comprehension abilities (Ransby, 2003; Kendeou et al., 2016), along with cognitive factors such as executive functions (Follmer, 2018). Working memory, for example, enables the processing and retention of information while integrating prior knowledge (Cain et al., 2004). Individuals with dyslexia often manifest weaknesses in executive functions and working memory (Brosnan et al., 2002; Smith-Spark et al., 2016), suggesting potential challenges in text comprehension.

Findings from existing literature present a mixed picture: certain studies indicate challenges in reading comprehension among individuals with dyslexia (Ferrer et al., 2015; Swanson & Ashbaker, 2000), while

others find no distinctions between clinical and control groups (Goulandris et al., 2000; Miller-Shaul, 2005; Parrila et al., 2020). A recent meta-analysis (Georgiou et al., 2022) suggests that individuals with dyslexia "experience significant difficulties in both reading and listening comprehension, but the effect sizes are smaller than those reported in the literature for word reading and spelling", and that "deficits in reading comprehension are likely a combination of deficits in both decoding and oral language skills" (Georgiou et al., 2022, p. 204). This confirms the observed weaknesses in broader language skills in prior studies (Adlof & Hogan, 2018; Snowling et al., 2020), with larger effect sizes in reading comprehension (g = 1.43) compared to listening comprehension (g = 0.43).

However, another meta-analysis, specifically focusing on the adult population with dyslexia and reading-related linguistic skills conducted by Reis et al. (2020), reveals significant differences in all reading and writing tasks (range: $1.735 \leq d \leq 2.034$), except for reading comprehension (d = 0.729). This suggests that some adults with dyslexia may develop compensatory strategies for their language impairments (Birch & Chase, 2004; Deacon et al., 2012; Parrila et al., 2007; Pedersen et al., 2016). It is noteworthy that the majority of adults recruited as participants in experimental studies are university students, who are more likely to employ such compensatory strategies.

In summary, the relationship between weaknesses in linguistic abilities and text comprehension, and whether they are consequences or co-occurring factors with decoding deficits in individuals with dyslexia, remains unclear.

4.6 Pragmatic skills

Pragmatic competence, defined as the ability to use and interpret language appropriately in context (Domaneschi & Bambini, 2020), has been a subject of interest in dyslexia research. Although earlier reviews from the 1980s onwards highlighted communication and social skills issues in dyslexia (McLoughlin et al., 2002; Riddick et al., 1997; Wallach & Liebergott, 1984), comprehensive assessments of pragmatic skills in individuals with dyslexia are relatively recent and still limited. Challenges in this

domain might manifest as inaccurate perceptions and interpretations of events (Chinn & Crossman, 1995) and disorganized speech content (Riddick et al., 1997).

Pragmatic behavior involves the contribution of multiple cognitive and neural resources, including attention, memory, and Theory of Mind abilities (ToM; Bambini et al., 2011). Previous discussions have delved into attention and memory deficits in dyslexia, emphasizing them as weaknesses associated with the disorder. ToM, the capacity to attribute mental states to oneself and others (Frank, 2018), is crucial for understanding beliefs, intentions, thoughts, and emotions, directly impacting pragmatic abilities in communication.

A study by Cardillo et al. (2018) investigated pragmatic and ToM skills in children with dyslexia, specifically those with associated language difficulties. In comparison to an age-matched typically developing control group, children with dyslexia exhibited poorer performance in the Metaphor and Implicit Meaning Comprehension subtests of the APL Medea battery (Lorusso, 2009) and a verbal ToM task from the Italian version of the NEPSY-II battery (Korkman et al., 2007; Urgesi et al., 2011). The ToM task focused on considering other people's points of view. These tasks were able to predict, with 52% accuracy, whether a child belonged to the dyslexia group. The authors attributed these findings to weaknesses in inhibiting literal meanings and drawing inferences from written texts.

Lam and Ho (2014) and Ferrara et al. (2020) employed the Children Communication Checklist second edition (CCC-2; Bishop 2003, Italian version by Di Sano et al. 2013), a standardized parental checklist designed to assess pragmatic and social communication skills, where respondents rate the frequency of specific behaviors on a 4-point scale. Both studies identified pragmatic difficulties in individuals with dyslexia.

Lam and Ho (2014), focusing on Chinese-speaking children with dyslexia, observed challenges in structural language skills and a reduced Pragmatic Language composite score. The primary difficulties were noted in inappropriate initiation of discourse and inefficient use of context. These findings were attributed to issues in processing semantic and syntactic elements of complex pragmatic tasks, compounded by deficits in working memory and automatization.

In the study by Ferrara et al. (2020) involving an Italian sample, a distinction was made between children with dyslexia with and without associated language disorders. Interestingly, those without associated language disorders scored lower than the other group in the Pragmatic Language composite score, the Social Interaction Deviance composite score, and the non-verbal communication subscale. The authors suggested that children with dyslexia without associated language disorders faced challenges primarily in social competencies, pragmatic abilities (such as idiom comprehension, irony, and sense of humor), and managing conversations in peer groups. Conversely, the Pragmatic Composite Score of children with dyslexia and associated language disorders was comparable to that of the typically developing group. Similar findings were reported by Kumari et al. (2016), who used Prutting and Kittchner's (1987) Pragmatic Protocol. They observed that the group with dyslexia without comorbidities performed worse than the group with dyslexia and concurrent learning disorders (dysgraphia and dyscalculia) in non-verbal communication tasks. Ferrara et al. (2020) proposed that these differences might stem from early intervention, as associated co-morbidities, especially language disorders, are often diagnosed more readily and at an earlier age compared to dyslexia alone. However, further research is needed to explore this issue.

Griffiths (2007) and Cappelli et al. (2018) investigated the pragmatic skills of adults, specifically university students, with dyslexia. Griffiths (2007) used four subtests from the Right Hemisphere Language Battery (RHLB; Bryan, 1995) and the Dyslexia Adult Screening Test (DAST; Fawcett and Nicolson, 1998). Findings indicated challenges in humor and metaphor comprehension, as well as in drawing inferences from a story among students with dyslexia. The authors hypothesized that these pragmatic tasks might demand elevated cognitive effort for processing. Similarly, Cappelli et al. (2018) employed the Batteria sul Linguaggio dell'Emisfero Destro SantaLucia (BLED; Rinaldi et al., 2006) and APACS, a pragmatic assessment tool for Italian (Arcara & Bambini, 2016). Participants with dyslexia scored lower in all APACS subtests, with 36% performing below the cut-off. Notable difficulties were observed in figurative language and an interview task. The more challenging BLED subtests involved figurative language, humor comprehension, and inference making. Significant correlations between

APACS scores and assessed cognitive measures were observed for reading, vocabulary, and working memory tests, but not for ToM. Hence, challenges in pragmatics appear to be "related to defining features of the dyslexic profile, such as reading and vocabulary abilities, as well as working memory" (Cappelli et al., 2022; p. 254).

Overall, pragmatic issues have been consistently identified in various studies, encompassing both children and adults with dyslexia. It is plausible that these challenges arise from more fundamental language abilities, such as lexical access and working memory, which impose an additional cognitive load when processing pragmatic content. This, in turn, results in difficulties in integrating contextual information, inferring figurative meaning, and engaging in conversation.

5. DYSLEXIA ACROSS THE LIFESPAN

During the 1990s, a growing body of research started to investigate how dyslexia evolved after development (e.g., Everatt et al., 1997; Lefly & Pennington, 1991). The question was whether adults with dyslexia continued to experience difficulties with reading and spelling despite years of education and remediation. The initial studies did not take into account other cognitive functions, and concluded that reading and spelling problems persisted into adulthood. A broader range of skills was investigated by Hatcher and colleagues (2002), namely literacy, processing skills, phonological skills, verbal fluency, verbal and non-verbal abilities. Adults with dyslexia resulted to be weaker in all skills except the general cognitive abilities assessed with the Wechsler Adult Intelligence Scale Vocabulary and the Raven Matrices. In the subsequent years, other smaller-scale studies were conducted, and Swanson and Hsieh (2009) collected them in a meta-analysis. Callens and colleagues (2012) combined the results in Swanson and Hsieh (2009) and in Hatcher and colleagues (2002) (a study that was not included in the meta-analysis) and revealed that the main difficulties were related to writing, reading and phonological processing skills. Moreover, the retrieval of information from long-term memory was weaker in adults with dyslexia than

in those without dyslexia. No differences were identified on general intelligence, problem solving, cognitive monitoring, perceptuo-motor skills, auditory and visual perception. Interestingly, adults with dyslexia outperformed controls in visuo-spatial memory. A study of Callens and colleagues (2012) further extended the previous meta-analysis with a large sample of university students with dyslexia, drawing similar conclusions. This research involved Dutch-speaking adults, overcoming the anglo-centrism of previous studies. In the Italian context (for a review see Montesano & Valenti, 2020), longitudinal studies confirm that difficulties in phonetic skills and reading persist into adulthood (Lami et al., 2009; Dellai et al., 2014). However, in transparent orthographies (i.e., where there is a consistent and predictable correspondence between letters and their corresponding sounds in words) such as Italian, reading speed is a more reliable measure than reading accuracy (Tressoldi et al., 2001). Franceschini et al. (2018) pointed to a peculiar visuo-spatial attention in a sample of Italian adults with dyslexia: in an orthographic processing task, inhibition of return (i.e., "the delay in responding to stimuli displayed in a cued location after a long cue-target interval" (Franceschini et al., 2018, p.1)) was measured and suggested that adults with dyslexia have a particularly efficient visual word form area. Interestingly, people with dyslexia – especially adults – may tap into their strengths to overcome reading difficulties, developing the so-called "compensation processes".

5.1 Compensation processes

Adults with dyslexia that manage to achieve good reading accuracy while remaining less fluent are usually referred to as individuals with "compensated" dyslexia (Shaywitz et al., 2003). However, this term has been criticized by some (e.g., McLoughlin et al., 2013) because even though there might exist more or less effective forms of compensation, the core phonological deficits and slowness of processing tend to endure (Kemp, Parrila, & Kirby, 2009), being that dyslexia is a neurobiological, permanent, disorder.

Regarding compensation processes, several studies have demonstrated that individuals with dyslexia tend to employ their strengths, such as visual processing, to compensate for deficient skills. For instance,

it has been observed that children with dyslexia exhibit significantly faster visual processing abilities compared to other groups (Ellis, McDougall, & Monk, 1996). Some studies have pointed to the fact that adults with dyslexia seem to rely on morphological cues while reading to increase fluency and accuracy (see Section 4.2 of this Chapter). For instance, a study conducted by Law et al. (2015) observed that adults with compensated dyslexia exhibited better performance in morphological awareness tasks compared to adults with uncompensated dyslexia, underscoring the significant role of this skill in dyslexia compensation mechanisms. These findings are further supported by Cavalli et al. (2017), who compared the performance in tasks of phonological and morphological awareness among a group of French university students with and without dyslexia. The results confirm the persistence of phonological deficits in individuals with dyslexia while revealing adequate morphological awareness skills, which could serve as a crucial foundation for fostering the development of strategies to compensate for reading difficulties.

Moreover, adults with dyslexia tend to develop better lexico-semantic skills which make them more equipped to cope with reading difficulties (Hanley, 1997). Recent research (Wiseheart & Altmann, 2017) corroborates this finding, examining sentence production skills among university students with dyslexia. The study reveals that even if individuals with dyslexia are slower and less accurate compared to the control group, those with higher vocabulary scores exhibit better performance in sentence production tasks, serving as a protective/compensatory factor that counterbalances working memory weaknesses. Other studies (e.g., Cavalli, 2016) proposed that unimpaired lexico-semantic skills could act as a compensatory strategy to overcome the persistent reading difficulties in adulthood (see Section 4.3 of this Chapter).

It is important to remember that adults with dyslexia confront with university and work environments that demand sophisticated skills, predominantly centered on literacy. Individuals in their late 20s and 30s (and even more, those of an older age) likely did not receive targeted assistance during their education, as understanding of dyslexia was limited until the past two decades. Consequently, alongside inherent compensatory mechanisms, tailored training programs designed to address the specific needs of adults with dyslexia play a crucial role in offering additional support for the enhancement of their literacy skills.

5.2 Effectiveness of reading interventions in adulthood

A recent systematic review conducted by Vender et al. (2022) shed light on the efficacy of literacy interventions for adults with dyslexia. While previous reviews primarily focused on children with dyslexia (e.g., Galuschka et al., 2014; McArthur et al., 2018) and consistently advocated for interventions emphasizing phonemic awareness, the automatization of grapheme-phoneme correspondences, and reading fluency, the study by Vender et al. (2022) extended this examination to adults. Reviewing the available eight studies for this population, the authors affirmed that reading interventions can be beneficial for adults with dyslexia. Notably, phonological-based interventions were the most frequently employed among adults, featuring multisensory instruction that resulted advantageous for improving decoding skills, especially in handling nonwords. Trainings on the application of grapheme-phoneme conversion rules were particular useful in languages with opaque orthographies, such as English (Eden et al., 2004; Guyer & Sabatino, 1989; Greenberg et al., 2011; Sabatini et al., 2011).

Enhanced efficacy in word and text reading accuracy was observed when training encompassed both phonological and morphological interventions, as exemplified in the study by Gray et al. (2018). Notably, even a brief and implicit morpheme-focused training, as the one implemented by Bar-Kochva (2016), yielded significant improvements in real word reading (large effect size) and passage reading (medium effect size). Morpheme-based interventions demonstrated effectiveness across languages with varying morphemic complexities, including Hebrew (Bar-Kochva, 2016), English (Gray et al., 2018), and Italian (Vender, *in prep.*)[3]. Encouraging explicit training in morphological awareness for adults is recommended, particularly considering its transferability, which proves beneficial in handling low-frequency words and in the process of acquiring new vocabulary. It is worth noting, however, that the studies did not report improvements in reading fluency.

[3] The results of this study have been presented at the conference "Accessible and inclusive practices in instructed Second Language acquisition" (ASLA), Università di Verona, December 2022.

Sabatini et al. (2011) demonstrated effective fluency training through the repeated reading methodology, involving the repeated reading of texts after initial modeling by the teacher. Positive outcomes were also achieved with the reading acceleration training method (Breznitz et al., 2013; Horowitz-Kraus, 2016), which imposes time constraints on the reading process. Reading inherently involves swift information processing but is also influenced by working memory. In fact, Shiran and Breznitz (2011) addressed both verbal and visuo-spatial working memory in their training, succeeding in enhancing the accuracy and fluency of word and nonword reading, as well as longer passage reading and comprehension. Significantly, only those interventions reporting gains in fluency demonstrated improvements in comprehension (Shiran & Breznitz, 2011; Sabatini et al., 2011; Breznitz et al., 2013), underscoring that "reading accurately but too slowly can indeed hinder the comprehension process" (Vender et al., 2022).

Another training that put emphasis on both increased reading speed and adequate comprehension levels is based on the SuperReading method (Cole, 2009). This approach highlights metacognition and emotional components, incorporating a specific reading practice known as eye-hopping. In eye-hopping, readers traverse texts printed in close columns, moving their eyes from the middle of one column to the middle of the other, synchronized with the movement of their index finger. Cole (2009) suggests that this technique enhances the ability to capture more words at a single glance. While the SuperReading method was not initially designed for individuals with dyslexia, some studies have investigated its efficacy within this population (Cooper, 2009, 2012; Santulli & Scagnelli, 2017; Scagnelli et al., 2018). Results indicate that the training is beneficial for both reading speed and comprehension. However, additional evidence is needed to establish its effectiveness, as pre- and post-standardized assessments were only available in Scagnelli and colleagues (2018).

Existing research underscores the value of literacy interventions for adults with dyslexia, especially when addressing various reading components and cognitive abilities. Notably, interventions solely focused on extensive or self-paced reading have been found to be ineffective, with the exception of the SuperReading method (although further evidence of its effectiveness is needed).

Importantly, these interventions should be flexible and adaptable to accommodate the diverse cognitive and linguistic profiles observed among adults with dyslexia, as discussed in this introductory chapter.

6. CONCLUSIONS

In this initial chapter, an introduction to developmental dyslexia was outlined. The intricate nature of this disorder makes it challenging to define, and its etiology remains largely unclear. The second part of the chapter delved into the cognitive aspects that exert the most influence on language skills in dyslexia, encompassing phonology, rapid naming, working memory, and inhibition. This discussion laid the foundation for outlining the linguistic profile of individuals with dyslexia, revealing a remarkable degree of heterogeneity. While there is broad consensus that dyslexia involves a spectrum of differences in linguistic abilities extending beyond reading and phonological challenges, these differences exhibit variations in severity and distribution. Moreover, dyslexia seldom manifests in isolation; rather, it emerges through a complex interplay of neurobiological, cognitive, and environmental factors. Consequently, delineating the "boundaries" of dyslexia and pinpointing its distinctive features remains a complex task.

At the word-level, individuals with dyslexia appear to employ compensatory processes to overcome processing challenges. Despite constraints in manipulating morphemes and exhibiting reduced morphological awareness, both children and adults with dyslexia seem to depend on these elemental units of meaning to enhance reading speed and mitigate decoding difficulties. This pattern extends to vocabulary knowledge and semantic skills. While several studies have identified a smaller vocabulary size in individuals with dyslexia, they appear to have preserved vocabulary depth and intact – albeit differently organized– semantic clusters. This adaptive organization may facilitate quicker access to meaning during reading, even in the presence of decoding deficits.

At sentence-level, individuals with dyslexia encounter difficulties with syntactically complex structures, particularly those involving syntactic movement. These challenges appear to stem more from limitations in working memory capacity than from inherent issues with syntax, a phenomenon evidenced by online measures like eye-tracking.

Upon transitioning to the text level, the previously outlined components converge, resulting in a multifaceted scenario. Specific elements, such as general knowledge and oral language skills, contribute significantly to the overall process of reading comprehension. While experiments using longer texts offer a closer approximation to real-life reading tasks, they present challenges in precisely measuring diverse processes occurring simultaneously. Evidence from various studies and meta-analyses suggests that difficulties in reading comprehension are more prominent in children than in adults with dyslexia, the latter potentially engaging compensatory processes.

In general, despite the persistent challenges associated with decoding, adults with dyslexia are believed to leverage their strengths and develop effective strategies. Empirical evidence supports the utility of reading interventions for adults, underscoring the potential benefits derived from targeted and adaptable reinforcement of linguistic skills. Additionally, it has been observed that individuals with dyslexia may experience compromised pragmatic competences, emphasizing the importance of considering these aspects when formulating specific training programs and instructions.

The insights derived from research studies should be useful for practitioners actively engaged with dyslexia-related issues. Furthermore, the collaborative contributions from linguistics and psycholinguistics – encompassing theoretical, experimental, and applied dimensions – alongside inputs from diverse disciplines, contribute to a progressively deeper and more nuanced understanding of dyslexia. This includes the refinement of participant profiles and diagnostic criteria in experimental studies. Thus, a multidisciplinary approach is paramount in advancing our comprehension of dyslexia, fostering more effective interventions and tailored support for individuals dealing with this condition.

CHAPTER 2

Underlying processes of metaphor comprehension

ABSTRACT

This chapter describes the main theories of metaphor comprehension. The way in which we access the figurative meaning and the role of the literal features in the time-course of metaphor comprehension will be discussed. Highlighted are the contributions of context and of metaphor intrinsic characteristics, such as aptness, novelty, conventionality, and familiarity to comprehension processes. Studies that consider the neural component of metaphor comprehension will be introduced, as well as those that point to individual cognitive and linguistic abilities required to understand different types of metaphors. After a review of the few studies available on metaphor comprehension in dyslexia, the main hypotheses that will guide the current research project will be presented.

1. THEORIES OF METAPHOR

Before the latter half of the twentieth century, the examination of metaphors was primarily led within the domains of literature and rhetoric, rather than linguistics or psychology. This perspective traces back to Aristotle, who viewed metaphor as a form of comparison between different domains, and to the interpretations of his works provided by Cicero and Quintilian. Only in the 20th century, the literary critic Richards (1936) and the philosopher Black (1962) provided the first systematic analysis on the structure of metaphor. They pointed out that a metaphor consists in the interaction between a tenor or *topic* (what

is been referred to) and a *vehicle* (the concept used metaphorically to characterize the topic). For example, in a metaphor such as "That lawyer is a shark", a lawyer (the topic) is described as a shark (the vehicle) to emphasize his or her aggressiveness. In later years, modern linguistics and psychology realized that metaphor is pervasive in our daily communication and in the way we perceive the world (e.g., Lakoff & Johnson, 1980). Building on previous accounts, several different theories of metaphor comprehension tried to explain how we access the figurative meaning and which variables might influence this process.

1.1 Literal first views

Traditionally, the field of pragmatics concentrated on metaphor as an example of the difference between what is said and what is meant. According to Grice (1991) people in conversation are mutually expected to be informative, truthful, relevant, and clear in what they say. Figurative language, however, entails uttering something false: for instance, in the statement (1), the speaker aims to convey the meaning in (1a) by saying something factually inaccurate (i.e., the lawyer is not an actual shark).

(1) My lawyer is a shark.

a. My lawyer is aggressive.

Given the assumption that speakers are cooperative, when one or more maxims of conversation are violated, listeners are expected to derive an appropriate "conversational implicature" about what the speaker intended to communicate in a specific context. Thus, if the speaker utters (1), the listener, after recognizing the falseness of the proposition literally expressed, infers that the speaker meant to ascribe shark-like qualities to his lawyer through a transfer of meaning (Grice, 1991). The listener initially computes the truth-conditional meaning of an utterance, then evaluates it on the basis of contextual information and subsequently reinterprets it.

This theorization was later adapted by psychologists into a processing hypothesis, leading to the development of the standard pragmatic models of metaphor comprehension (Clark & Lucy, 1975; Searle,

1979, 1993). This model proposed that literal meaning takes precedence over metaphorical meaning: receivers first derive the literal meaning, then assess it within the context of the utterance, and – if it does not fit the context – look for an alternative, nonliteral, interpretation. Specifically, this conventional pragmatic model posits that metaphors are comprehended through a three-stage process, encompassing: (i) decoding the words of the utterance and generating a literal interpretation; (ii) considering contextual information and rejecting the literal interpretation as contextually inappropriate (iii) inferring an alternative, non-literal interpretation that is more suitable for the utterance's context. Consequently, metaphors such as (1) are initially recognized as literally false class-inclusion statements, and their meaning is then rejected to find a more appropriate non-literal interpretation. From this we can derive that, unlike the processing of the literal meaning of an utterance, processing its metaphorical interpretation is considered optional, as it could be disregarded, allowing one to adhere to the literal interpretation without delving further. The primary implication of this model is that the comprehension of figurative language demands more time and effort compared to literal language. This was confirmed by Janus & Bever (1985), who reported longer reading times for sentences used metaphorically rather than the same sentences in a literal context. More recently, Bambini et al. (2013) found out that judging the meaningfulness of metaphorical sentences takes nearly 200 milliseconds more than judging the meaningfulness of literal sentences.

1.2 Direct access views

The standard pragmatic model of metaphor comprehension faced criticism from both theoretical and empirical perspectives (e.g., Carston, 2012; Glucksberg et al., 1982; Gibbs, 1984; Recanati, 2004; Wilson & Sperber, 2012). In fact, several experiments have shown that metaphor comprehension do not necessarily require more time to be reached than those of literal meaning. According to the direct access hypothesis advanced by Gibbs (1990), if the context is supportive enough, it is not necessary to analyze the complete literal meaning before accessing what speakers want to communicate. Gibbs compared the processing of short shories that ended either with a metaphorical sentence, a literal sentence containing

a synonym for the referent or a control one mentioning an irrelevant referent. Since reading times did not differ across the three conditions, the author concluded that metaphorical meaning is directly accessed with no additional processing cost.

Glucksberg and colleagues (1982) conducted several experiments aimed at showing the direct access (that they defined as "automatic") to metaphorical meaning. In a sentence-verification task, participants were asked to judge sentences as literally true or literally false. The task included four sentence types: (a) metaphors, such as "Some jobs are jails" and "Some flutes are birds"; (b) scrambled metaphors, such as "Some jobs are birds" and "Some flutes are jails", obtained by scrambling the nouns from the metaphor sentences; (c) literally true sentences (e.g., "Some birds are eagles"); and (d) nonsensical literally false sentences (e.g., "Some fish are eagles"). If processing of literal and non-literal meanings is simultaneous, then scrambled metaphors and literally true/false sentences would be quicker to judge than metaphors because they only have literal interpretations. However, Glucksberg et al. (1982) found that people took longer to categorize metaphorical sentences as literally false compared to scrambled counterparts. This delay is attributed to the simultaneous processing of literal and non-literal meanings, creating interference that needs resolution before judging the sentence. This phenomenon is known as the Metaphor Interference Effect (MIE; see Chapter 4 for its application to a sample of people with dyslexia) and indicates that metaphorical meaning is automatically computed even in tasks that do not explicitly require it, leading to interference with literal-meaning judgments and generating a response conflict. The research conducted by Glucksberg and colleagues, challenging the precedence of literal meaning and the initial formulations of categorization processes, contributed to the formulation of the Dual Reference theory. This theory posits that the meaning of a metaphoric vehicle undergoes spontaneous alteration to refer to a category with a higher level of abstraction, of which the metaphoric vehicle is considered a prototypical member (Glucksberg, 1989, 2008; Glucksberg et al., 1997; Glucksberg & Keysar, 1990; Glucksberg & McGlone, 2001). The entire expression is comprehended as a category statement, signifying that the metaphoric topic is perceived as a member of the category represented by the vehicle. Consequently, a novel ad-hoc abstract category is generated; hence, processing a metaphor like "My lawyer is a shark"

involves the formation of an abstract category of 'vicious predators', while suppressing the literal properties associated with sharks (Glucksberg, 2008).

Another model that emphasize the importance of ad hoc categorization processes in metaphor understanding is that proposed in the framework of Relevance Theory (Sperber & Wilson, 2008). According to this theory, there is no specific process that distinguish figurative language from the rest of the linguistic phenomena: metaphors are alternative ways to achieving optimal relevance, and their comprehension depends on the mutual adjustment of content, context, and cognitive effects in order to satisfy the overall expectation of relevance. According to the authors, there is no evidence that the literal meaning is tested first. Instead, they are understood with online processes of loosenings or narrowings of lexical concepts. In loosening processes we make the *ad hoc* concept's denotation larger, while in narrowing ones we add constraining information to make their denotation smaller. The processes of narrowing and loosening play a crucial role in meaning construction, enabling the interlocutor to create an *ad hoc* concept encompassing the relevant meaning for the context. From a processing perspective, this implies that literal meaning aspects are accessible early in the process and remain active throughout metaphor comprehension, something that will provide the basis for the development of hybrid accounts of metaphor comprehension.

1.3 Hybrid accounts

While the consensus leaned towards the rejection of sequential models of metaphor, hybrid processing models emerged and began to be juxtaposed to direct access views. A study conducted by Noveck et al. (2001) replicated Gibbs (1990)'s experiment and yielded different results: reading stories with a metaphorical ending required more time than reading those with a literal ending. This finding suggests that metaphorical sentences may incur processing costs even within supportive and rich contexts. Noveck and colleagues argued that Gibbs' experiment lacked the sensitivity to detect a significant difference, and furthermore, it did not adequately consider the influence of context and of metaphor characteristics.

Further hypotheses were later advanced by other authors. A compromise between literal first and direct access views was proposed by Giora (2003) with the Graded Salience hypothesis. According to the author, there are two processes that occur in parallel: a bottom-up one allows to select from the mental lexicon the meaning of lexical items based on their salience (i.e., more familiar meanings are accessed first); a top-down process allows to evaluate the appropriateness to the context. When the meaning is compatible with the context, whether it is literal or metaphorical, the process stops with no further processing costs. When the most familiar meaning is not suitable to the context, then the processing continues, and reaction times are longer. Therefore, context plays an important role, but also metaphor familiarity does so. In the case of conventional metaphors, the metaphorical meaning is already stored in the mental lexicon, leading to rapid activation. In contrast, with novel metaphors, the salient literal meaning is accessed initially and is suppressed in later stages if it impedes the construction of the appropriate interpretation.

Another hybrid theory is the Career of Metaphor hypothesis, formulated by Bowdle & Gentner (2005). Considering the notion that novel metaphoric mappings can generate new word meaning, they contended that when a metaphor is initially encountered, one term undergoes structural enhancement relative to the other through analogy. In particular, the topic is lexically extended by the vehicle, and new abstract categories (thus, meanings) are created. Conversely, when a metaphor becomes conventionalized (i.e., integrated into language usage), it is comprehended through categorization processes. For instance, when the word 'shark' is metaphorically used for the first time to depict a lawyer, it necessitates analogical reasoning. However, with repeated exposure to this specific metaphoric vehicle (as per Bowdle & Gentner, 2005) or this specific topic-vehicle pair (according to Thibodeau & Durgin (2011), it is increasingly likely to be processed as a category statement due to the reinforced association between the vehicle's literal and figurative meanings. Consequently, the term 'shark' acquires the secondary meaning of 'aggressive' and it is processed akin to a polysemous word.

The role of literal components in metaphor processing was further explored by Rubio Fernández (2007), who conducted a cross-modal lexical decision experiment to investigate the proposition that

metaphor interpretation involves the amplification of pertinent properties related to the metaphor vehicle (loosening) while simultaneously inhibiting irrelevant ones (narrowing). After exposing participants to a metaphor biasing context (e.g., John hates physical contact), the metaphor "John is a cactus" prompted the activation of both literally related superordinate terms like 'plant' and distinctive features like 'spike' during the initial stages of interpretation. This observation lends support to the concept that the comprehension of novel metaphors necessitates the active suppression of irrelevant literal meaning. Building on these empirical observations, Carston (2010) postulated the persistence of literal meaning in the processing of figurative language in her Dual Route account. She argued that metaphors are understood with literal meaning aspects in mind, drawing on Relevance Theory. According to the author, there are two different routes to the understanding of metaphors: the first is a quicker and local process of online meaning adjustment, in which we recover the word meanings of the utterance; the second is a slower and more global appraisal of the overall meaning. Thus, both the lexical and the pragmatic component are needed to comprehend a metaphor.

The debate around what theory would be the most appropriate to describe the way we access the metaphorical meaning is still open, but it is now clear that there is not a single one can account for how all aspects of figurative language are understood. More insights came from neurofunctional research, that was able to overcome the limitations of behavioral data.

1.3.1 Neural components of metaphor comprehension

A meta-analysis of neuroimages studies conducted on metaphor comprehension (Rapp et al., 2012) revealed that brain activations occur in different areas, distributed in both left and right hemispheres. Particularly, metaphor comprehension seems to activate those brain regions that have the function to integrate linguistic and non-linguistic elements in the context of discourse, thus allowing to infer the intended meanings. The bilateral activation of frontal and temporal regions indicates that understanding a metaphor involves high-level language processes (i.e., the integration of background and contextual information) and cognitive processes that are not merely linguistics, such as executive functions and Theory of Mind (see Section 2 of this Chapter).

An instrument that was useful to determine the timing in which the figurative meaning is accessed and the role of literal features is the electroencephalogram (EEG), and specifically Event-Related Potential (ERP), the cerebral response to specific stimuli. Weiland et al. (2014) employed ERP in conjunction with masked priming, a highly time-sensitive method, aimed at testing whether we access the metaphorical meaning directly or if a passage from the literal meaning is required. Their results indicated that during the lexical access phase, irrespective of figurativity, the literal meaning is activated. Consequently, primes related to the literal meaning of the critical word facilitated lexical access, leading to a reduced N400. Additionally, masked priming data revealed that literal meaning aspects are initially accessible, regardless of contextual relevance. This contradicts theories positing that literal meaning plays no role or even has a detrimental effect on the processing of figurative expressions (e.g., Glucksberg, 2008; Sperber & Wilson, 2008). Instead, data align more with theories that incorporate the literal meaning in the processing of metaphors.

ERP was also used to determine the role of context in metaphor comprehension. Bambini et al. (2016) explored the roles of the N400 and the P600 components by presenting to participants metaphors in a minimal and in a supportive context. Interestingly, N400 was only visible in the minimal context, whereas the P600 was there in both conditions. The results of this study and of a similar one conducted on metonymy (Schumacher, 2014) revealed that the N400 is probably related to efforts due to the absence of a supportive context, when expectations about upcoming words are not matched. Instead, the P600 could reflect the derivation of the intended meaning, which capitalizes on context beyond the process of lexical access (observed in the N400 response).

To sum up, we have seen that each of the different theories we presented contribute to our knowledge on the way we access the metaphorical meaning. The main conclusions we can draw (Bambini, 2017) are that (i) in the same contextual conditions, we take more time to compute metaphorical rather than literal sentences; (ii) context can significantly reduce this gap; (iii) the timing of the process depends on the metaphor type. This third point will be covered in the next paragraph.

1.4 Different processes for different metaphors

A vast body of research attempted to reconcile the different theories of metaphor by proposing that distinct processes are required based on the intrinsic characteristics of metaphors.

First, metaphors can be placed on a continuum based on how frequently one has already encountered them in life. This scale ranges from novel metaphors, which have been never or rarely heard before, to conventional metaphors, which have been frequently encountered. In their Career of Metaphor hypothesis, Bowdle & Gentner (2005) describe the process of conventionalization of metaphors, which emerge as novel and their meaning gradually enters the use. Several neural studies identified different processes for the comprehension of novel and conventional metaphors. Arzouan et al. (2007) employed ERP to investigate the impact of novelty in metaphor processing. Findings from their semantic judgment task showed a linear increase in the N400 effect, progressing from literally related words to conventional metaphors, novel metaphors, and semantically unrelated pairs. This indicates that novel metaphors are "unexpected" and potentially require more effort to be understood.

Further insights were offered by Lai et al. (2009), who conducted an ERP study comparing brain responses to the same target word in various sentence types: anomalous, novel metaphorical, conventional metaphorical, and literal sentences. The ERP findings indicated that conventional metaphors elicited a brief additional processing effort compared to literal sentences, whereas novel metaphors necessitated a more sustained effort, akin to the effort observed in anomalous sentences. The distinctive processing patterns of conventional metaphors, differing from both literal and novel metaphors, suggest a comparison process that is in line with the Career of Metaphor Hypothesis. This process involves mapping to the target category from a literal base category rather than from a metaphoric one.

A different approach was employed by Mashal & Faust (2009), who used the divided visual field technique to test whether the conventionalization of novel metaphors is linked to a shift from right to left hemisphere processing. They created word pairs that consisted in novel metaphors, conventional

metaphors, literal expressions, and nonsensical expressions, which were presented in two distinct sessions. During the first session, novel metaphors interpretation was related to right brain regions, while in the second presentation (when they were more "conventionalized" to the hearer) there was no difference between the elaboration on the right and on the left hemispheres. Therefore, the degree of conventionality influenced the involvement of the two hemispheres, determining a more pronounced right hemisphere activity when processing novel metaphors.

A well-known theory that is crucially linked to metaphor conventionality is the one that pointed out that metaphor processing involves our sensory-motor system. This hypothesis is referred to as embodiment, and it was developed in the framework of Cognitive Linguistics, which studies the cognitive processes that are at the basis of metaphorical thinking. According to the Conceptual Metaphor Theory (Lakoff, 1993, 1994; Lakoff & Johnson, 1980; Lakoff & Turner, 1989), conventional metaphors stem from our patterns of thought. Mappings (i.e., correspondences) between two concepts are established based on how conventional they are in our human experience. Usually, conceptual mapping is activated between an abstract (i.e., the target domain) and a more concrete concept (i.e., the source domain). For instance, a conceptual metaphor such as ANGER IS HEAT, originate expressions such as "Burning with indignation" or "To be hot tempered", that allow to understand the abstract experience of rage through sensory feelings. Therefore, embodied cognition explains why certain metaphorical expressions seem to be grounded in our sensorimotor perception (Barsalou, 2010; Gibbs, 2005). The ongoing debate about the extent to which cognition is embodied extends far beyond the realm of metaphor. Evidence suggests that semantic representations are, to some degree, shaped by representations associated with perception and action (e.g., Andrews et al., 2009). In the context of metaphors, research indicates that sensorimotor input can impact their processing, leading to faster processing after making a relevant body movement (e.g., the sentence "push the argument" after a pushing movement, as demonstrated by Wilson & Gibbs, 2007). Additionally, neuroimaging studies have identified connections between brain areas related to sensorimotor processing and metaphor processing (Boulenger et al., 2009; Desai et al., 2013; Lacey et al.,

2012), possibly due to the linkage of sensorimotor experience with abstract concepts. However, according to these studies, as a metaphor becomes more familiar the involvement of sensorimotor areas decreases.

Familiarity is another influential factor in metaphor processing. Unlike conventionality, which depends solely on the vehicle, familiarity is associated with the entire sentence, particularly the topic-vehicle pair (Bowdle & Gentner, 2005). It has been shown that both familiarity and aptness have an influence on metaphor processing and recall. Aptness is defined as "the extent to which the vehicle captures important features of the topic" (Chiappe et al., 2003, p. 97). Through a cross-modal priming technique, Blasko & Connine (1993) observed a quicker activation of the figurative meaning in high familiar metaphors. Conversely, low familiar metaphors exhibited activation only if they also demonstrated a reasonable level of aptness. In another study, Blasko & Briihl (1997) monitored readers' eye movements and observed that high familiar metaphors were read more rapidly. However, they highlighted that familiarity might not necessarily confer a memory advantage in a sentence recall task. In fact, it was found that less familiar metaphors were relatively more memorable due to their novelty, potentially offsetting any advantage associated with familiarity.

Dulcinati et al. (2014) included familiarity and aptness into their examination of the Career of Metaphor theory. Their hypothesis posited that familiar metaphors, whether conventional or novel, should exhibit a preference for a categorization-based interpretative process, with aptness playing a role in the model. However, their results did not support the idea that conventionality or familiarity determined categorical form preference. In contrast, aptness emerged as a significant predictor of categorical form preference. Notably, a post-hoc analysis unveiled the role of another factor, named metaphor dominance, which indicates the frequency with which a word is used to convey a metaphorical meaning rather than its literal one.

To conclude, the ongoing debate regarding the processing of metaphors remains open, with occasionally conflicting results. The challenges in defining and assessing constructs such as metaphor aptness, conventionality, or familiarity contribute to this uncertainty. These constructs can be inherently ambiguous (as discussed by Gentner & Bowdle, 2008, in the case of aptness) or may require a departure

from subjective ratings, as suggested by Thibodeau & Durgin (2011). Recent studies have increasingly shifted focus towards individual differences in cognitive abilities rather than exclusively examining features inherent to the metaphor itself, as will be further discussed in the next section.

2. INDIVIDUAL DIFFERENCES IN METAPHOR COMPREHENSION

The comprehension of language is associated with individual differences in cognitive abilities, shaping how things are processed and understood. This association is particularly evident in conditions such as dyslexia, where deficits in specific cognitive skills can influence language comprehension, as discussed in Chapter 1.

The processing of figurative language varies among individuals, as highlighted by Blasko (1999) in an anecdote. He reports that, during a lecture, one of his students interpreted the sentence "For Freud, personality was an iceberg" as implying that Freud thought people's personalities were 'cold and hard' as ice, rather than understanding the more prevalent characteristic of an iceberg as 'something only partially visible'. This illustrates the variability in interpretative behaviors driven by individual differences. In fact, the complexity of metaphor comprehension imposes demands on several cognitive abilities.

In this section, we will describe those cognitive factors that have been extensively investigated in research on individual differences and metaphors. This overview is intended to establish a foundation for our examination of metaphor comprehension within the context of dyslexia.

2.1 Executive functions

Executive control plays a pivotal role in metaphor comprehension, a process that demands the retention of all semantic features pertaining to both the topic and the vehicle, while simultaneously inhibiting irrelevant ones. Consequently, scholarly investigations into the involvement of executive

functions in metaphor comprehension have specifically highlighted the roles of working memory and inhibition.

Working memory assumes a critical role in language comprehension as an active workspace that facilitates the execution of various processes and the transient retention of information (refer to Section 3.2.3 in Chapter 1 of this dissertation). Its relevance to metaphor comprehension is multifaceted (Olkoniemi et al., 2016): working memory is essential for activating and maintaining both literal and figurative interpretations during processing, as well as for selecting the salient meaning to be integrated into the context. A body of research consistently highlighted the correlation between higher working memory capacity and increased proficiency in interpreting metaphorical expressions.

A first study was conducted by Blasko (1999), who found that individuals with high working memory produced deeper, more detailed interpretations of metaphors. Consistently, Chiappe and Chiappe (2007) found that individuals with higher working memory spans generated better and quicker interpretations of metaphors and produced more apt metaphors than did individuals with lower working memory spans. Furthermore, they noted that the backward digit span task, involving the repetition of a series of numbers in reverse order, proved to be a more reliable predictor of the quality of produced metaphors than the forward digit span task, which requires the simple repetition of a series of numbers. This finding suggests that metaphor processing relies more on the active manipulation of meanings.

A similar finding was reported by Mashal (2013) who observed that the comprehension of both unfamiliar and familiar metaphors exhibited a correlation with digit span backward but not with digit span forward. The authors interpreted this outcome as evidence supporting the engagement of the central executive in metaphor comprehension. This involvement reflects the process of resolving semantic conflicts between the two domains or the suppression of irrelevant properties associated with the modifier term, as posited by Gernsbacher et al. (2001).

Olkoniemi et al. (2016) employed eye tracking to examine individual variations in metaphor processing. The findings revealed an association between working memory and the processing of metaphors, specifically influencing eye movement patterns. Individuals with lower working memory

capacity exhibited longer processing times, likely attributed to their tendency to look back at metaphorical sentences. The hypothesis posited suggests that these individuals encounter difficulties in suppressing prominent literal meanings, leading to the necessity of revisiting the metaphorical target sentence to refresh it in working memory for the validation of the metaphorical interpretation.

Pierce et al. (2010) analyzed the role of working memory in a Metaphor Interference Effect task (see Section 1.2 of this Chapter; Chapter 4 of this dissertation). This task involves participants judging a set of stimuli as either literally true or literally false, encompassing metaphors (e.g., "Some jobs are jails", "Some roads are snakes"), scrambled metaphors (e.g., "Some jobs are snakes"), and literal sentences. Typically, participants take longer to judge metaphors as literally false compared to judging scrambled metaphors as literally false, indicating automatic access to metaphorical meanings. This difference in response time is called Metaphor Interference Effect (MIE). Pierce et al. (2010) identified that the magnitude of the MIE is predicted by working memory capacity, wherein higher working memory results in a smaller MIE. This suggests that although metaphor comprehension is automatic, the early processing of metaphors can be regulated by executive mechanisms.

The task employed by Pierce et al. (2010) incorporated both working memory span and inhibitory control, involving the suppression of proactive interference. Participants were presented with sets of words sequentially on a computer screen and later had to recall the words in the set. Successful performance necessitated the suppression of words from earlier sets to prevent interference with memory for the current set. The authors underscored that measures of proactive interference are indicative of the ability to suppress unwanted thoughts (Verwoerd et al., 2009) as it happens in metaphor comprehension. In fact, inhibiting the literal meaning is necessary for constructing coherent semantic representations of the metaphorical sense. Additionally, essential properties linked with a metaphorical vehicle are activated during comprehension, while irrelevant ones are deliberately suppressed (Gernsbacher et al., 2001; McGlone & Manfredi, 2001). In the aforementioned study by Chiappe and Chiappe (2007), the role of inhibition in metaphor processing was also explored together with working memory. Inhibition was measured through inhibition errors on a working memory task, as well as performance on a Stroop task,

which entails suppressing irrelevant features of a stimulus. The findings suggested that inhibitory control significantly predicted metaphor processing, showing correlations with the speed and quality of metaphorical interpretations.

In conclusion, working memory and inhibition emerge as crucial elements in metaphor comprehension, with lower proficiency in these executive functions potentially resulting in slower or less accurate interpretations. As highlighted by Chiappe and Chiappe (2007), individuals with higher working memory spans possess greater cognitive resources to allocate to the inhibition task compared to those with lower spans. Notably, these two aspects appear intricately linked, as the capacity to inhibit potentially distracting information is contingent on working memory capacity.

2.2 Vocabulary and Semantic Skills

Several investigations have included assessments of vocabulary knowledge when exploring metaphor comprehension, recognizing that possessing an extensive repertoire of word representations might enhance the grasp of figurative meanings.

Metaphors necessitate individuals to perceive similarities between two entities typically regarded as distinct, often involving features that are not the most salient in either entity. Therefore, one must possess enough world knowledge and sufficiently broad semantic representations to grasp the intended comparison. Evans & Gamble (1988) investigated the role of semantic knowledge in metaphor comprehension by asking a group of children to list the salient features of metaphorical topics and vehicles. Six weeks later, the children were tasked with defining metaphors containing those topics and vehicles. The study revealed comprehension errors when children had initially provided incomplete or irrelevant information in the salient features list, showing that semantic representation might influence the way in which we process metaphors.

Verbal analogical reasoning is also deemed crucial in this context as it is linked not only to vocabulary knowledge but also to the ability to comprehend relationships between words. In an initial investigation,

Trick & Katz (1986) observed positive correlations between verbal analogical reasoning test scores and ratings of metaphor comprehensibility, particularly when the source and target were drawn from dissimilar categories. However, when vocabulary knowledge was measured, it did not add any predictive power. Similarly, Nippold & Sullivan, (1987) reported a relationship between perceptual analogical reasoning with both verbal analogical reasoning and the comprehension of metaphors. Verbal analogical reasoning, however, did not independently predict metaphor comprehension. In contrast, Kazmerski et al. (2003) reported that vocabulary skills predicted the quality of metaphor interpretation in their study. Similarly, a study by Chiappe & Chiappe (2007) identified a predictive relationship between vocabulary knowledge and the quality of metaphor production.

Stamenković et al. (2019) evaluated metaphor comprehension of college students, correlating their performance with measures of both fluid and crystallized intelligence. Fluid intelligence involves non-verbal reasoning about novel problems, and it is typically linked to analogical reasoning (Holyoak, 2012). In contrast, crystallized intelligence, related to verbal reasoning and drawing upon prior knowledge, is linked to lexico-semantic competences. Their findings revealed that each of the two measures had a distinct and separate predictive relationship with metaphor comprehension. Specifically, crystallized intelligence influenced metaphor comprehension across a wide spectrum of metaphor types, while individual differences in fluid intelligence primarily affected the comprehension of more cognitively complex metaphors, particularly those found in literary sources. According to their conclusions, vocabulary skills played a more pivotal role in metaphor comprehension than analogical thinking. Additionally, cognitive complexity was identified as establishing a stronger link to analogical reasoning, as analogical reasoning was specifically required for the comprehension of literary metaphors, aligning with the perspectives of Glucksberg & Haught (2006) and Kintsch (2000).

Moreover, they linked their findings with literature suggesting a more substantial impact of vocabulary skills compared to executive functions. They proposed that processing strategies might undergo changes during cognitive development, aligning with the expansion and refinement of lexical-semantic representations. For instance, Carriedo et al. (2016) observed a reduction in the reliance of

metaphor comprehension on executive functions from adolescence to young adulthood. Additionally, a neuroimaging study by Prat et al. (2012) revealed that, in adults, reading experience (likely associated with vocabulary growth and crystallized intelligence) exhibited a stronger correlation with the neural efficiency of metaphor comprehension than did working-memory capacity. Thus, some studies seem to suggest that vocabulary knowledge is key to metaphor comprehension, even more than executive functioning.

2.3 Theory of Mind

Theory of Mind (ToM) refers to the ability to comprehend the mental states of others. Its involvement in metaphor comprehension is intricate and not universally agreed upon (Bosco et al., 2018; Gernsbacher & Pripas-Kapit, 2012). Certain scholars propose that ToM skills are crucial, contending that grasping a metaphor necessitates understanding another person's perspective on the world (Happé, 1993). In contrast, others argue that ToM alone is not sufficient for the comprehension of metaphorical language (Norbury, 2005).

The foundational investigation on the role of ToM in metaphor comprehension was proposed by Happé (1993). She posited that metaphors, in contrast to similes, demand the interlocutor to infer the speaker's intention, given that the meaning is not literal. Happé tested this hypothesis using a sentence completion task encompassing synonyms, similes, and metaphors, involving participants on the autism spectrum disorder (ASD) with impairments in first-order, second-order, or both orders of ToM. First-order ToM involves inferring another person's mental states, while second-order ToM involves inferring another person's mental states about a third party (Duval et al., 2011). The group with impairments in both orders of ToM exhibited lower scores only in the metaphor condition. The other two groups did not show significant differences from each other. Consequently, Happé concluded that ToM is a prerequisite for understanding metaphors.

Norbury (2005) introduced a nuanced perspective, noting that the relationship between ToM and metaphor comprehension is not straightforward. She observed that children with language impairments

face challenges in understanding metaphorical language (Highnam et al., 1999; W. Rinaldi, 2000), despite maintaining relatively intact ToM abilities (Leslie & Frith, 1988; Shields et al., 1996; Ziatas et al., 1998). In her investigation, Norbury demonstrated that only children with language impairment, with or without concurrent ASD features, exhibited impairments in the metaphor task. Moreover, possessing first-order ToM skills did not guarantee metaphor comprehension, whereas semantic ability emerged as a more robust predictor of performance on a metaphor task. Consequently, she emphasized that semantic knowledge plays a central role, with ToM skills supporting metaphor understanding by contributing to a more robust contextual representation.

A recent study by Canal et al. (2022) reviewed the varied findings on the role of ToM in metaphor comprehension and identified a potential influence related to the type of metaphor under consideration. They specifically differentiated between physical and mental metaphors, where the former involves inferences about physical attributes (e.g., "Dancers are butterflies"), and the latter involves inferences about psychological attributes of the topic (e.g., "Teachers are lanterns"). Lecce et al. (2019) suggested that enhanced ToM skills are linked to a better understanding of mental metaphors, particularly in the early stages of middle childhood, while not necessarily impacting physical metaphors. This perspective is also supported by additional evidence indicating differential behavior in mental versus physical metaphors in children with ASD and associated ToM difficulties (Melogno et al., 2017).

Consequently, Canal et al. (2022) investigated the connection between ToM and physical/mental metaphors using Event Related Potentials (ERPs) in neurotypical adults. Their findings revealed a contribution of ToM skills to metaphor processing, manifested particularly in the N400 component. Importantly, this influence of ToM was observed in both mental and physical metaphors. However, the distinct role of ToM for mental metaphors appeared to be more temporally early (not necessarily greater) compared to its role in physical metaphors. Additionally, among various ToM components, emotion recognition emerged as involved in the processing of metaphors in general, exerting an early impact on mental metaphors.

In summary, while there appears to be a role of ToM in metaphor comprehension, the precise magnitude of its contribution remains to be fully clarified. This role extends beyond atypical populations with ToM impairments and has been observed in neurotypical adults, since metaphor comprehension is "a language phenomenon placed at the crossroad of social and perceptual experience" (Canal et al., 2022, p. 11).

3. HYPOTHESES ON METAPHOR COMPREHENSION IN DYSLEXIA

When it comes to developmental disorders, a complex set of characteristic features should be considered alongside the different theories of metaphor comprehension. Several studies have tried to explain the underlying causes of deficiencies in figurative language tasks in people with neurodevelopmental disorders (for a review, see Chahboun et al., 2021). As far as dyslexia is concerned, observed issues have been attributed to difficulties in language competence, such as vocabulary knowledge (Kasirer & Mashal, 2017; Cappelli et al., 2018), pragmatic skills (Cappelli et al., 2018; Griffiths, 2007) and Theory of Mind (ToM) impairments (Cappelli et al., 2018; Cardillo et al., 2018; Griffiths, 2007). Also, cognitive abilities such as working memory were considered (Cappelli et al., 2018).

Authors have shown that there are many ways in which people with neurodevelopmental disorders may experience figurative language difficulties, and that is very hard to discriminate between the effects of the disorder itself, and those of any presenting comorbid conditions (Chahboun et al., 2021).

3.1 State of the Art

To date, there are only four studies that address metaphor comprehension in people with dyslexia and most of them come from the field of pragmatics (see Table 1; cfr. Section 4.6, Chapter 1).

Paper	Participants	Age	Lang.	Batteries	Metaphor tasks
Griffith (2007)	20 (20 TD)	18-45 (range)	English	Right Hemisphere Language Battery RHLB (Bryan, 1995).	Metaphor picture test (picture selection); metaphor written test (multiple choice, aurally presented).
Kasirer and Mashal (2016)	18 (19 TD) 17 (18 TD) 17 (17 TD)	11.2 (mean) 14.29 22.82	Hebrew	Multiple-choice questionnaire (Mashal and Kasirer, 2011); concept-creation task (Kasirer and Mashal, 2014).	Conventional and novel metaphor comprehension (multiple choice) and generation.
Cardillo (2018)	21 (21 TD)	8-10 (range)	Italian	APL Medea battery (Lorusso, 2009).	Picture metaphors (picture selection); verbal metaphors (meaning explanation).
Cappelli et al. (2018)	19 (19 TD)	21 (mean)	Italian	APACS (Arcara and Bambini, 2016); BLED (Rinaldi et al., 2006).	Metaphor picture test (picture selection); metaphor written test (multiple choice); metaphors in short context (verbal explanation); multiple choice sentence matching task (figurative, literal and unrelated interpretation).

Table 5. Previous studies involving metaphor comprehension in developmental dyslexia. The label TD refers to typically-developing people included in the control groups.

Two studies (Cardillo et al., 2018; Lam et al., 2014) delved into the pragmatic abilities of children with dyslexia, revealing a diminished pragmatic competence within this group. Specifically, Cardillo et al. (2018) employed metaphor-related tasks and found that dyslexia could be predicted with 52% accuracy using a pictorial metaphor comprehension task from the APL Medea Battery (Lorusso, 2009) and the Theory of Mind task from NEPSY-II (Korkman et al., 2007). Challenges were specifically evident in understanding metaphors and also in implicitly extracting meaning from texts. The study proposed that individuals with dyslexia face difficulties in (1) inhibiting literal meaning and (2) constructing coherent semantic representations of the intended (metaphorical) meaning. Notably, even after controlling for reading and vocabulary skills, only the performance in the picture metaphor test remained statistically significant when comparing dyslexic and control groups. This led the authors to suggest that certain pragmatic difficulties in individuals with dyslexia might be directly linked to core areas of impairment, such as literacy, while also considering potential challenges in processing and integrating visual information (Li et al., 2009).

Two additional studies (Cappelli et al., 2018; Griffiths, 2007) expanded the examination of pragmatic skills in adults with dyslexia. Both studies utilized the Right Hemisphere Language Battery (RHLB) (Bryan, 1995), and Cappelli et al. (2018) also incorporated APACS (Arcara & Bambini, 2016), a standardized battery designed for evaluating pragmatics in Italian-speaking adults. Both assessments revealed impairments in pragmatic skills among the group with dyslexia, which exhibited lower scores in metaphor comprehension tasks. Griffiths (2007) observed that metaphor tasks (RHLB 1 and 2) posed similar challenges for both groups. However, when assessed with BLED (Rinaldi et al., 2006) – the Italian version of the RHLB – in Cappelli et al. (2018), individuals with dyslexia demonstrated significantly poorer performance than controls in the Picture Metaphor task, with a trend also noted in the Written Metaphor task. This study further indicated subpar performance by the group with dyslexia across all subtests of APACS, including Figurative Language 1 and Figurative Language 2. As a result, the authors suggested that metaphor comprehension is a significant challenge for young adults with dyslexia, especially when evaluated through an explanation task requiring verbalization of abstract meanings (Figurative Language 2). The challenge persists even in a multiple-choice task (Figurative Language 1). These tasks exhibited correlations with reading fluency and comprehension, vocabulary, and working memory.

At present, Kasirer and Mashal (2017) have conducted the sole study exclusively focused on metaphor comprehension in dyslexia. Their research delved into the comprehension and generation of metaphors across three age groups (children, adolescents, and adults) and explored the impact of executive functioning on metaphor processing. For assessing metaphor comprehension, they utilized a questionnaire developed by Mashal and Kasirer (2011). The questionnaire featured ten conventional metaphors (e.g., "A sharp tongue") and ten novel metaphors (e.g., "A pure hand"). Each metaphoric expression was followed by four alternatives: a correct metaphoric interpretation, a literal interpretation, an unrelated interpretation, and an option stating "This expression is meaningless". Participants were required to select one option from the four provided. Although the task was presented in written form, participants had the option of having the questionnaire read aloud to them, a compensatory measure that

none of the dyslexic participants in the adolescent or adult groups opted for. Significant group differences were only observed in children, who exhibited impairments specifically in conventional metaphor comprehension (with a medium-to-large effect size, $\eta^2 = 0.29$), but not in novel metaphor comprehension. In adults, neither group effects nor effects based on the type of metaphor were significant (i.e., $\eta^2 < 0.04$). The authors acknowledged some limitations related to presenting metaphors in a multiple-choice format, which might have facilitated comprehension by offering participants distinct and readily available interpretations.

Metaphor generation was evaluated using a concept-creation task devised by Kasirer and Mashal (2014). Participants were presented with ten concepts related to common emotions (e.g., feeling sad), and their task was to generate a new and original way to express the meaning. In this context, both children and adolescents with dyslexia exhibited similar performance to the control group. Intriguingly, adults with dyslexia outperformed the control group, indicating a small-to-medium effect size ($\eta^2 = 0.17$). The researchers further conducted regression analyses to identify the skills that best predicted metaphor comprehension and generation. Positive correlations were observed between verbal knowledge and mental flexibility and conventional metaphor comprehension. Additionally, non-verbal tests were positively correlated with mental flexibility and novel metaphor generation. The association between metaphor processing and mental flexibility, recognized as a component of creativity (Brockett, 1985), holds particular significance in the context of dyslexia, where such abilities are generally enhanced, especially in adults (Cancer & Antonietti, 2020; Majeed et al., 2021).

For the sake of completeness, it is worth mentioning a recent study of Egan et al. (2022) that employed eye tracking to gauge reading times of similes in adults with dyslexia. Sentences were manipulated for novelty (e.g., familiar: 'as cold as ice', novel: 'as cold as snow') and figurativeness (e.g., literal: 'as cold as ice' [low temperature], figurative: 'as cold as ice' [emotionally distant]). Participants with dyslexia encountered greater difficulty compared to the control group in processing novel similes, irrespective of idiomatic or literal conditions. Intriguingly, online eye tracking measures revealed that the challenge was more closely linked to novelty itself rather than figurativeness. Readers with dyslexia

exhibited shorter first-pass reading times for figurative interpretations. Consequently, these findings suggest a subtle semantic processing anomaly in handling unexpected or novel idiomatic phrases. However, the authors cautioned against generalizing these findings to other types of figurative language, such as metaphors, given that similes represent a form of figurative formulaic language with a highly predictable format.

3.2 Discussion

This brief literature review highlights some challenges in metaphor comprehension associated with dyslexia. Specifically focusing on children, all available studies concur that individuals with dyslexia exhibit lower performance in metaphor tasks compared to their peers without dyslexia. It is plausible that the ability to suppress the literal interpretation may not be fully developed in children with dyslexia, as evidenced by errors indicating a lack of integration of semantic and literal representations (Cardillo et al., 2018). Notably, Kasirer and Mashal observed difficulties specifically in conventional metaphors, those stored in the mental lexicon, and not in novel metaphors. Unfortunately, Cardillo et al. (2018) employed metaphors that were not normed for novelty (Lorusso, 2009); however, upon examining the stimuli, it becomes apparent that they primarily comprised highly conventional metaphors (e.g., "Anne's room is a pigsty").

As previously discussed, working memory and inhibition are necessary for efficient metaphor comprehension, and these functions are typically impaired in children with dyslexia, whose challenges with complex linguistic tasks are often correlated with deficits in executive functioning (Vender, 2017). Furthermore, individuals with dyslexia appear to develop compensatory mechanisms, relying on vocabulary and semantic skills, but this happens particularly in later stages of development. Before adulthood, reduced vocabulary and semantic skills may pose challenges for metaphor comprehension. This tendency is particularly evident in the difficulties identified with conventional metaphors, the meanings of which should already be encoded in one's mental lexicon. Kasirer & Mashal (2017) observed

a positive correlation between vocabulary and children's metaphor comprehension, indicating that an increase in vocabulary test performance is associated with improved metaphor comprehension. Conversely, insufficient development of vocabulary size in children may result in a lack of stored meanings needed for accurate metaphor interpretation.

In the context of novel metaphors, where the metaphorical meaning is constructed on-spot and relies less on pre-existing lexical knowledge compared to conventional metaphors, the ability to identify similarities among objects (i.e., analogy perception) and to accept multiple labels for the same referent (i.e., alternative naming) assumes critical importance. Di Paola et al. (2020) underscored the significance of these two competences in the understanding of metaphors among children. Interestingly, children with dyslexia are likely to exhibit these abilities, according to research that indicates heightened mental flexibility in individuals with dyslexia (Cancer & Antonietti, 2020). Nevertheless, this aspect warrants comprehensive investigation within the domain of metaphor processing.

In the case of adults, the scenario becomes less straightforward. As outlined in Chapter 1, dyslexia in adulthood assumes a more varied profile across individuals, with divergent cognitive and linguistic characteristics as well as compensatory mechanisms. This diversity is mirrored in metaphor comprehension, as indicated by three available studies on adults with dyslexia. Both Cappelli et al. (2018) and Griffiths (2007) identified significantly lower scores in adults with dyslexia across various metaphor comprehension tasks. This held true regardless of the task type, whether involving the comprehension of visual or verbal metaphors, the selection of meanings from multiple choices, or the provision of meaning explanations. Data available demonstrated correlations with critical factors for both metaphor comprehension and the dyslexic profile, including reading fluency and comprehension, vocabulary, and working memory. These findings led the authors to conclude that "understanding figurative language (metaphors, idioms, and proverbs) seems to be the main challenge for these individuals" (Cappelli et al., 2018, p. 302). However, it is crucial to note that the majority of these tasks encompassed both metaphors and more conventionalized idioms and proverbs, which, once again, rely more heavily on vocabulary

knowledge than novel metaphors. Unfortunately, data specific to novel metaphor comprehension are not provided in these two studies.

In Kasirer & Mashal (2017), the generation of novel metaphors emerges as a strength in the adult sample, and novel metaphor comprehension does not differ across groups in adults as well. In contrast, Egan's study on similes revealed a distinct difficulty associated with the novelty of items rather than figurativity. However, given that metaphors involve more implicit comparison and distinct processes compared to similes, the roles of novelty and figurativity warrant further exploration.

4. CONCLUSIONS

Based on these considerations, the current research aims to address a gap by examining novel metaphor comprehension in adults with dyslexia. While executive functioning impairments tend to persist in the majority of adults with dyslexia, compensatory roles of vocabulary and semantic skills may contribute to efficient comprehension.

Three studies are planned to investigate metaphor understanding in adults with dyslexia at different stages: Study 1 (Chapter 3) will employ eye tracking to explore metaphor processing and the deployment of visual attention while listening to metaphorical vs literal sentences, providing novel insights into online metaphor processing in dyslexia; Study 2 (Chapter 4) will replicate the Metaphor Interference Effect paradigm to analyze whether the metaphorical meaning is automatically activated in individuals with dyslexia; finally, Study 3 (Chapter 5) will investigate metaphors in context to identify any possible influence on overall text comprehension. Each study will include assessments of cognitive abilities closely related to dyslexia and metaphor comprehension to examine potential correlations with the specific tasks designed for this doctoral research.

The importance of unraveling the relationship between dyslexia and metaphor comprehension becomes apparent given the prevalence of metaphors in various forms of communication (Steen et al.,

2010). Metaphors constitute a substantial portion of daily discourse, ranging from casual conversations to more formal contexts, and understanding how individuals with dyslexia navigate this linguistic landscape has implications for both clinical understanding and educational strategies.

CHAPTER 3

Novel metaphors processing in dyslexia: evidence from eye tracking

ABSTRACT

The first study aimed to examine the processes involved in the comprehension of novel metaphors among adults with dyslexia. Individual factors such as rapid naming, vocabulary size, working memory capacity, and Theory of Mind were assessed. Employing the Visual World Paradigm, an online metaphor comprehension task was administered, using eye tracking technology. Metaphors and corresponding literal sentences were presented auditorily, and participants were tasked with choosing the image that most accurately represented the auditory input. Findings revealed that individuals with dyslexia exhibit a delay in metaphor processing, with observable differences in the allocation of visual attention as indicated by eye movements. Notwithstanding these distinctions, participants with dyslexia demonstrated comparable accuracy to the control group in selecting the intended meaning of the sentences.

1. INTRODUCTION

Metaphors have been subject of extensive investigation across various disciplines, with linguists, psychologists, and philosophers proposing diverse theories on the mechanisms underlying their comprehension (refer to Chapter 2 for an in-depth overview of metaphor theories). Recent research

studies have sought to establish connections between these theoretical frameworks and those individual differences that are crucial for processing and comprehending metaphors (Stamenković et al., 2019).

The processing of figurative language is not uniform across individuals. On one hand, individuals need adequate prior knowledge and linguistic competence to grasp a metaphor; studies employing Event-Related Brain Potentials (ERPs) have demonstrated that metaphor comprehension involves an initial phase of lexical processing followed by inferential operations (Bambini et al., 2016; Weiland et al., 2014). On the other hand, the mapping of shared features may rely on the active manipulation of complex multi-component structures, placing a substantial demand on executive functions and working memory (Cho et al., 2007; Menashe et al., 2020; Waltz et al., 2000). Prior research suggests that individuals with higher working memory capacity also exhibit more accurate interpretation of metaphorical expressions (Blasko, 1999; Chiappe & Chiappe, 2007; Olkoniemi et al., 2016; Pierce et al., 2010). Specifically, novel metaphors seem to require different processes compared to more familiar ones, tapping into executive control and vocabulary knowledge (see Chapter 2, Section 1.4). This is particularly relevant when it comes to disorders that affect cognitive and linguistic functions, as in the case of dyslexia.

The existing body of research provides a fragmented perspective, indicating that cognitive functions implicated in metaphor comprehension vary based on specific conditions (e.g., type of metaphor, individual differences), and linking metaphor processing to a singular component is not possible (Domaneschi & Bambini, 2020). Nevertheless, endeavors to elucidate whether individual differences associated with specific disorders influence metaphor comprehension are indeed necessary. Such investigations not only hold significance for understanding the impact of disorders on metaphor comprehension, but also contribute to unveiling the underlying cognitive abilities that play a role in (figurative) language comprehension.

2. CURRENT STUDY

The first study examines the processing of novel metaphors in individuals with dyslexia and explores the influence of individual differences in executive functioning on both online and offline metaphor comprehension. A comprehensive battery of cognitive assessments was administered, together with a metaphor comprehension task during which eye movements were recorded. Existing research on metaphor comprehension in dyslexia has predominantly focused on the written modality, with a notable absence in the exploration of online metaphor comprehension. Eye tracking was used during the metaphor comprehension task to address these gaps. Additionally, potential challenges arising from reading impairments were mitigated by presenting metaphors in the auditory modality. This involved representing distinct interpretations of the auditory sentence visually through various pictures.

Two main research questions were addressed:

1. Are there differences in metaphor processing in adults with dyslexia compared to a no-dyslexia age-matched group? (RQ1)
2. If so, what differences in cognitive resources are they related to? (RQ2)

Literature on cognitive abilities involved in understanding metaphors allows us to predict a possible processing difficulty of people with dyslexia. As mentioned above, cognitive abilities correlated with novel metaphor comprehension are (i) executive functions, such as working memory, where higher abilities predict more accurate and faster metaphor processing (Pierce et al., 2010); (ii) vocabulary knowledge, which promotes better metaphoric interpretations (Kazmerski et al., 2003); (iii) mental flexibility, which was frequently found to be positively correlated to metaphor understanding (Kasirer & Mashal, 2014; Mashal & Kasirer, 2011); (iv) Theory of Mind and pragmatic abilities, which may help in reaching a non-literal interpretation (Bambini and Resta, 2012; Norbury, 2005). In adults with dyslexia, executive functions are usually impaired, with poorer inhibitory control (Faccioli et al., 2008; Proulx and Elmasry, 2015), and lower working memory capacity (Cancer & Antonietti, 2018). Theory of Mind and pragmatic abilities also tend to be weaker in this population (Cappelli et al., 2018; Egilsdóttir, 2015).

Additionally, semantic processing of unexpected or novel idiomatic phrases seems problematic in adults with dyslexia (Egan et al., 2022).

However, certain challenges for individuals with dyslexia may be mitigated by the fact that they do not appear to have deficits in vocabulary knowledge (Cavalli et al., 2016; Rasamimanana et al., 2020). Moreover, there is evidence suggesting that they exhibit higher levels of mental flexibility, including creative skills, compared to typically developing controls (Cancer & Antonietti, 2020; Majeed et al., 2021).

To address Research Question 2 (RQ2), we evaluated participants' working memory, reading history, vocabulary knowledge, rapid automatized naming, and Theory of Mind. However, we did not assess mental flexibility and creativity due to the multifaceted nature of tasks associated with these constructs, often involving multiple measurements (e.g., fluency, flexibility, elaboration, and originality). Additionally, there is an ongoing debate regarding the reliability of such assessments (see Plucker et al., 2020; Sternberg, 2020).

3. METHODS

3.1 Participants

A total of 79 participants took part in the study, including 38 English native speakers with a diagnosis of dyslexia and no associated comorbidities (D) and 41 typically-developing English native speakers as control participants (C). Both groups were recruited from the University of East Anglia. After removing individuals who showed anomalous reaction times (2.5 SDs from the mean; see the "Results" section) the final samples included 36 participants (6M, 30F, mean age= 21.4, SD= 4.50) in the D group and 39 participants (8M, 31F, mean age= 21.1, SD= 4.53) in the C group. The two groups did not differ in age ($t= -0.352$, $p= 0.726$) or gender (χ^2 (1) = 0.18, $p =0.66$).

The study was approved by the School of Psychology Research Ethics Committee at the University of East Anglia (UK). Informed consent was obtained from all participants before carrying out the study and all were debriefed at the end of the study.

3.2 Individual difference assessment

All participants were tested individually before the eye tracking task. The standardised procedures of administration for each test were followed as described in the test manuals.

Rapid Automatised Naming. All participants completed both a letter and a number RAN test (Denckla and Rudel, 1976; Norton and Wolf, 2012) using the Comprehensive Test Of Phonological Processing (CTOPP 2). The RAN task requires participants to name four rows of nine letters or numbers sequentially out loud as quickly and accurately as possible. The time taken to complete the two arrays (letters and numbers) was recorded. Participants completed one practice row before each task. The score for each array was the total time needed to complete the task, and higher scores indicate worse performance. Letters and numbers were presented in Arial font (20 pt.) on an off-white A4 paper. The reliability of the CTOPP-2 subtests has been demonstrated by average internal consistency that exceeds .80.

Adult Reading History Questionnaire (ARHQ). Participants completed the self-report screening tool designed to measure risk of dyslexia in adults (Lefly & Pennington, 2000). The ARHQ is a screener and does not constitute a formal evaluation or diagnosis, but it is a way to assess participants' reading history and reading habits. Normative scores are based on actual testing and a good validity was demonstrated (Lefly & Pennington, 2000). The test was also used to identify any possible non-diagnosed people with dyslexia in the control group, together with other standardized measures.

Working Memory. Working memory was measured using the digit span tasks (i.e., digit span forward and digit span backward) from the 4th edition of the Wechsler Adult Intelligence Scale (WAIS-IV). In the digit span forward task, participants were given increasing sequences of numbers, and they were asked to repeat them back in the same order. In digit span backward, they had to repeat them back in reverse

order. In each task, the score was the total number of sets of digits that the participants could recall accurately.

Peabody Picture Vocabulary Test - 4 (PPVT-4). The PPVT-4 (Dunn and Dunn, 2007) is a tool to assesses receptive vocabulary. The researcher aurally presented a target word and participants were asked to choose the image, which best illustrated the meaning between four. The reliability range for Form A (the one used in this study) is reported to be from .89 to .97.

Faux Pas. This task (Stone et al., 1998) represents an advanced Theory of Mind (ToM) task. For understanding a faux pas (i.e., a social *gaffe*), a representation of cognitive and emotional states of the interlocutor is required (Li et al., 2013; Shamay-Tsoory et al., 2010; Stone et al., 1998). The extent to which the ability to understand other's mental states contributes to comprehend non-literal language (and metaphors, in particular) is not straightforward (Bosco et al., 2018; Gernsbacher and Pripas-Kapit, 2012): ToM may not be sufficient to comprehend metaphorical language (Norbury, 2005) but some scholars suggest that this process also involves understanding how another person sees the world (Happé, 1993). The original test includes 10 *faux pas* stories and 10 literal control stories. To avoid cognitive overload, we used a reduced version with a set of 10 stories (5 faux pas and 5 control) validated by Fernández-Modamio et al. (2018). This version was administered to control and clinical groups and showed good psychometric properties for both controls and patients: test-retest reliability of 0.97 and 0.78, inter-rater reliability of 0.95 and 0.87 and Cronbach's alpha of 0.82 and 0.72. The procedure remains the same: the researcher reads the stories aloud in random order, while the participant has a written copy which s/he can follow. Each story comes with six questions and two control questions that assess general comprehension.

3.3 Metaphor Comprehension Task

Our metaphor task employed the Visual World Paradigm (Tanenhaus et al., 1995), with stimuli comprising a visual array featuring three pictures along with an aurally presented sentence. These stimuli were adapted from Pouscoulous and Tomasello (2020) and Di Paola et al. (2020). To create more suitable

materials for adult participants, we devised twenty pairs of novel metaphors and corresponding literal expressions in the form [The X with the Y], where (Y) was figurative in the metaphor condition. The sentences were matched in length, and the nouns used in the (X) and (Y) positions were both frequent and concrete. Concreteness and frequency ratings were validated using assessments from Brysbaert et al. (2014) and van Heuven et al. (2014). For each trial, three pictures were employed: (1) the target picture displayed the target object referred to either metaphorically or literally (e.g., a cup with handles for "The cup with the ears/handles"), (2) the irrelevant picture illustrated the metaphor target without the relevant property (e.g., a cup without handles), and (3) the distractor was a literal competitor, literally showing both the target and the vehicle (e.g., a cup and a boy pointing at his ears) (refer to Figure 1).

Figure 6. Example visual array 'The cup with the ears' and the literal item 'The cup with the handles': (1) target picture, (2) irrelevant, and (3) distractor.

Metaphors were normed on a 7-points Likert scale for their familiarity, aptness, and conventionality following the same procedure, as in Dulcinati et al. (2014). Target pictures were also normed for their suitability to the sentence, gauged by the question "How suitable is this image to represent the sentence?". A total of 120 native English speakers, recruited through Prolific (www.prolific.co), participated in the norming task, with 30 unique participants assigned to each survey group. Three sentences were identified as outliers and were subsequently excluded from the study. Two of these sentences exhibited high familiarity or conventionality ratings (between 4 and 7 points), while one showed low picture suitability (less than 3 points). All sentences were deemed apt metaphors, indicating that they were perceived as providing an accurate description of the topic. One sentence was designated as a practice item. The study

included a total of 16 sentences rated as apt novel metaphors, along with their 16 literal corresponding expressions and 32 fillers. The fillers consisted of half idioms and half literal controls, where the sentence referred to only one picture. Detailed materials and norming results can be found in the Appendix A.

3.3.1 Apparatus

Eye movements were recorded with an SR Research Ltd. EyeLink 1000 eye-tracker, which records the position of the reader's eye every millisecond. Head movements were minimised with a chin rest. Eye movements were recorded from the right eye. Experiment Builder was used to program the experiment, and Data Viewer was used to extract the interest area reports for eye movements. The sentences were aurally presented through a speaker.

3.4 Procedure

The task was structured based on the Visual World Paradigm (Tanenhaus et al., 1995), employing a 2 × 2 design (Sentence Type × Group), with sentence type (literal and metaphorical) as a within-subject factor. Participants engaged in two practice trials, followed by 32 experimental trials and 36 fillers, all presented in a randomized order. Critical trials were arranged using a Latin Square design, with images rotating across three possible positions, resulting in six stimulus lists.

Before the starting of the experiment, participants received explicit instructions outlining the experimental procedure. The researcher provided additional explanations if necessary. Participants, situated at the eye tracker, interacted with on-screen instructions using the keyboard. At the start of each trial, a prompt appeared, instructing participants to press a button when ready to proceed. After button press, participants focused on a drift-correction dot at the screen center. The experimenter initiated the trial, preceded by two practice trials. Once participants were ready and had no further queries, they advanced to the critical trials.

During each trial, participants heard sentences while concurrently viewing three pictures. The audio file began 500 ms after picture presentation. A 2000 ms window followed the sentence, during which

participants selected the picture that best corresponded to the sentence by pressing '1' for the left picture, '2' for the center, and '3' for the right. The eye tracking session for each participant lasted approximately 5 minutes. Participants were kept unaware of the inclusion of figurative language to prevent bias. Detailed explanations of the experiment's objectives were provided during the debrief.

4. RESULTS

Outliers were identified by examining standardized scores and histogram plots, employing a threshold of 2.5 standard deviations from the mean. Two reaction time outliers were observed in the control group and were subsequently excluded from all analyses. Additionally, one participant in the dyslexia group exhibited a mean reaction time exceeding 3 standard deviations and was also excluded.

Results for the metaphor comprehension task are presented in the following sequence: comprehension accuracy, reaction time (for all trials and correct trials), and eye movements (for correct trials exclusively). Inferential analyses were executed using linear mixed effects models, implemented in R (R Core Team, 2012) with the lme4 package (Bates et al., 2012). These models encompassed subjects and items as random effects, featuring maximally specified models with random intercepts for both subjects and items. In cases of fit issues (convergence or singularity), we simplified random slopes for items and subjects. If fit issues persisted, further simplification of random effects ensued, involving the removal of items. Analyses for individual differences variables started with bivariate correlations. Subsequently, variables correlating with metaphor processing were identified, leading to the execution of multiple regression analyses.

4.1 Comprehension Accuracy

In the examination of comprehension accuracy, we fitted a linear mixed model with *comprehension accuracy* as the outcome variable, *condition* (metaphorical, literal) and *group* (D, C) as fixed effects, and *item* and *participant* as random effects. The results revealed a main effect of sentence type (SE= 0.05; β= 0.32; t = 11.9, p < .001), indicating that comprehension was higher for literal trials compared to metaphorical trials. However, the main effect of group did not reach significance (SE= 0.04; β= -0.03; t = -1.18, p = 0.23), and the interaction between group and sentence type was also non-significant (t = 0.88, p = 0.37). Hence, both groups exhibited comparable performance, with higher accuracy observed in the literal condition compared to the metaphorical condition (refer to Figure 2).

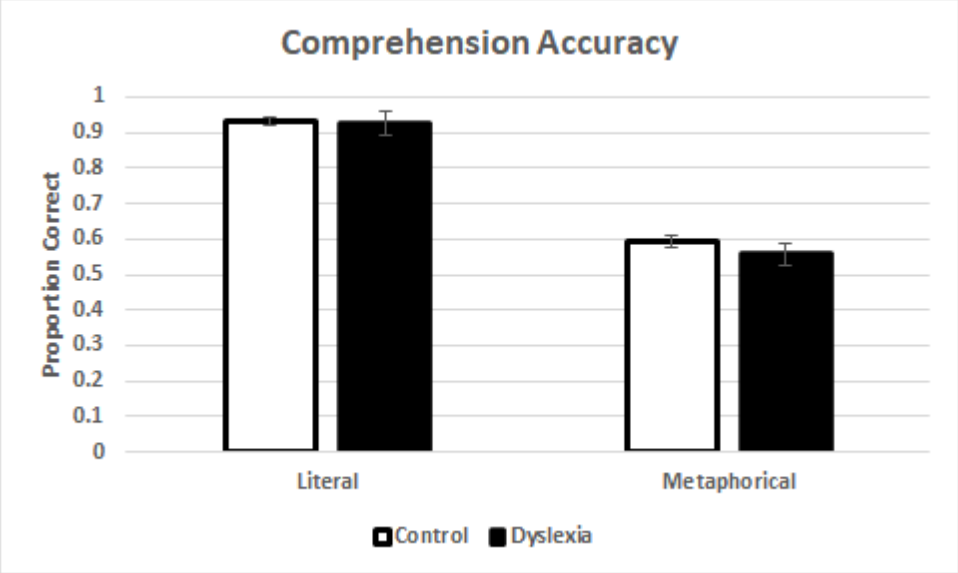

Figure 2. Means of comprehension accuracy. Error bars show the standard error of the mean.

4.2 Reaction Times

For reaction times, we fitted a linear mixed model with *reaction time* as the outcome variable, *condition* (metaphorical, literal) and *group* (D, C) as fixed effects, and *item* and *participant* as random effects. Results

for all trials revealed significant main effects of sentence type (SE= 78.81; β= -372.9; t = -5.48, p < .001), indicating quicker processing for literal trials, and group (SE= 166.22; β= 530.1; t = 3.58, p < .001), with controls exhibiting shorter reaction times than participants with dyslexia (see Figure 3). The interaction was also significant (t = 3.14, p = .001). Paired comparisons indicated significant differences between literal and metaphorical items for both groups: D (t = 9.63, p < .001), and C (t = 5.48, p < .001). Comparing D vs. C revealed significant differences for the metaphorical trials (t = -3.55, p = .003), but not for the literal trials (t = -1.49, p = .44). Therefore, the interaction primarily stems from the extended reaction times for metaphorical trials in individuals with dyslexia.

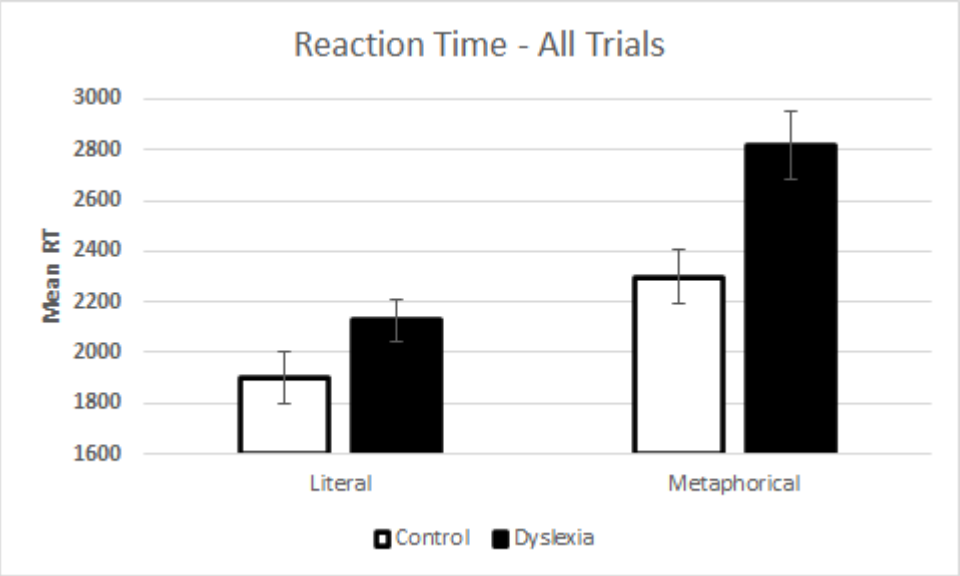

Figure 3. Means of reaction time for all trials. Error bars show the standard error of the mean.

Reaction times for correct trials confirmed significant main effects of sentence type (SE= 74.50; β= -441.06; t = -5.90, p < .001) and group (SE= 149.5; β= 422.6; t = 3.58, p < .01), with a marginally significant interaction between variables (t = -1.9 p = .05). Moreover, there were significant group differences for metaphorical trials (t = -2.8, p < .02), whereas for literal trials, the group effect was not significant (t = -1.55, p = 0.4) (see Figure 4).

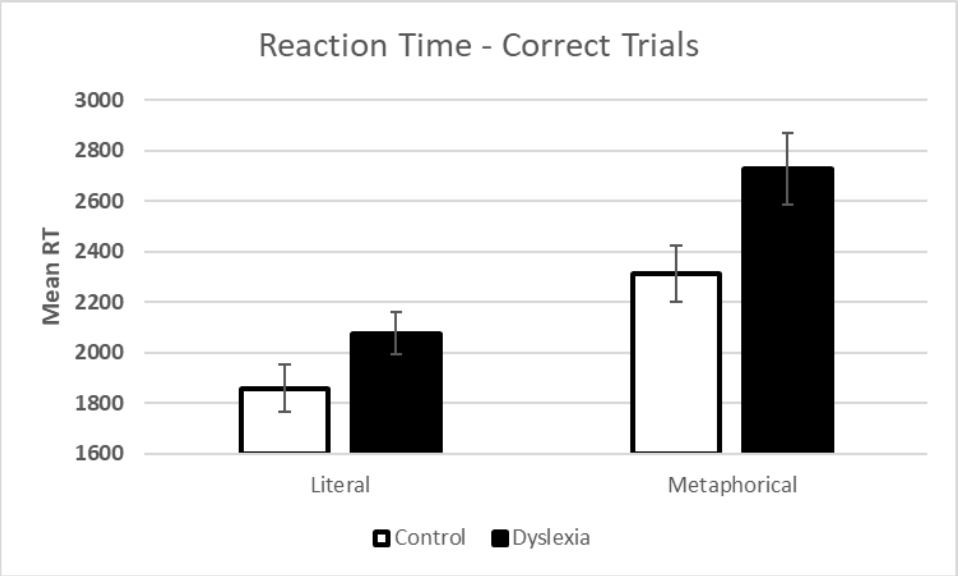

Figure 4. Means of reaction time for correct trials. Error bars show the standard error of the mean.

4.3 Eye Movements

For eye movements, there were no outliers. In the mixed effects model, we fitted a linear mixed model with *dwell time* as the outcome variable, *condition* (metaphorical, literal), *group* (D, C) and *picture* (target, distractor) as fixed effects, and *item* and *participant* as random effects. It's important to note that these analyses excluded the irrelevant picture, focusing solely on eye movements for correct trials. The means for irrelevant pictures were included in Figure 5 for reference, particularly in comparison with the target and distractor images. We defined five key time points for each trial (see Table 1).

500ms	The	cup with the	ears	*2000 ms*
Blank	Det1	NP1+PP+Det2	NP2	Ending/Button Press

Table 1. Key time points for dividing the sentence into regions of interest. Determiner (Det), noun phrase (NP).

Based on the defined key time points, we analyzed three time windows. The first (Region 1) spanned from the onset of the picture to the onset of the first noun phrase (NP1). The pictures appeared on the screen, and there was a 500 ms interval of silence before the sentence began. The second time window (Region 2) extended from the onset of NP1 to the mid-point of the second noun phrase (NP2), with a mean time of approximately 900 ms for this region of interest. The final time window (Region 3) ranged from the mid-point of NP2 to when the participant initiated a button response. It's important to highlight that we initiated this time point at the mid-point of NP2 to allow sufficient time for word recognition and the planning of eye movements (i.e., the earliest possible moment when participants' attention could shift to the target picture).

4.3.1 Region 1

In the initial time window, there was only a notable main effect of picture type (SE= 19.48; β= -56.7; t = -2.91, p = 0.003). The distractor elicited increased fixation time compared to the target. The other main effects and interactions did not reach significance (refer to panel A in Figure 5).

4.3.2 Region 2

In the second time window, there was solely a significant main effect of picture type (SE= 23.2; - β= 74.4; t = -3.20, p = 0.001). The distractor received more extended fixation time compared to the target. None of the other main effects or interactions demonstrated statistical significance (see panel B in Figure 5).

4.3.3 Region 3

In the third time window, the results revealed significant main effects of picture (SE= 25.93; β= -74.47; t = 8.19, p < .001) and sentence type (SE= 28.16; β= -11.59; t = 9.41, p < .001). Participants dedicated more time to viewing the target picture compared to the distractor, and metaphorical trials exhibited longer viewing times, aligning with the reaction time analyses (refer to panel C, Figure 5). Two

significant interactions emerged: sentence type × picture type (SE= 39.33; β= -206.63; t = -5.25, p < .001) and the three-way interaction between group × picture type × sentence type (SE= 56.76; β= 123.59; t = 2.17, p = .02). The interaction between sentence type and picture type was mainly influenced by fixations on the distractor, which were considerably lower in the literal condition (around 350 ms) than in the metaphorical condition (around 600 ms). This effect was anticipated because the distractor picture in literal trials essentially represents an unrelated or irrelevant image, although it's worth noting that it received more fixation time than the irrelevant picture, possibly due to its slightly more complex nature.

To decompose the three-way interaction, we examined literal and metaphorical trials independently. For literal trials, there was only a main effect of picture type (SE= 24.21; β= 212.45; t = 8.77, p < .001), indicating that the target had a longer fixation time than the distractor.

Concerning metaphorical trials, a significant interaction between group × picture type (SE= 47.14; β= 103.88; t = 2.204, p = .02) was observed. This interaction was primarily influenced by the prolonged fixation times on the target by the dyslexia group (~675 ms) compared to the control group (~580 ms), with this difference being statistically significant (t = -1.984, p = 0.04). Moreover, there were significant differences when comparing the target and distractor in the dyslexia group (t = -3.15, p = .009). In contrast, both groups spent nearly equal amounts of time viewing distractors (t = 0.67, p = 0.9), and there was no difference between target and distractor for the control group (t = -0.18, p = 0.99). In summary, this interaction is attributed to the elevated fixation times on the target in individuals with dyslexia during metaphorical trials.

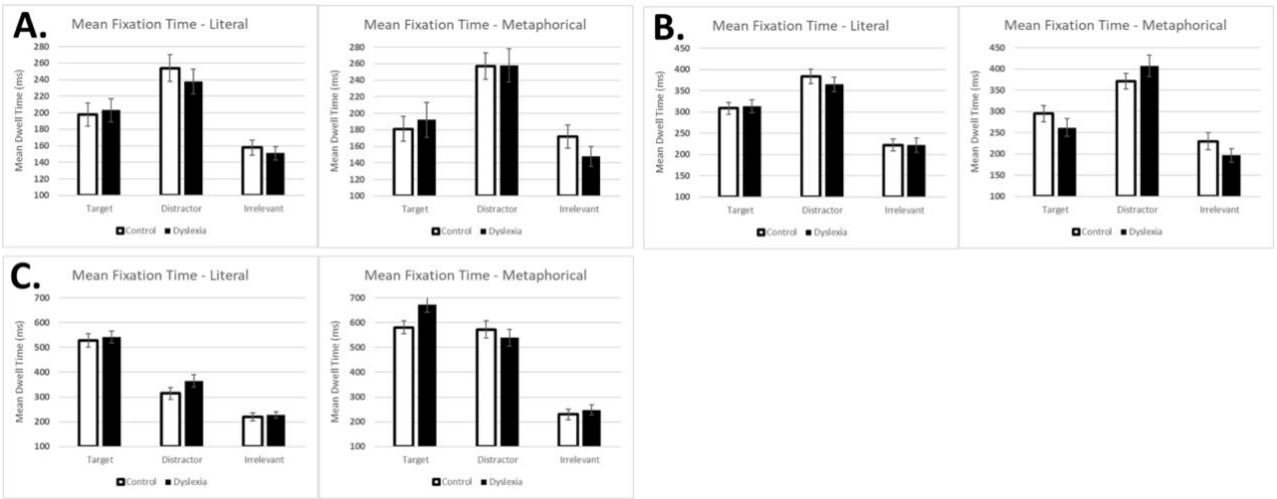

Figure 5. Mean fixation times. Upper left (panel A) shows results from the onset to NP1, and upper right (panel B) shows results from the onset of NP1 to the onset of NP2. The lower left panel (panel C) shows results from NP2 to the button response.

4.4 Cognitive abilities

The groups were matched for age and gender, but significant differences were observed in the three dyslexia screening measures (Table 2). These results indicate that our groups were well-balanced concerning key demographic variables and exhibited anticipated distinctions related to dyslexia (notably, all screening effect sizes were large).

	C (N=39) *Mean (SD)*	**D (N=36)** *Mean (SD)*	***t*-value**	***p*-value**	**Cohen's *d***
Dyslexia screening					
RAN Letters (sec.)	13.4 (2.80)	18.6 (6.29)	-4.762	< .001*	-1.1006
RAN Digit (sec.)	12.1 (2.86)	16.6 (4.19)	-5.499	< .001*	-1.2709
ARHQ	0.34 (0.09)	0.59 (0.13)	-9.399	< .001*	-2.1722
Working Memory					
Digit span forward	10.5 (1.92)	8.83 (1.63)	4.070	< .001*	0.9406
Digit span backward	8.41 (1.92)	7.83 (1.54)	1.430	0.157	0.3305
Vocabulary					
PPVT	98.6 (9.46)	96.0 (12.1)	1.045	0.3	0.2415
Theory of Mind					
Faux Pas test	28.8 (2.36)	26.4 (3.74)	3.358	.001*	0.7760

Table 2. Means and standard deviations for individual differences measures.

Regarding cognitive abilities, distinctions were noted in forward digit span and Theory of Mind (ToM), while no differences were identified in vocabulary and backward digit span (Table 2). Given that our participants with dyslexia were all university students, they may be what is referred to in the literature as compensated adults with dyslexia (Parrila et al., 2007; see Chapter 1, Section 5.1). Their enrollment in higher education may have equipped them with compensatory strategies to alleviate many challenges related to reading, spelling, and writing. The observed separation between forward and backward digit span is a phenomenon not previously witnessed in our samples (e.g., Stella & Engelhardt, 2019).

We began the individual differences analysis by examining the bi-variate correlations between variables (Table 3). However, before doing so, we examined the individual differences measures for skew.

We applied the square root transformation to backward digit span, and for Faux Pas, we reflected the distribution and applied the inverse transformation. Forward digit span and vocabulary were normally distributed.

Variable	1	2	3	4	5	6	7	8	9
1. Group (D/C)	-	-.43**	-.16	-.12	-.51**	-.08	.26*	.26*	-.08
2. Forward Digit		-	.31**	.26*	.16	-.09	-.06	-.27*	.04
3. Backward Digit (sqrt)			-	.33**	.20	.26*	-.01	-.03	.16
4. Vocabulary				-	.35**	-.13	-.04	.12	.04
5. Faux Pas (inv)					-	.00	-.15	-.17	.17
6. Metaphorical Comprehension						-	-.02	.04	-.08
7. Metaphorical Reaction Time							-	.45**	.62**
8. Target Fixations - Metaphorical								-	.01
9. Distractor Fixations - Metaphorical								-	

Table 3. Bivariate correlations between individual differences variables and metaphor processing

Note. *p < .05, **p < .01.

As shown in Table 3, several significant correlations emerged. Vocabulary and Faux Pas did not exhibit significant correlations with any of the dependent measures. Forward digit span displayed a significant correlation with target fixations (dwell time), while backward digit span was significantly correlated with comprehension accuracy. Hence, enhanced working memory was linked to improved comprehension and shorter target fixation times. Subsequent analyses on the dyslexia and control groups separately revealed no correlation between backward digit span and comprehension in the dyslexia group, while a significant correlation (0.41**) was observed in the control group. Consequently, the effects of backward digit span seem to be specific to control participants. Group-specific correlations for vocabulary and Faux Pas did not reveal any substantial differences between the groups. Similarly, there were no notable group differences in the correlation between forward digit span and the measured variables.

4.5 Filler Idioms Analysis

For the sake of completeness, we present here some results from the idioms used as fillers. Idioms such as *He kicked the bucket* were included, with the target picture displaying the figurative meaning (e.g., a grave) and the distractor showing the literal meaning (e.g., a leg kicking a bucket). They were not normed nor divided into time regions, for this reason, their analysis was merely explorative. Results are summarized in Table 4, which compares the difference between the control and dyslexia participants, across comprehension, reaction time (RT), and mean target and distractor fixations (whole sentence). Reaction time and eye movements are for correct trials only. The only significant difference for idioms trials is the time participants took to select an answer, which was longer for people with dyslexia.

	C (N=39) *Mean (SD)*	**D (N=36)** *Mean (SD)*	***p*-value**
Comprehension (prop. correct)	.59 (.19)	.57 (.17)	.57
Reaction Time (ms)	2148 (675)	2686 (827)	.003*
Target Fixations (ms)	646 (195)	729 (195)	.07
Distractor Fixations (ms)	420 (170)	469 (149)	.199

Table 4. Results of comprehension, reaction time, and mean target and distractor fixations

Table 5 shows the results of bi-variate correlations for the idiom trials. As in the case of metaphor trials, we applied the square root transformation to backward digit span, and reflected the distribution and applied the inverse transformation for Faux Pas. Forward digit span and vocabulary were normally distributed. In this case, Faux Pas is correlated with both idiom comprehension and reaction time, something that did not happen for metaphors.

Variable	1	2	3	4	5	6	7	8	9
1. Group (D/C)	-	-.43**	-.16	-.12	-.51**	-.07	.34*	.21	.15
2. Forward Digit		-	.31**	.26*	.16	.10	-.07	-.21	-.05
3. Backward Digit (sqrt)			-	.33**	.20	.08	.06	.08	.09
4. Vocabulary				-	.35**	.17	-.09	-.09	.04
5. Faux Pas (inv)					-	-.01	-.24*	-.29*	.02
6. Idiom Comprehension						-	-.09	.10	-.20
7. Idiom Reaction Time							-	.44**	.70**
8. Target Fixations - Idiom								-	.13
9. Distractor Fixations - Idiom									-

Table 5. Bivariate correlations between individual differences variables and idiom processing.

Note. *p < .05, **p < .01.

5. DISCUSSION

The present study aimed to address two research questions. The first question focused on whether the processing of metaphors in adults with dyslexia differed from that of typically-developing controls (RQ1). The second question explored how individual differences in cognitive abilities influenced metaphor processing in dyslexia (RQ2).

To address RQ1, we conducted an examination of online metaphor processing, using eye tracking and the Visual World Paradigm. The analysis of comprehension, reaction time, and eye movements yielded the following findings: (i) individuals with dyslexia grasped the metaphorical meaning at a rate comparable to that of the control group; (ii) individuals with dyslexia exhibited a significant slowness, particularly in metaphor trials; (iii) individuals with dyslexia did not manifest any atypical patterns in the allocation of visual attention to the presented pictures.

The accuracy rates in metaphorical trials were similar between the two groups, suggesting no discernible difference in metaphor comprehension for the group with dyslexia. It's important to note that lower accuracy in metaphorical trials compared to literal trials was expected and aligned with findings

from prior studies using the same stimuli (Di Paola et al., 2020; Pouscoulous & Tomasello, 2020). This is because the literal interpretation of metaphorical sentences remained plausible, albeit to a lesser extent. What holds greater relevance for our research questions than accuracy itself is the comparability of response patterns between the two groups, both exhibiting similar picture selections.

Eye movements revealed that in the early time windows (Regions 1 and 2), the distractor picture was fixated more than the target, with a general increase in viewing time from Region 1 to Region 2. However, there were no discernible effects related to group or sentence type during these initial time windows. In the final time window, a difference emerged: looks to the distractor picture markedly decreased for literal trials, while for metaphorical trials, they continued to rise. Fixations on the target picture in the final time window were significantly higher, with individuals with dyslexia exhibiting prolonged fixation times on the target – a trend aligning with their slower reaction times. This implies that individuals with dyslexia did not exhibit abnormal fixation patterns, as would be expected if they fixated on the irrelevant image or distractor for an extended duration. Instead, the heightened fixation time on the target, coupled with delayed reaction times, suggests that processing differences are more intricately tied to language processing rather than variations in how visual attention is distributed among the different images in the array.

In addressing RQ2 and evaluating working memory, vocabulary, and ToM, the analysis of individual difference variables yielded fewer significant relationships than anticipated. The most evident findings were associated with the working memory tasks. Specifically, we noticed a correlation between forward digit span and shorter target fixation times in both metaphors and idioms. We interpret this outcome as individuals with larger memory spans being capable of more rapidly encoding verbal information. Consequently, upon hearing the entirety of the sentence, they can swiftly redirect their attention to the "correct" picture and formulate their response. An alternative interpretation is that working memory, being a domain-general ability, tends to correlate with various cognitive assessments, potentially rendering this result somewhat spurious. We find this explanation improbable for two primary reasons. First, the significant correlation between target fixations and forward digit span persists for idioms, which were

part of the fillers. Therefore, we observe very similar relationships across two distinct types of non-literal language. Second, when we tested the group on target fixations while covarying forward digit span, the group was no longer significant. This result implies a substantial overlapping variance between dyslexia measures, smaller forward span capacity, and the time participants spent fixating the target image. Digit span only correlated with comprehension (the offline measure), and this result only held for our control participants. Interestingly, our groups did not differ in digit span backward. Some argue that backward digit span performance involves visual strategies (St Clair-Thompson & Allen, 2013), so one possibility for this dissociation in working memory is compensatory strategies in people with dyslexia. We speculate that these strategies are partially successful, as individuals with dyslexia have a greater tendency to employ visual imagery under situations of high cognitive load (Bacon & Handley, 2010), such as in backward digit recall. Essentially, their scores on backward digit span may be less reflective of their true working memory abilities, which would also correspond to a lack of group differences. Based on our data, we are not in a position to provide further evidence for this speculation.

Individual differences analysis also showed that the two groups were significantly different in ToM abilities. However, ToM did not show correlations with any measure of metaphor processing, but only with the filler idioms. Recent findings suggest that the influence of ToM may also depend on the type of metaphor. Our stimuli were novel metaphors that mainly referred to the physical characteristics of the object referred to (e.g., *the cake with the snow*). Recent findings indicate that ToM seems to play a more prominent role for metaphors expressing psychological characteristics rather than for those expressing physical characteristics (Canal et al., 2022). Moreover, in individuals with dyslexia, Cardillo et al. (2017) identified a clear correlation between verbal ToM abilities and metaphor comprehension in children, but the results in Cappelli et al. (2018) for adults were in line with our findings. It is also possible to hypothesize that metaphor processing and ToM are more closely related in development and become more independent in adulthood.

Vocabulary was not found to be related to metaphor processing, and the two groups were matched on this measure. Interestingly, there was a vocabulary effect that went against expectations, as vocabulary

was negatively correlated (-.13) with comprehension accuracy. Notably, the three individuals with the highest vocabulary scores in our sample were those with dyslexia. This aligns with the findings of Cavalli et al. (2016) and Rasamimanana et al. (2020), which indicate no impairments in vocabulary among university students with dyslexia.

The present study does not provide a definitive explanation for the inconsistent findings in the literature concerning cognitive abilities and their relation to metaphor processing. The most relevant result suggests that individuals with higher memory spans are likely to exhibit shorter fixation times on the target image (~80 ms). Importantly, target fixations constitute a key online measure of metaphor processing, an aspect that has not been explored extensively before.

6. CONCLUSIONS

The current study showed that individuals with dyslexia obtained the metaphorical interpretation at the same rate as controls. However, they took significantly longer to do so. They also spent more time viewing the target image, which we argued, showed that there were no abnormalities in the way in which visual attention was deployed to the visual information displayed on the screen. Instead, we suggested that the online measures (reaction times and target fixations) reveal either slow processing or a semantic impairment of computing or shifting to the metaphorical interpretations. Our study did confirm working memory span as being related to target fixation times, but did not support the influence of ToM in metaphor processing, as those correlations were not significant for either the offline or online measures, even if the dyslexia and the control group significantly differed on this measure.

CHAPTER 4

Early processing of high and low familiar metaphors

ABSTRACT

The second study investigates the early stages of metaphor processing in adults with dyslexia. The aim is to determine at what stage of metaphor processing previously identified difficulties or slowness in metaphor comprehension might arise. Through a semantic judgment task and a sentence recall task within the framework of the Metaphor Interference Effect (MIE) paradigm, we assessed two initial phases of metaphor comprehension: the generation of the figurative meaning and the suppression of the literal meaning. Our results indicate that individuals with dyslexia exhibit a similar capacity to automatically derive metaphorical meanings when compared to participants without dyslexia. Consequently, challenges observed in previous studies may be attributed to the construction of meaning within a contextual framework rather than deficiencies in online semantic processing.

1. INTRODUCTION

Traditionally, the comprehension of figurative language was perceived as a more demanding process compared to literal language (for a comprehensive discussion, refer to Chapter 2). However, Glucksberg et al. (1982) challenged this perspective by demonstrating that the interpretation of metaphors does not necessarily require more time than that of literal expressions, and that the processing of metaphorical

utterances is automatic. They used a sentence-verification task where participants were asked to judge sentences as either literally true or literally false. The task encompassed four sentence types: (a) metaphors, like "some jobs are jails" and "some flutes are birds"; (b) scrambled metaphors, such as "some jobs are birds" and "some flutes are jails", constructed by scrambling the nouns from the metaphor sentences; (c) literally true sentences (e.g., "some birds are eagles"); and (d) nonsensical literally false sentences (e.g., "some fish are eagles"). It was found that metaphors (which are literally false) resulted in longer response times than other literally false sentences, such as scrambled metaphors. In other words, people took longer to judge the metaphor "some jobs are jails" as literally false, because a viable figurative meaning (i.e., some jobs limit our freedom) was automatically generated. This supported the notion that metaphor processing involves the automatic and simultaneous generation of both literal and nonliteral meanings which causes an interference, known as the Metaphor Interference Effect (MIE). This interference leads to prolonged response times for metaphorical stimuli compared to literal sentences, which have a singular literal meaning. Conversely, if the initially available meaning is the literal meaning for all sentence types, including metaphors, then all literally false sentences would exhibit similar response times, thus suggesting a sequential processing.

In a subsequent recall task, it was noticed that participants remembered more metaphors than control sentences (Glucksberg et al., 1982). This recall task aims to assess the depth of processing for each stimulus. Previous studies (Craik & Lockhart, 1972) and recent investigations (Hargreaves et al., 2012; Kroneisen & Erdfelder, 2011) suggest that items subjected to more profound processing or robust encoding are more likely to be better remembered. Therefore, the greater recall of metaphor sentences compared to other types of literally false sentences indicates that the authentic metaphorical meaning was generated, despite its irrelevance to the task of judging literal truth.

The MIE paradigm has been successfully replicated in various studies (Al-Azary et al., 2021; Chouinard et al., 2019; Keysar, 1989; Pierce et al., 2010) and is considered a "robust indicator of automatic, early, and coarse-grained semantic processing" (Al-Azary et al., 2021, p. 176). Importantly, it can be used to examine the earliest stages of metaphor comprehension and to distinguish the phase in

which the metaphorical meaning is generated from that in which the unintended meanings are suppressed. The generation of the metaphorical meaning, in fact, might happen independently from the process of understanding the metaphor in conversation, which requires the subsequent step of inhibiting the literal meaning and integrating the metaphoric utterance within discourse and social contexts.

As clarified by Glucksberg et al. (1982), the term 'automatic' doesn't imply that understanding is effortless, but rather that a speaker lacks voluntary control over it. Research indicates that individual differences can influence this automaticity. For instance, Pierce et al. (2010) found that the magnitude of the MIE is predicted by working memory capacity and inhibitory control. Individuals with higher working memory capacity exhibit a smaller MIE (see Chapter 2, Section 2.1 of this dissertation). This implies that, while metaphor comprehension is automatic, executive mechanisms play a role, and higher working memory capacity can facilitate the rapid categorization of metaphors as literally false, leading to a reduced MIE.

While individual differences undeniably impact the processing of metaphors, it is important to consider that inherent characteristics of metaphors themselves can also influence comprehension. One such factor is familiarity, defined by Blasko & Connine (1993, p. 305) as "the perceived experience with the metaphor", denoting the frequency of exposure to a metaphor (Thibodeau & Durgin, 2011). Blasko and Connine (1993) contend that familiar metaphors achieve a level of accessibility comparable to that of literal interpretations, resulting in shorter reading times compared to their less-familiar counterparts. To date, the sole exploration into the role of familiarity within the framework of the MIE paradigm is the study conducted by Di Paola et al., (2019). This study, the first MIE investigation conducted with an Italian sample, revealed that participants took significantly more time to assess highly familiar metaphors as literally false, compared to their scrambled counterparts. Conversely, for low-familiar metaphors, no difference in response time (and thus, no MIE) was observed between metaphors and scrambled counterparts. Hence, it seems that familiarity indeed plays a role in modulating the MIE: high metaphor familiarity appears to present greater challenges in categorizing it as literally false.

In the scope of our investigation, we aim to address a gap by examining the influence of familiarity within the MIE framework. However, our primary focus is on evaluating a specific population: adults with dyslexia. Interestingly, the MIE has not been investigated in the context of dyslexia, notwithstanding the well-established effects of the condition on executive functioning, a crucial aspect in inhibiting metaphorical (or literal) interpretations (Pierce et al., 2010).

2. CURRENT STUDY

The primary objective of the present study is to determine at which stage previously identified challenges with metaphor comprehension in individuals with dyslexia arise. The MIE paradigm allows the examination of two early stages of metaphor comprehension: the generation of the figurative meaning and the suppression of the literal (unintended) meaning.

Notably, prior studies utilizing the MIE task in individuals with Autism Spectrum Disorder (ASD) (Chouinard & Cummine, 2016; Hermann et al., 2013) have suggested that in this population the metaphorical meaning is correctly generated, but difficulties might arise in the phase of inhibition of the unintended meaning. The presence of the MIE and similar sentence recall rates compared to the control group indicated successful generation of metaphorical meaning, while lower response accuracy in suggested challenges in the meaning selection phase. These results indicate that potential issues of people with ASD might stem from the phase of suppressing irrelevant literal features, something that also explains the longer response times and greater N400 amplitudes observed by Gold et al. (2010) despite similar accuracy rates in individuals with ASD.

In the context of dyslexia, our first study (Chapter 3) demonstrated metaphor processing difficulties, revealing longer reaction times but similar accuracy in response choice. However, further investigation is needed to pinpoint the specific stage of processing causing this slowness. Building upon this, we expect that individuals with dyslexia will correctly generate the metaphorical meaning.

Potential impairment might emerge in suppressing the irrelevant meaning (as in individuals with ASD). In this case, we would find comparable MIE size and recall rates, but different accuracy between groups. By contrast, the absence of between-group difference on these three measures would indicate that difficulties identified in previous studies (e.g., Cappelli et al., 2018) are likely to arise from later stages of processing, such as the integration of metaphorical meaning into a broader context.

Considering individual differences in cognitive abilities becomes crucial for formulating clearer hypotheses, even as the existing literature on metaphor comprehension in dyslexia remains limited. The initial stages of metaphor comprehension necessitate accessing and understanding word meanings. In the case of adults with dyslexia, semantic knowledge seems to be intact, and some studies even suggest it acts as a compensatory factor for phonological deficits in word retrieval processes (Cavalli et al., 2017; Rasamimanana et al., 2020).

On the other hand, individuals with dyslexia often exhibit lower working memory capacity (Cancer & Antonietti, 2018; Jeffries & Everatt, 2004) and inhibitory control (Faccioli et al., 2008; Proulx & Elmasry, 2015; Wang & Yang, 2015; Wilcockson et al., 2019). Both of these abilities play a role in the MIE, where the activated figurative meaning creates interference and necessitates the suppression of the dominant response (metaphorically true, but literally false). If inhibitory control is less efficient, response times to judge metaphors as literally false should be slower. Simultaneously, if working memory capacity is bigger, one would anticipate smaller MIE sizes (Pierce et al., 2010).

The role of metaphor familiarity will also be considered. Building on the only previous study (Di Paola et al., 2019), we anticipate that this feature will modulate the MIE, with high familiar metaphors creating more interference and being more slowly judged as literally false.

In light of our primary hypotheses, our research questions are as follows: (1) Is metaphorical meaning automatically generated by individuals with dyslexia? (2) If so, can the group with dyslexia successfully inhibit the generated meaning? (3) What are the roles of executive functions and metaphor familiarity in these stages?

To our knowledge, the MIE has never been measured in individuals with dyslexia, nor has the automatic activation of metaphorical meaning. We aim to address this gap through a spoken MIE task, presenting stimuli aurally to circumvent difficulties associated with reading in the dyslexic group.

3. METHODS

3.1 Participants

A total of 57 adults participated in the study. The dyslexia group (D) was composed of 26 people (12 M, 14 F, mean age = 24.5, SD = 7.58) with developmental dyslexia and no associated comorbidities; the control group (C) was composed of 31 people (13 M, 18 F, mean age = 27.1, SD = 8.31) without any diagnosed learning difficulty or neurodevelopmental disorder. The two groups did not differ for age ($t = 1.26$; $p = 0.33$), gender (χ^2 (1) = 0.1, $p = 0.74$), nor handedness (χ^2 (1) = 0.45, $p = 0.49$).

Participants with dyslexia proved that they have previously received a diagnosis by showing their clinical documentation to the experimenter. All participants had Italian as L1 and were not bilingual. The study was approved by the University of Genoa Ethics Committee (decree n. 2022/53). Informed consent was obtained from all participants before carrying out the study and all were debriefed at the end of the study.

3.2 Individual differences assessment

Prior to the main task, all participants underwent individual testing. Standardized procedures, as outlined in the respective test manuals, were strictly adhered to for each test.

Working memory. For the assessment of working memory, we utilized the digit span tasks (both forward and backward) from the 4th edition of the Wechsler Adult Intelligence Scale (WAIS-IV, Wechsler, 2008). In the digit span forward task, participants were presented with increasing sequences of numbers and instructed to repeat them back in the same order. Conversely, in the digit span backward task, participants were required to recall the sequences in reverse order. Scores for each task were determined by the total

number of sets of digits correctly recalled. For digit span forward, participants were tasked with recalling sequences ranging from two to nine digits, while for digit span backward, the range was from two to eight digits. The task concluded upon the occurrence of two consecutive errors.

Inhibition. Inhibition was assessed using a brief paper version of the Stroop task, standardized for the Italian population (Caffarra et al., 2002). Stimuli consisted of three color names – giallo (yellow), verde (green), and blu (blue) – and three colored circles corresponding to yellow, green, and blue. The task comprised three conditions, each comprising 30 items:

1. Word Reading: participants were required to read aloud color words presented in black ink.
2. Rapid Color Naming: participants had to name the color of the circles.
3. Interference (Stroop Task): participants were tasked with naming the color of the ink with which a color-word was written. For instance, if the word 'red' was written in blue ink, the correct response would be 'blue'.

Stimuli for all conditions were presented on paper in three columns of 10 items. The presentation layout followed easy-to-read guidelines, using the Easy Reading font, with a font size of 14 pt. and printed on a light grey background. This design aimed to minimize potential barriers for participants with dyslexia. The experimenter recorded the reading/naming time (i.e., the time taken by participants to complete the 30-item list) for each task (word reading, rapid color naming, and interference), along with accuracy. The first two tasks (word reading and rapid color naming) also served to assess the severity of dyslexia and ensure the exclusion of any undiagnosed individuals with dyslexia from the no-dyslexia group.

3.3 Metaphor Interference Effect

The MIE task was structured based on the paradigm introduced by Glucksberg et al. (1982). The MIE is calculated by comparing the response times in a task in which participants have to decide whether a visually presented sentence is literally true or literally false. A MIE emerges if the response time in the metaphorical sentences is significantly higher than that in the scrambled metaphors. This is due to the

fact that metaphors used in the MIE paradigm have a viable metaphorical meaning (usually verified by a previous norming study), while scrambled metaphors do not; therefore, scrambled metaphors are categorized faster as literally false, compared to metaphors, whose figurative meaning is computed and must be subsequently inhibited to categorize them as literally false.

Differing from the original paradigm, our study presented items in the auditory modality to mitigate potential reading-related interference for participants with dyslexia. Chouinard et al. (2019) previously demonstrated that a MIE can also be found with spoken stimuli, establishing the comparability of results between written and auditory modalities. Our stimuli comprised 160 sentences structured as 'Those x are y'. We deliberately avoided the form 'Some x are y', used in Glucksberg et al. (1982) and most other replication studies, due to reported difficulties of individuals with dyslexia in computing scalar implicatures (Stoicescu et al., 2021; Vender, 2017).

Metaphorical stimuli were taken from Bambini et al. (2013); they were already in the form 'Those x are y', where y is the word triggering the metaphorical interpretation (i.e., the metaphor vehicle). In their study, all sentences were normed for major psycholinguistic properties considered in the figurative language literature, including meaningfulness, difficulty, cloze probability, and familiarity. To construct our list of stimuli, we particularly considered familiarity to investigate any potential impact of this feature on the MIE.

From the norming study in Bambini et al. (2013), we specifically selected 10 metaphors with the highest familiarity ratings (HF_MET) and 10 with the lowest familiarity ratings (LF_MET) to be included in the stimuli. Correspondingly, 20 scrambled counterparts were generated by interchanging the metaphor vehicles within the high familiarity conditions (HF_SCR) and low familiarity conditions (LF_SCR). To serve as fillers, we incorporated 80 literally true sentences (LIT_T) and 40 literally false sentences (LIT_F); the latter were devised by rearranging the second term of LIT_T sentences. This lexical item matching ensured that word frequency and length remained consistent across conditions (MET-SCR and LIT), preventing any influence on response times. For the practice phase, an additional 20 sentences were created following the same procedure. The practice sentences comprised two high

familiar metaphors, two low familiar metaphors, two scrambled metaphors, four literally false sentences, and ten literally true sentences.

The distribution of items across each condition aligns with the proportions used in Glucksberg et al. (1982). A balanced distribution was maintained, with half of the stimuli designated as literally true and the other half as literally false. Examples illustrating each sentence type are provided in Table 1, and the complete list of stimuli is in the Appendix B.

All sentences were recorded by a female native speaker of Italian, delivered at a typical conversational pace, and presented in a random order to eliminate any potential intonation variations between sentence types.

Metaphor		Scrambled metaphor		Literally false	Literally true
High Familiar (10)	Low Familiar (10)	High Familiar (10)	Low Familiar (10)	(40)	(80)
Quei giornalisti sono avvoltoi "Those journalists are vultures"	*Quei maestri sono lanterne* "Those teachers are lanterns"	*Quei giornalisti sono giungle* "Those journalists are jungles"	*Quei maestri sono dighe* "Those teachers are dams"	*Quelle finestre sono liquirizie* "Those windows are liquorices"	*Quelle finestre sono oblò* "Those windows are portholes"
Quelle città sono giungle "Those cities are jungles"	*Quegli eserciti sono dighe* "Those armies are dams"	*Quelle borse sono trombe* "Those bags are trumpets"	*Quelle malattie sono fontane* "Those illnesses are fountains"	*Quei fiori sono commedianti* "Those flowers are comedians"	*Quei fiori sono rose* "Those flowers are roses"

Table 1. Sample Stimuli.

3.3.1 Sentence decision task

When presented with stimuli, participants are tasked with determining whether each sentence is 'literally true' or 'literally false'. Following Glucksberg et al. (1982)'s framework, the simultaneous generation of both literal and metaphorical meanings could lead to interference, resulting in the MIE. This interference is manifested as prolonged response times (RTs) for metaphorical stimuli compared to literal sentences, which have a singular literal meaning. Conversely, if the initially available meaning is the literal interpretation for all sentence types, then all literally false sentences, including metaphors, would exhibit similar RTs. The original study by Glucksberg et al. (1982), conducted in the context of written metaphor comprehension, revealed that metaphors (literally false) elicited longer RTs than control false

sentences, supporting the conclusion that integration involves the automatic and simultaneous generation of both literal and nonliteral meanings.

3.3.2 Sentence recall task

Similar to Glucksberg et al. (1982), participants, in the final phase, were allotted ten minutes to recall as many sentences as possible. This recall task serves the purpose of assessing the depth of processing for each stimulus type. Consistent with earlier studies (Craik & Lockhart, 1972) and more recent investigations (Hargreaves et al., 2012; Kroneisen & Erdfelder, 2011), it is established that items subjected to more profound processing or robust encoding are more likely to be better remembered. Thus, a greater recall of metaphor sentences compared to other types of literally false sentences would imply that the authentic metaphorical meaning was generated, even if the computation of a metaphorical meaning was not imperative to complete the task.

3.4 Procedure

The procedure closely followed the design of Glucksberg et al. (1982), with adjustments to accommodate the spoken condition based on Chouinard et al. (2019). Stimuli were organized into 10 blocks, each containing 16 items. Blocks were presented in a random sequence, and within each block, stimuli were randomly delivered. PsychoPy software (https://www.psychopy.org) was employed for stimulus presentation, response collection, and recording response times.

The experiment started with the assessment of cognitive abilities; inhibition and working memory tasks were alternated to counterbalance potential order effects. Subsequently, participants were seated in a soundproof chamber facing a computer. Before the sentence verification task (i.e., MIE experiment), a practice phase was conducted. During this phase, the experimenter provided guidance to help participants understand and complete the task. On-screen instructions were complemented by verbal explanations from the experimenter. Participants were instructed to listen to a sentence and determine whether it was

"literally true" or "literally false". To illustrate these concepts, two example sentences were presented. Response buttons were color-coded for clarity: the "A" button, marked with a green sticker, indicated the "literally true" option, while the "L" button, with a red sticker, indicated the "literally false" option. Colored stickers and on-screen labels ("TRUE" and "FALSE") were incorporated to enhance task intuitiveness and reduce potential interference from executive functioning and memory in participants with dyslexia (see Figure 1).

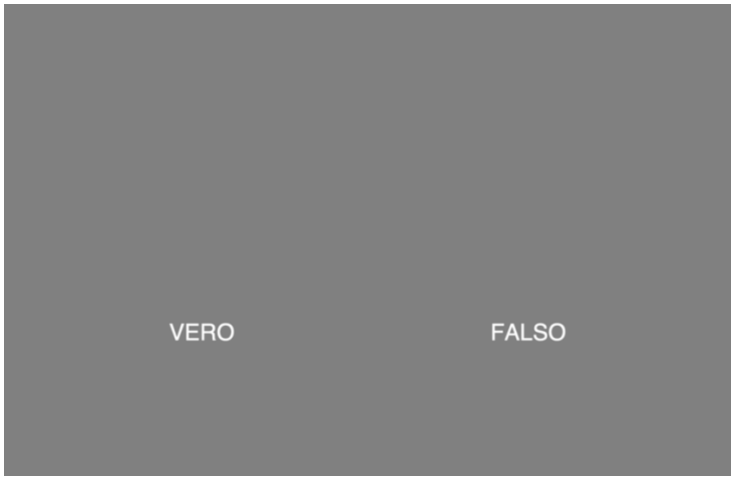

Figure 7. Screen displayed to participants while hearing the spoken stimuli.

Participants were not informed in advance about the inclusion of metaphorical stimuli. The practice phase commenced upon the participant pressing the space bar. During this 20-item practice session, stimuli were randomly presented, and the experimenter thoroughly reviewed each response with the participant, who had the opportunity to seek clarification or ask questions. Participants were explicitly instructed to respond with both speed and accuracy. They were also informed that they could take a break at the conclusion of each block, with an on-screen prompt stating, "You've completed the block. If you want, you can take a break. When you're ready to start again, press the spacebar".

Once ready, participants entered the soundproof cabin, and the experiment started with the press of the spacebar. Auditory stimuli were presented through external speakers; no headphones were used. Within each block, stimuli followed one another, with the next stimulus appearing 500 ms after the response button click. During this interval, a fixation cross was displayed on the screen.

The entire experiment lasted approximately 15-20 minutes. The recall task constituted the final segment of the session, and participants were unaware of this part beforehand. A blank document on the same computer was provided for participants to transcribe the sentences. Following the entire procedure, participants were debriefed about the study's objectives.

3.5 Data Analysis

Inferential analyses were executed utilizing linear mixed effects models (LMMs and GLMMs) in R (R Core Team, 2012), employing the lme4 package for model fitting (Bates et al., 2012). The mixed function of the *afex* package (Singmann et al., 2023) was employed for testing significant main effects and interactions, while the *emmeans* package (Lenth, 2022) facilitated the breakdown of any significant interactions. Our models incorporated both subjects and items as random effects, utilizing maximally specified models that included random intercepts for both subjects and items. In cases of fit issues, such as convergence or singularity, we adopted a stepwise simplification approach, initially adjusting random slopes for items and subsequently for subjects if fit issues persisted. The analysis of individual differences variables commenced with bivariate correlations. Once variables correlating with metaphor processing were identified, we conducted multiple regression and additional linear mixed models analyses to delve deeper into the relationships.

Only interactions involving the sentence type factor will be presented in the following section, as the presence of this factor is necessary for the MIE, which indicates the difference in response times between metaphors and their scrambled counterparts. Additionally, only significant pairwise differences between sentence types and their corresponding scrambled counterparts will be reported, as other differences lack theoretical significance (e.g., the difference between high-familiar metaphors and scrambled low-familiar metaphors).

4. RESULTS

Results for the metaphor interference effect task are presented in the following order: response times and presence of MIE, accuracy in the sentence decision task, correlations with the assessed cognitive abilities (working memory and inhibition), and sentence recall task.

4.1 Metaphor Interference Effect

Response Times (RT) from correct responses were considered for the analysis. Table 2 reports the means for each sentence type.

	C (N=31)	**D (N=26)**
Sentence type	*Mean (SD)*	*Mean (SD)*
Literally False	2882.195 (259)	2974.533 (333)
High Fam. Metaphors	3040.306 (440)	3260.919 (519)
Scrambled High Fam. Metaphors	2867.587 (244)	2984.265 (348)
Low Fam. Metaphors	2930.114 (319)	3037.599 (442)
Scrambled Low Fam. Metaphors	2864.002 (276)	2926.957 (376)

Table 2. Response times for each group in milliseconds.

Following the methodology of Hermann et al. (2013), log-transformed reaction times (RT) were used in the analysis, and only correct responses were considered. A linear mixed model was employed, with RT as the dependent variable, and sentence type (metaphorical, scrambled), familiarity (high, low), and group (C, D) as fixed effects. Random effects included item and participant. A significant main effect of sentence type was observed, χ^2 (1) = 4.45, p = .035, indicating the presence of the Metaphor Interference Effect (MIE) in both participant groups, irrespective of familiarity. No other significant effects were noted.

In terms of accuracy, Table 3 illustrates comparable performance between the two groups. This finding was further confirmed statistically through a logistic mixed-effects model, where the dichotomous response was the outcome variable. Sentence type (metaphorical, scrambled), familiarity (high, low), and

group (C, D) were included as fixed effects, while item and participant were treated as random effects. No significant effects of sentence type or interactions were identified.

Sentence type	**C (N=31)** *% correct (SD)*	**D (N=26)** *% correct (SD)*
Literally False	99,7% (0.008)	99.3% (0.01)
High Fam. Metaphors	98.5% (0.03)	95.4% (0.12)
Scrambled High Fam. Metaphors	100% (0)	99.2% (0.02)
Low Fam. Metaphors	100% (0)	100% (0)
Scrambled Low Fam. Metaphors	100% (0)	100% (0)

Table 3. Accuracy in the sentence decision task.

4.2 Sentence Recall Task

The recalled sentences were marked as accurate if they were part of the stimuli included in the study or if they differed just in the singular/plural form (e.g., "This dancer is a butterfly" instead of "Those dancers are butterflies"). Sentences recalled multiple times by the same participant were counted only once. we conducted a linear mixed model with the count of recalled sentences as the dependent variable. Fixed effects included sentence type (metaphorical, scrambled), familiarity (high, low), and group (C, D), while item and participant were incorporated as random effects. The analysis revealed significant effects of sentence type (χ^2 (1) = 50.54, $p < .001$), familiarity (χ^2 (1) = 23.92, $p < .001$), and group (χ^2 (1) = 10.43, $p = .001$). An interaction effect between sentence type and familiarity (χ^2 (1) = 12.13, $p < .001$) indicated that familiarity influenced recall rates in both groups, with high familiar metaphors exhibiting superior recall. Another significant interaction between sentence type and group (χ^2 (1) = 8.28, $p = .004$) suggested that each group displayed distinct recall rates based on sentence type. In both groups, high familiar metaphors were better retained than low familiar ones and other sentence types. However, individuals with dyslexia demonstrated lower recall rates across all sentence types (except scrambled). Mean values for individual sentence types were compared and are presented in Table 4.

Sentence type	**C (N=31)** *Mean (SE)*	**D (N=26)** *Mean (SE)*	***t*-ratio**	**p-value**
High Fam. Metaphors	1.774 (0.152)	0.923 (0.166)	3.78	0.000 *
Scrambled High Fam. Metaphors	0.419 (0.152)	0.192 (0.152)	1.01	0.310
Low Fam. Metaphors	0.903 (0.152)	0.192 (0.166)	3.16	0.001 *
Scrambled Low Fam. Metaphors	0.290 (0.152)	0.038 (0.166)	1.12	0.263

Table 4. Accuracy in the sentence recall task.

Note. *$p < .05$

4.3 Cognitive Abilities

Results for the assessment of cognitive abilities and differences between groups are reported in Table 5. The two groups were significantly different in all the assessed cognitive measures.

	C (N=31) *Mean (SD)*	**D (N=26)** *Mean (SD)*	***t*-ratio**	***p*-value**
Word reading (sec.)	10.8 (1.41)	14.1 (2.91)	-5.715	< .001*
Color naming (sec.)	14.8 (1.83)	18.6 (3.21)	-5.585	< .001*
Stroop interference (sec.)	24.7 (4.83)	31.0 (6.96)	-4.072	< .001*
Digit Span forward	9.83 (1.79)	8.43 (1.79)	2.890	0.006 *
Digit Span backward	9.09 (2.3)	6.96 (1.23)	3.535	< .001*

Table 5. Means and standard deviations for demographic variables and cognitive measures.

Note. *$p < .05$

The correlation matrix reports the correlations between the MIE size for high familiar (HF) and low familiar (LF) metaphors and the other tests administered to participants (see Table 6). The size of the MIE for each group was measured by subtracting RTs from the scrambled condition relative to the metaphor condition RTs (Glucksberg et al., 1982). MIE size for high familiar metaphors correlated with inhibition, but this wasn't the case for that of low familiar metaphors. No other relevant correlations between the MIE size and other cognitive measures were found.

	1	2	3	4	5	6	7
1. DSF	—						
2. DSB	0.487***	—					
3. Word reading time	-0.275*	-0.153	—				
4. Color naming time	-0.328*	-0.281*	0.686***	—			
5. Inhibition	-0.332*	-0.327*	0.559***	0.714***	—		
6. MIE size (HF)	-0.245	-0.247	0.056	0.171	0.376***	—	
7. MIE size (LF)	0.173	0.06	0.111	0.023	0.155	0.219	—

Table 6. Correlations between the MIE size and digit span forward (DSF), digit span backwards (DSB), word reading time, color naming time, inhibition (Stroop interference time).

Note. *$p < .05$, ** $p < .01$, *** $p < .001$

5. DISCUSSION

The primary objectives of this study were to investigate (i) whether individuals with dyslexia automatically generate metaphorical meaning and, if so, to examine (ii) whether the inhibition of unintended meaning differs from that of individuals without dyslexia. Additionally, we aimed to explore (iii) how executive functions and metaphor familiarity play a role in modulating these processes. To address these questions, we conducted a spoken Metaphor Interference Effect (MIE) task, specifically designed to mitigate any potential influence primarily arising from reading difficulties in the group of individuals with dyslexia.

Our findings indicate that individuals with dyslexia automatically generate the metaphorical meaning, since a MIE was observed in both the dyslexia and control groups. The generation of the figurative meaning in the early stages was further supported by the greater recall of metaphors compared to scrambled metaphors, a pattern observed in both groups, highlighting effective encoding of the metaphorical meaning. At the same time, however, individuals with dyslexia exhibited significantly lower

recall of metaphors compared to the control group. We attribute this difference to the common difficulties in word and sentence retrieval associated with dyslexia (Hanly & Vandenberg, 2010; Mengisidou et al., 2020), which, in our study, also extends to metaphorical expressions.

Regarding our second research question, we observed no differences in how individuals with and without dyslexia inhibit the unintended meaning. Both groups exhibited comparable Metaphor Interference Effect (MIE) sizes and accuracy rates in judging the sentences, indicating that the selection stage is unlikely to be the source of the previously identified issues with metaphor comprehension. Consequently, we propose that potential impairment in understanding metaphors may arise in later stages, such as when the meaning needs to be integrated into broader contexts.

The processing of metaphorical meaning involves the activation of semantic representations (a bottom-up process) as well as the inference of broader contextual meaning (e.g., a top-down process; Burgess & Chiarello, 1996). Another hypothesis is that previous studies involved tasks that required explaining the metaphorical meaning (e.g., Cappelli et al., 2018; Griffiths, 2007), which could be challenging for individuals with dyslexia, who often experience difficulties with word retrieval and discourse organization (McLoughlin & Leather, 2013). Therefore, our results contribute to clarifying the comprehension profile of people with dyslexia, suggesting that impairments may stem from difficulties in integrating metaphors within a discourse context rather than initial semantic activation involving the processing of a figurative resemblance between concepts.

As far as our third research question is concerned, our findings revealed that executive functions and familiarity played a less significant role in the MIE than initially anticipated. When considering working memory, no substantial correlations emerged. This result contrasts with the findings of Pierce and colleagues (2010), who proposed that the magnitude of the MIE is predicted by working memory capacity, with higher working memory leading to a smaller MIE. However, we attribute this discrepancy to the different working memory measures used in our study compared to those used by Pierce et al. (2010), where working memory span and inhibitory control (specifically, suppressing proactive interference) were assessed simultaneously.

However, our results contribute to disentangling the roles of working memory capacity and inhibitory control, highlighting that the latter plays a more significant role in moderating the MIE. Table 6 indicated that inhibition correlated with the MIE size (i.e., the difference in reaction times between metaphorical items and scrambled items) only for high-familiarity metaphors. This suggests that less familiar metaphors might be more easily rejected and do not necessitate specific inhibitory skills. This outcome aligns with the findings of Di Paola et al. (2019), who observed longer response times for high-familiarity metaphors, something that seems to point to an increased effort. Despite this, our study did not reveal any other differences related to familiarity in modulating the MIE, neither in the dyslexia nor in the control group. In Di Paola et al. (2019), participants took significantly longer to judge high familiar metaphors as literally false, but this was not the case for low-familiarity metaphors, which participants judged as quickly as their anomalous scrambled counterparts. We argue that the difference between the stimuli used in Di Paola et al. (2019) and ours might have contributed to this variation. In fact, they used longer metaphors with additional adjectives or adverbs that could increase the complexity of sentence judgment, and their manipulation of high vs. low familiarity only involved the vehicle, while we also provided different topics.

6. CONCLUSIONS

The conducted spoken MIE task in this investigation has provided evidence that metaphorical meaning is automatically accessed in individuals with dyslexia. The observed pattern of effects and accuracy rates in this group closely resembles those of individuals without dyslexia. Both the dyslexia and control groups exhibited a higher recall rate for metaphors compared to other types of literally false sentences, indicating a more profound encoding of the metaphorical meaning. However, individuals in the dyslexia group displayed an overall lower recall rate than the control group across all sentence types. This suggests that metaphors are subject to the same diminished word/sentence retrieval challenges observed in dyslexia.

Our results seem to exclude that people with dyslexia have issues that are specifically related to figurative language. Even if metaphors are automatically processed as such by people with dyslexia, difficulties that were found in previous studies in the literature may be due to a less efficient construction of the appropriate meaning, or downstream contextual processes, something that was not assessed in the present study. The third study of this dissertation will be aimed at considering metaphor processing and consequent meaning construction and integration in context.

CHAPTER 5

Understanding and appreciating metaphors in academic texts

ABSTRACT

The third study delves into the impact of metaphors on academic text comprehension. While metaphors are commonly employed by scholars to enhance conceptual understanding, their influence on how students, including those with dyslexia, learn from academic texts remains unexplored. This research aims to evaluate how metaphors affect overall comprehension in university students with dyslexia. Excerpts from scientific articles featuring novel metaphors were adapted for presentation in two comparable conditions: metaphorical and literal. Participants underwent a multiple-choice comprehension task for two texts, one for each condition, and provided evaluations of text perception. The results revealed that, when controlling for reading ability, students with dyslexia exhibited significantly lower comprehension scores specifically in texts containing metaphors. This occurred despite comparable perceived complexity and increased interest in metaphorical texts.

1. INTRODUCTION

Metaphor engages cognitive processes that are crucial for a comprehensive understanding of text, and "reaching full-fledged metaphor skills represents an important achievement in language

development" (Tonini et al., 2022). Conceptually, comprehending a metaphor necessitates nearly the same cognitive abilities as general reading comprehension. As pointed out by Contini (2012), understanding a metaphor involves: (i) integrating new meanings and constructing broader mental representations; (ii) selecting the most pertinent information based on the context; (iii) activating background knowledge; (iv) drawing inferences; and (v) employing cognitive strategies to manage the process. However, the "opacity" or "novelty" of certain metaphors likely demands more cognitive effort from the recipient. In contrast to conventional metaphors, which are encoded in our mental lexicon and primarily reflect our familiar way of interpreting experiences (Lakoff & Johnson, 1980), novel metaphors are unfamiliar to the reader or listener. Metaphors are often intentionally created to convey new and conflicting meanings that should be resolved to grasp the speaker's intentions (Steen, 2015). They emerge from the portrayal of intricate and conflicting meanings that challenge the foundations of conceptual coherence (Prandi, 2021). Therefore, novel metaphors do not "prompt the recipient to look back and recognize familiar concepts, but rather to look forward in search of a creative solution to an unresolved problem" (ibid., p. 40, translated).

Undoubtedly, context plays a pivotal role in this process (Stamenković et al., 2020). While many studies on metaphor comprehension concentrate on isolated metaphors for experimental simplicity, it is crucial to recognize metaphor as a context-sensitive phenomenon (Camp, 2006), typically embedded within a broader discourse. Within this context, the conceptual framework assists in generating a more precise interpretation. Carston's (2012) review suggests that metaphorical meaning can be quickly derived, comparable to literal meaning, if the context provides sufficient support. This observation is corroborated by a neuroimaging study revealing no discernible processing difference between metaphors and corresponding literal sentences in an appropriate context (Hartung et al., 2020). Conversely, a context aligning more with a literal interpretation can impede the metaphorical one (McGlone & Manfredi, 2001). It is plausible, then, that a supportive context facilitates the integration of metaphorical meaning (Lemaire & Bianco, 2003) and diminishes the cognitive effort associated with analogical reasoning.

2. CURRENT STUDY

Prior investigations into metaphor comprehension in individuals with dyslexia – including our Study 1 and 2 – have predominantly employed isolated metaphors, lacking contextual or linguistic cues, despite suggestions that context can influence comprehension. This research study specifically targets university students with dyslexia, a population whose enrollment in higher degree programs is steadily increasing, as indicated by the ANVUR report for Italy (2022). There is a growing focus on addressing the specific needs of these learners, even in adulthood. While efforts are often made to implement compensatory or dispensatory measures during exams or educational activities, little consideration is given to their actual ability to comprehend academic texts (Pedersen et al., 2016). Academic texts pose unique linguistic challenges for individuals with dyslexia, including anaphoric references, logical connectors, and passive sentences (Vender, 2017; Cardinaletti, 2018; Simi, 2021). According to a study by Steen (2010), metaphors constitute approximately 18.5% of academic texts. Hence, if university students with dyslexia struggle to grasp metaphorical meaning, their comprehension of study texts would be further hindered. In the realm of education, metaphors have always been considered tools for discovery, enabling learners to visualize and recall abstract concepts (Duit, 1991). However, previous research on metaphors as pedagogical tools has not explicitly addressed the need for inclusivity in teaching practices for students with dyslexia.

This third research study aims to evaluate the influence of metaphors in academic texts on text comprehension in university students, comparing those with and without dyslexia. Therefore, the primary research question revolves around whether metaphors in academic texts hinder text comprehension or facilitate it. To address this question, participants were presented with either a literal or a metaphorical version of two academic texts specifically created for this study. Subsequently, they completed a comprehension task. In addition to this, participants underwent a standardized assessment of general reading comprehension and cognitive abilities, including reading speed, reading accuracy, and working memory, which are closely linked to the dyslexic profile (Chapter 1).

3. METHODS

3.1 Participants

A total of 58 university students took part in this study. The dyslexia group (D) consisted of 28 young adults (7 males, 21 females, mean age = 22.75, SD = 3.85) with developmental dyslexia and no associated comorbidities. The control group (C) comprised 30 young adults (9 males, 21 females, mean age = 24.33, SD = 5.1) with no learning difficulties. Both groups were primarily recruited through announcements on the Laboratory of Language and Cognition website and via coursemates of students undergoing an internship at the laboratory. Participants with dyslexia were additionally recruited through the office for students with Special Needs at the University of Genoa, which sent an email promoting this optional opportunity.

The two groups exhibited no significant differences in age (t= 1.33, p=0.91) or gender distribution, χ^2 (1) = 0.181, p = 0.67. They also showed no significant differences in terms of education level, χ^2 (2) = 5.15, p = 0.08. Within the C group, 34.5% held a high-school diploma, 8.6% held an undergraduate diploma, and 8.6% held a post-graduate diploma. In the D group, 36.5% held a high-school diploma, 8.6% held an undergraduate diploma, and 3.4% held a post-graduate diploma.

All participants had Italian as their first language and were not bilingual. Participants with dyslexia confirmed their previous diagnosis by presenting clinical documentation to the experimenter. The study received approval from the University of Genoa Ethics Committee (decree n. 2023/21). Informed consent was obtained from all participants, and debriefing occurred at the conclusion of the session.

3.2 Individual differences assessment

To measure individual differences in reading, comprehension and working memory skills, the following battery of standardized tests was applied.

Reading speed and accuracy. The evaluation of these skills employed the word and nonword reading tasks from the LSC-SUA battery (Cornoldi et al., 2020). Participants were instructed to read aloud, as quickly and accurately as possible, four lists of words varying in length and frequency of use (word reading task) and two lists of nonwords (pronounceable but nonexistent strings of letters in the Italian language) with differing lengths (nonword reading task). Z-scores were calculated based on normative values for accuracy (number of reading errors) and speed (syllables per second), referencing the age group of 18-35 years.

Working memory. Working memory was evaluated using the digit span tasks from the 4th edition of the Wechsler Adult Intelligence Scale (WAIS-IV) (Wechsler, 2008). In the forward digit span task, participants were presented with progressively longer sequences of numbers, which they had to reproduce in the same order. Conversely, in the backward digit span task, participants were required to repeat the numbers in reverse order. Performance in both tasks was assessed based on the total number of sets of digits accurately recalled by the participants.

Reading comprehension. This skill was evaluated using the written comprehension task from the LSC-SUA battery (Cornoldi et al., 2020). The task required participants to silently read a text followed by multiple-choice questions. The test had no time constraints, allowing participants to refer back to the text as needed. The readability of the text was assessed using the Gulpease Index (= 43). Following the classification by GULP (Gruppo Universitario Linguistico Pedagogico, University of Rome La Sapienza), readers with a high school diploma can easily comprehend texts with an index higher than 40. Each correct answer earned 1 point, while incorrect answers received 0 points. Z-scores were computed based on the normative values provided in the test manual for the age range of 18-35.

3.3 Metaphor comprehension task

For the comprehension task, four experimental texts were specifically crafted for the study (available in the Appendix C). These texts were tailored to simulate scientific research articles. Two texts were designed for the metaphorical condition, while the other two served as their corresponding literal counterparts, and were created after the metaphorical versions. The novel metaphors used in the metaphorical texts were sourced from Mastroianni (2016) and Di Ricco et al. (2016). The selected topics of the two texts were intentionally chosen to be interdisciplinary and of a general nature, with the aim of minimizing potential effects primarily linked to participants' background knowledge or field of study. Text A delved into people's attitudes toward the internet, while text B explored the role of teachers in our society (Table 1).

	Met	Lit
Text A	A study by Mastroianni (2016) has shown how people's attitude online has changed over the years. […] From the very beginning, in fact, there has been a discrete and hardworking population that saw the Web for what it is: **a land to cultivate**. Digital **farmers**, while others didn't even notice, understood that arguments and disputes are not the solution; instead, it is the quality of **food** provided to people that matters. [Translated from Italian]	A study by Mastroianni (2016) has shown how people's attitude online has changed over the years. […] From the very beginning, in fact, there has been a discrete and hardworking population that saw the Web for what it is: **an opportunity for creation**. Digital **creatives**, while others didn't even notice, understood that arguments and disputes are not the solution; instead, it is the quality of **contents** provided to people that matters. [Translated from Italian]
Text B	A completely different perception is held by other interviewed teachers, who identify themselves as **silkworms**. They recognize the weight of bringing value to today's society, in addition to the significant challenges faced by the education system and the limitations	A completely different perception is held by other interviewed teachers, who see themselves as **producers of something valuable**. They recognize the weight of bringing value to today's society, in addition to the significant challenges faced by the education system and the limitations

	imposed by the lack of investments in this sector. However, their moment of **transformation into butterflies** is perceived as distant in time. [Translated from Italian]	imposed by the lack of investments in this sector. However, their moment of **positive transformation** is perceived as distant in time. [Translated from Italian]

Table 1. Excerpts of the experimental texts.

In both the metaphorical and literal conditions, consistency in the readability of the texts was maintained concerning word length, word frequency, syntax complexity, and vocabulary complexity. These conditions were assessed with the Gulpease and Read-It indexes, calculated using the DyLanTextTools platform (http://www.italianlp.it/demo/read-it/), developed by the Italian Natural Language Processing Lab at CNR in Pisa (Dell'Orletta et al., 2011). The Gulpease index gauges the readability of a text by considering factors such as word length (measured in letters), word count, and sentence length. Higher Gulpease scores indicate greater readability of a text. The Read-It index (Global) is a model that evaluates the lexical and syntactic difficulty of a text as a percentage. The four experimental texts exhibited a Gulpease index between 45 and 49, and a Read-It index (Global) between 98% and 99%. These indexes indicate that all texts are readable but sufficiently complex for students who already possess a high school diploma.

Each participant received two texts (A and B), one in the literal condition and one in the metaphorical condition, ensuring randomization and preventing a specific text version from consistently appearing first through a Latin Square design. This design also guaranteed that participants did not encounter both versions of the same text. The texts were presented using light gray paper and a sans-serif font, sized at 14 points, with double line spacing, in accordance with guidelines for enhanced readability (Rello & Baeza-Yates, 2017). Participants were instructed to read the passages silently and subsequently respond to the provided questions. There was no time limit for completing the task, and participants had continuous access to the text, being free to refer back to it as needed.

3.3.1 Multiple-choice questions

Comprehension was assessed using a multiple-choice task that included eight questions for each text (A and B), with the same questions across conditions. Task design followed the guidelines outlined by Lastrucci (2019) for creating reliable multiple-choice items. All questions adopted the same structure (i.e., an affirmative sentence to complete followed by a colon), as exemplified by the translated example reported in Table 2.

The "discreet and hardworking" population:
a) was able to use the web productively.
b) chose to avoid using the web because it is too violent.
c) learnt how to manage discussions with other users.

Table 2. Example of question (translated) from text A.

This approach aimed to prevent participants from spending unnecessary time and cognitive effort in adapting to varying logical and formal presentations. Response options were crafted to be as homogeneous as possible in terms of length, syntactic structure, and information amount. Each option was both plausible and relevant to the text, aiming to avoid exclusion based solely on logical reasoning. For ecological validity, each question featured three response alternatives, with only one correct answer, a format that was more suitable for participants with dyslexia. In fact, Cardinaletti (2018) cautioned against including four or five alternatives, as this could elevate cognitive load and compromise effective text comprehension measurement in this population.

All questions sought to gauge participants' overall understanding of the topic. The examiner provided a clear explanation of the test characteristics and emphasized the importance of selecting a single option for all questions. In instances where participants found multiple answers plausible, they were instructed to choose the option that seemed most correct. Participants were also informed of the opportunity to revise their answers if they reconsidered their initial responses. Each correct answer was assigned one point, while each incorrect answer received zero points.

3.3.2 Self-reported measures

As a concluding task, participants were requested to provide two self-reported measures for each text they read. These measures pertained to the difficulty of the text ("How difficult did you find this text?") and the level of interest in the text ("How interesting did you find this text?"). The objective of these measures was to examine whether the metaphor condition could influence the perceived difficulty and participants' appreciation of the text. Responses were collected using a Likert scale ranging from 1 (very poor) to 5 (very good).

3.4 Procedure

All participants underwent individual testing before the main task, adhering to standardized procedures as outlined in the test manuals. Initial assessments encompassed reading abilities and working memory. Following this, participants engaged in the two experimental comprehension tasks without time constraints. The concluding test was the reading comprehension segment from the LSC battery. Participants were encouraged to have some breaks after each task. The entire session, conducted by three trained members of the research team, lasted approximately one hour in a quiet room.

4. RESULTS

Inferential analyses were conducted using linear mixed effects models in which we used R (R Core Team, 2012) and lme4 package (Bates et al., 2012). The emmeans package (Lenth, 2022) was used to break-down any significant interactions. We included subjects and items as random effects, and maximally specified models, including random intercepts for both subjects and items. In the event of fit issues (convergence or singularity), we simplified random slopes for items and then subjects. Results for

the individual differences variables began with examination of bi-variate correlations. After identifying which variables correlated with our comprehension task, we conducted multiple regression analyses.

4.1 Metaphor comprehension task

For comprehension accuracy, we fitted a linear mixed model with *comprehension accuracy* as the outcome variable, *condition* (metaphorical, literal) and *group* (DYS, TD) as fixed effects, and *item* and *participant* as random effects. Global reading ability (mean score of word and nonword reading skills) was included as a covariate.

Results showed a significant main effect of condition (SE = 0.69; β = 1.45; t = 2.09; p = 0.036) and a significant interaction between condition and group (SE= 0.42; β = -0.89; t = -2.13; p = 0.033), indicating that the impact of condition on comprehension scores varied between the two groups. No main effect of group was evident (SE= 0.41; β = -0.06; t = -0.15; p = 0.873) nor other interactions.

Further investigation through post-hoc tests revealed that both the C group (t =-2.4, p = 0.016) and the D group (t = 2.21, p = 0.03) exhibited significant differences in scores between the metaphorical and literal conditions. However, the direction of the effect was divergent for the two groups: the control group performed better in the metaphorical condition, while participants with dyslexia obtained higher scores in the literal condition.

Concerning between-group divergences, a significant difference was identified in the metaphorical condition (t = 2.9, p = 0.005) and not in the literal one (t = -1.006, p = 0.31), as depicted in Figure 1. This implies that the impact of the metaphorical condition on comprehension scores significantly varied between the C and the D groups. The dyslexia group encountered more challenges in the metaphorical condition.

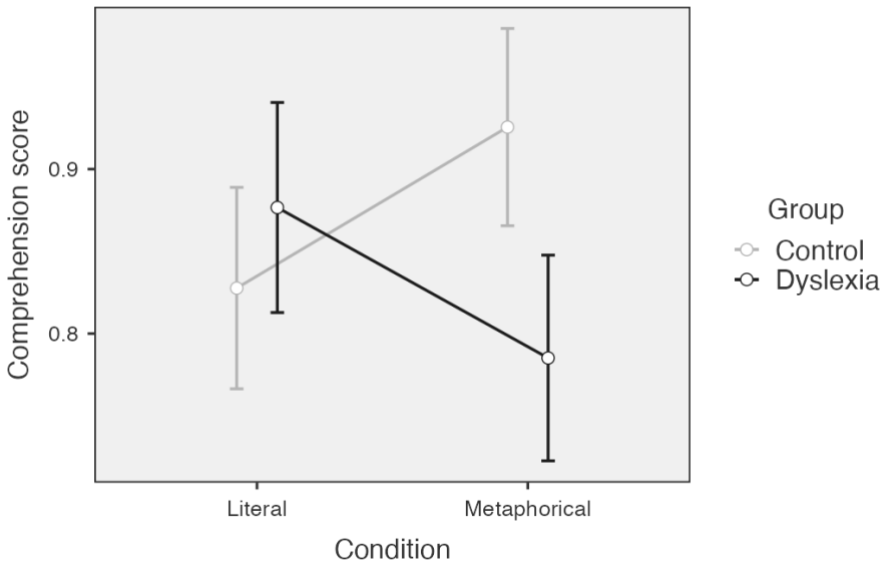

Figure 8. Comprehension scores.

We report in Table 3 the estimated marginal means for each condition and group.

	C (N=30)	**D (N=28)**
	Mean (SE)	*Mean (SE)*
Condition		
Metaphorical	0.92 (0.02)	0.78 (0.03)
Literal	0.82 (0.03)	0.87 (0.03)

Table 3. Estimated marginal means in multiple-choice questions.

4.2 Cognitive abilities

Comprehensive measures of working memory and reading abilities were integrated into the tested models. The mean of the forward and backward digit span was calculated to derive a global working memory measure. Similarly, the scores from the words and nonwords tasks were averaged to obtain a

global measure for reading speed and accuracy. A composite measure of overall reading ability was then computed by combining the global measures for reading speed and accuracy.

T-test comparisons between the D and the C group in the standardized test revealed the expected profile associated with dyslexia. Despite being university students, participants with dyslexia exhibited significant differences compared to the control group in working memory, as well as in word and nonword reading speed and accuracy. Additionally, the two groups demonstrated lower reading comprehension abilities (Table 4).

	C (N=30)	D (N=28)	*t*-value	*p*-value
	Mean (SD)	*Mean (SD)*		
Working Memory				
Digit span forward	6.23 (1.07)	5.57 (0.83)	2.61	0.012 *
Digit span backward	5.03 (1.07)	4.21 (0.95)	3.07	0.003 *
Global working memory	5.63 (0.9)	4.89 (0.71)	3.46	0.001 *
Word reading (z-scores)				
Syll./sec.	0.3 (0.99)	- 0.8 (1.76)	3.04	0.004 *
Accuracy	-0.06 (1.03)	- 1.83 (1.91)	4.44	< .001 *
Nonword reading (z-scores)				
Syll./sec.	0.45 (1.25)	- 1.01 (1.71)	3.73	< .001 *
Accuracy	0.02 (1.47)	- 1.89 (2.52)	3.57	< .001 *
Global reading speed	0.3 (0.88)	- 0.97 (1.44)	4.16	< .001 *
Global reading accuracy	- 0.01 (1.16)	- 1.86 (1.99)	4.34	< .001 *
Global reading ability	0.18 (0.71)	- 1.38 (1.35)	5.58	< .001 *
Reading comprehension (z-scores)				
LSC	0.61 (0.79)	0.07 (0.92)	2.4	0.02 *

Table 4. Descriptive statistic and t-test differences between groups for reading, comprehension and working memory standardized measures

To examine the relationships between the assessed cognitive abilities and the performance in the experimental comprehension task, bivariate correlations were conducted (Spearman ϱ, see Table 5). The metaphor comprehension was correlated with reading accuracy, working memory, and reading comprehension. In contrast, the comprehension score in the literal condition exhibited correlations with

reading speed and reading comprehension. This suggests that when dealing with metaphors, a more comprehensive array of cognitive abilities is necessary to attain comprehension.

	1	2	3	4	5	6
1. Global reading speed	—					
2. Global reading accuracy	0.374 **	—				
3. Global working memory	0.414 **	0.304 *	—			
4. LSC Comprehension	0.142	0.339 **	0.099	—		
5. Score MET condition	0.179	0.359 **	0.300 *	0.368 **	—	
6. Score LIT condition	0.261 *	0.132	0.142	0.298 *	0.109	—

Table 3. Bivariate correlations between individual differences variables and comprehension.

Note. * p < .05, ** p < .01, *** p < .001

Since global working memory significantly correlated with accuracy in the metaphor condition, we wanted to further explore its role by include it as a predictor in our model. When global working memory was included, its effect only approached significance (SE= 0.1; β = 0.18; t = 1.82; p = 0.06). However, when digit span forward and digit span backward were separately included as predictor in the model, the effect of digit span forward was significant (SE= 0.08; β = 0.2; t = 2.34; p = 0.01). No other interaction, nor effects related to digit span backward emerged.

4.3 Metaphor effect on perceived difficulty and interest

Two separate linear mixed models with *condition* (metaphorical, literal) and *group* (DYS, TD) as fixed effects, and *item* and *participant* as random effects were fitted to investigate the effects of condition (i.e., metaphor, literal) on self-reported difficulty of the text and interest in the topic respectively.

Regarding the perceived difficulty of the text, no significant effects nor interaction were found. Both groups rated the texts as relatively easy, with no observed differences between the metaphorical and literal conditions (see Figure 2).

Concerning interest in the topic, an interaction emerged between condition and group (SE= 0.08; β = 1.12; t = 12.7; p = <.001), while no main effect of group was evident (SE= 0.21; β = -0.4; t = -1.88; p = 0.06). Post-hoc analyses revealed that the control group assigned significantly different scores to the metaphorical and literal conditions (t = -3.1, p = 0.002), whereas participants in the dyslexia group did not exhibit such differentiation (t = 1.4, p = 0.15). Additionally, the two groups differed in the scores assigned to the metaphorical texts (t = -2.4, p = 0.01). As illustrated in Figure 2, the D group demonstrated a higher level of appreciation for the metaphorical text compared to the C group (Table 6).

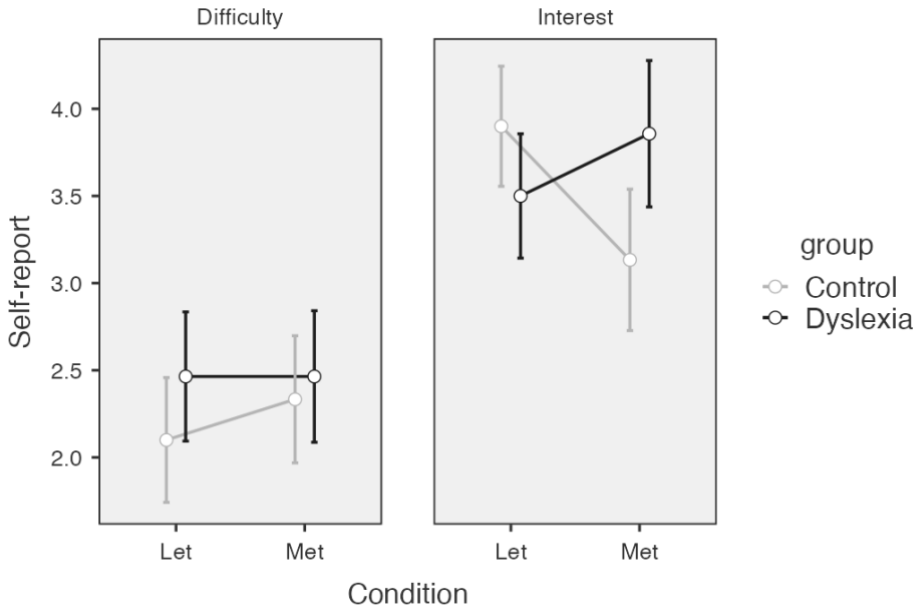

Figure 9. Self-reported scores on difficulty of the text and interest in the topic.

	C (N=30)		D (N=28)	
	Mean (SE)		*Mean (SE)*	
	LET	MET	LET	MET
Difficulty	2.10 (1.17)	2.33 (1.18)	2.46 (1.19)	2.46 (1.18)
Interest	3.90 (0.17)	3.13 (0.20)	3.50 (0.17)	3.86 (0.21)

Table 4. Estimated marginal means of self-reported measures for each condition and group.

5. DISCUSSION

The present research aimed to explore the influence of metaphors in academic texts on comprehension among university students, with a specific focus on individuals with dyslexia. The central research question sought to determine whether metaphors in academic texts impede or enhance comprehension in adults with dyslexia. To address this question, participants engaged in a reading comprehension task that involved both a literal and a metaphorical version of an academic text, crafted specifically for this investigation. The multiple-choice comprehension task utilized in this study was not tailored to specifically assess the understanding of metaphorical meanings. Instead, its purpose was to evaluate the overall comprehension of the textual content. Consequently, the same task was implemented in both the metaphorical and literal conditions.

5.1 Metaphor comprehension task

Our findings suggest that university students with dyslexia encounter difficulties when confronted with metaphors in academic texts. Notably, significant differences between groups were identified solely in the metaphorical condition, where individuals with dyslexia exhibited lower performance compared to their counterparts. While both groups demonstrated comparable performance in the literal condition, the control group, when controlling for reading skills, outperformed participants with dyslexia in the metaphorical condition.

Prior research on metaphor comprehension in dyslexia has yielded mixed results, but often relatively simple and decontextualized metaphors were employed. Metaphors embedded in academic texts, already inherently intricate, may potentially amplify challenges in overall text comprehension. The question arises as to whether these metaphors bear similarities to literary metaphors. In academic writing, authors frequently employ novel metaphors to enrich conveyed meaning, enhance the explanation of abstract concepts, or achieve stylistic goals. Literary metaphors are often deemed more challenging for readers.

In a machine-learning analysis conducted by Jacobs and Kinder (2017, 2018) on a collection of literary metaphors normed by Katz et al. (1988), specific qualities that distinguish literary metaphors from experimentally created ones were revealed. These distinctive features include high surprisal (a statistical measure of word unexpectedness), dissimilarity between the source and target concepts, the combination of concrete words with complex grammar and lexical diversity, as well as an additional level of difficulty in comprehending the metaphorical meaning. These collective properties suggest that apt literary metaphors exhibit a notable degree of cognitive complexity, as discussed in Holyoak (2019), Lakoff and Turner (1989), and Stamenković et al. (2020).

On the other hand, considering the existing evidence on the impact of context in everyday metaphor and language processing (Stamenković et al., 2020; Gerrig & Healy, 1983; Gildea & Glucksberg, 1983; Inhoff et al., 1984; Ortony et al., 1978), one might reasonably anticipate that the textual dimension (i.e., the information within the text), plays a significant role in facilitating comprehension. This facilitation occurs by enhancing predictability and meaningfulness, while reducing difficulty (Pynte et al., 1996). However, our findings do not entirely align with this perspective. As demonstrated in the study by Bambini et al. (2014), literary metaphors are perceived as less familiar when contextualized compared to when presented as isolated phrases. In the absence of context, subjects are prompted to process metaphorical phrases without interpretational cues. While the context of everyday discourse and conversation appears to facilitate comprehension, literary texts seem to foster mechanisms that render metaphors more accessible to diverse interpretations across different scenarios, rather than making them more familiar (Bambini et al., 2014). This characteristic aligns well with the distinctive feature of literary metaphor highlighted in pragmatics, namely the open-endedness of the interpretative activity (Pilkington, 2000).

Assuming that the metaphors used in our stimuli can be regarded as akin to literary metaphors, deliberately included by the author to convey deeper meanings, it is conceivable that the difficulties faced by individuals with dyslexia in constructing coherent interpretative scenarios may have played a role in our results. These challenges align with previous investigations into the pragmatic abilities of adults with

dyslexia (Cappelli et al., 2018; Griffiths, 2007), suggesting that this population may encounter difficulties in efficiently interpreting pragmatic content. Moreover, the lower performance of adults with dyslexia in Theory of Mind tasks (Cappelli et al., 2018) could potentially impact their ability to comprehend the author's point of view and intention when introducing a metaphor in context. Prior studies that focused on interpreting metaphors in isolation (Kasirer and Mashal, 2017) required individuals with dyslexia to extract the metaphorical meaning without the necessity to integrate it into a broader context or align it coherently with the specific text and author's intentions. Furthermore, they might have drawn upon their well-developed creative abilities (Cancer and Antonietti, 2020), which could be inhibited when comprehending a text written by others, especially in the context of answering multiple-choice questions. As demonstrated by Kasirer and Mashal (2017), adults with dyslexia outperform control participants in generating new metaphorical meanings. However, these observations remain speculative and definitive conclusions cannot be drawn. This area requires further research, as the comprehension hindrance for individuals with dyslexia when metaphors are "provided by others" may be in contrast with the potential enhancement in the learning process through the act of creating metaphors.

5.2 Reading abilities, working memory and metaphor comprehension

Given the association between impaired reading abilities, written comprehension difficulties, and reduced working memory skills in individuals with dyslexia, differences among participants in all these measures were considered in our analyses. In line with prior research on the cognitive profile of adults with dyslexia (e.g., Cancer & Antonietti, 2018), participants with dyslexia scored significantly lower than the control group in standardized tests assessing written comprehension, reading speed, reading accuracy, and working memory. Following the tenets of The Simple View of Reading (Gough & Tunmer, 1986), challenges in text comprehension in dyslexia can be attributed to impairments in reading speed and accuracy. Once reading speed and accuracy were accounted for, no difference in literal comprehension emerged between participants with and without dyslexia.

However, the reading comprehension task from the LSC battery might not be directly interchangeable with the experimental literal comprehension task. The LSC task requires inferential skills more closely aligned with those needed in the metaphorical condition. Despite the text in the LSC battery having similar legibility indexes compared to our experimental texts, it comprises a larger number of questions, seven of which involve inferential skills. As a standardized test designed to evaluate the broader comprehension abilities of adults, it is not exclusively literal, as it is intended to assess the capacity for extracting information, inferring implicit meanings, and making inferences.

We also investigated the relations between the examined abilities and performance in the experimental comprehension task through bi-variate correlations. The comprehension score in the metaphorical condition exhibited correlations with reading accuracy, working memory, and reading comprehension, while the comprehension score in the literal condition correlated with reading speed and reading comprehension. These findings suggest that both reading accuracy and working memory play roles in the comprehension of metaphors. The involvement of working memory in metaphoric interpretations, especially for novel metaphors, and its specific role in suppressing irrelevant information through the central executive, has already been established in the literature (Mashal, 2013). The association with reading accuracy can be situated along a continuum within the dyslexia-related profile, indicating that higher accuracy may contribute to better preservation of cognitive effort for understanding metaphorical meanings.

5.3 Metaphor effect on perceived difficulty and interest

After completing the comprehension task, participants were asked to provide self-reported measures related to each text, specifically focusing on perceived difficulty and interest level. The objective was to examine whether the metaphor condition could influence participants' perception of difficulty and their appreciation of the texts. No significant differences were observed for perceived difficulty, as both groups rated the texts as relatively easy.

Interestingly, a notable disparity emerged in the measure of interest in the text. While control participants rated the texts in the literal condition as more interesting, participants with dyslexia rated the texts in the metaphorical condition as such. This result suggests that participants with dyslexia, despite obtaining lower scores in the metaphor comprehension task, demonstrated a higher level of appreciation for texts containing metaphors. These findings indicate that the use of metaphors may not be entirely detrimental for students with dyslexia. As pointed out in Cancer et al. (2016) and Lowe (2003), individuals with dyslexia appear to possess an enhanced ability to identify shared meaning between disparate elements, which may be beneficial in metaphor comprehension. This mode of thinking can foster originality in information processing, representing a valuable skill in the context of academic learning. Further research is necessary to understand the most effective ways to introduce metaphors, the suitable forms (e.g., visual), and how to make them effective tools for addressing various instructional needs.

6. CONCLUSIONS

The outcomes of this study contribute to our comprehension of how metaphors impact text comprehension in individuals with dyslexia. Our findings indicate that metaphors in academic texts present challenges for university students with dyslexia, as reflected in their lower overall comprehension scores in texts containing metaphors. Reading abilities and working memory appear to be influential factors in this process. Nevertheless, participants with dyslexia demonstrated heightened levels of appreciation for metaphorical texts, suggesting a positive impact of metaphors on perceived interest.

This study aimed to address several limitations observed in prior research by presenting metaphors in a more ecological yet experimental context, with the intention of drawing conclusions that could be beneficial for educators and writers. Often, authors intentionally incorporate novel metaphors into instructional or academic texts for specific purposes, not solely for embellishment but primarily to offer concrete imagery that can elucidate abstract concepts. Recognizing that this approach may lead to

comprehension difficulties for certain students, writers might reconsider their style to enhance accessibility. Simultaneously, educators should be encouraged not to overlook the significance of metaphors but rather provide training in techniques for extracting figurative meanings.

CHAPTER 6

Conclusions and future directions

ABSTRACT

In this concluding chapter, the outcomes of the three studies presented in this dissertation will be comprehensively discussed. Initially, we will consider metaphor comprehension in individuals with dyslexia, underlying the contributions that this research has made to the topic. Then, we will examine individual differences that modulated metaphor processing, while also acknowledging the limitations of the current research project. The latter part of the discussion will center on metaphors in educational settings. We will put forth hypotheses and outline potential avenues for future research, aiming to conceptualize how metaphors can be effectively employed as tools to support learning in students with dyslexia.

1. DISCUSSION ON THE RESULTS OF THE THREE STUDIES

1.1 Metaphor processing and comprehension

The three research studies presented in this doctoral dissertation aimed at clarifying the underlying processes of metaphor comprehension in individuals with dyslexia. In Study 1 (Chapter 3), the eye movements of adults with dyslexia were recorded during a Visual-World metaphor comprehension task,

alongside their response time for providing metaphorical interpretations. Interestingly, individuals with dyslexia did not display abnormal fixation patterns. The prolonged fixation time on the target (correct) picture, coupled with delayed reaction times compared to the control group, might indicate that processing differences are more intricately linked to language processing than to variations in how visual attention is distributed among the different images in the array. This aligns with perspectives that attribute slowness of processing in complex linguistic tasks to individuals with dyslexia, which do not necessarily correspond to a lack of comprehension of meaning. In fact, accuracy and response patterns in this initial task were comparable to those of the control group.

The timing delay observed in metaphor processing in Study 1 was further investigated in Study 2 (Chapter 4), focusing on early activation of metaphorical meaning. The study employed a Metaphor Interference Effect (MIE) task to explore potential impairments in the initial stages of metaphor comprehension. Multi-stage models of metaphors suggest that comprehending metaphors involves accessing relevant information for all words in the utterance, integrating this information to generate both literal and nonliteral meanings of the sentence, and finally selecting the intended meaning through the inhibition of irrelevant ones. The results of Study 2 did not reveal any evidence of delay or slowness in these early stages of metaphor processing, whether dealing with familiar or less familiar metaphors. However, it is important to note that those stages are significantly influenced by contextual information, which was not considered in Study 2 since it was specifically aimed at providing a more detailed understanding of the early activation of metaphorical meaning.

The influence of context on metaphor comprehension was explored in Study 3, where metaphors were embedded in longer texts. To ensure that our findings could be applied to the daily experience of our target population, we chose to examine academic texts. This decision was prompted by the fact that the majority of our participants were university students, likely to encounter challenges in comprehending intricate texts required for university exams. Our research question sought to uncover any potential impact of metaphor presence on overall text comprehension. Notably, our results indicated that metaphors in academic texts pose challenges for university students with dyslexia. While both groups

performed similarly in the literal condition, even after accounting for reading skills, the control group outperformed participants with dyslexia in the metaphorical condition. Difficulties in metaphor comprehension seem then to emerge in later stages, where the interpretative process extends beyond the figurative expression and encompasses broader contextual elements.

Nonetheless, our data suggest the hypothesis that the challenges faced by individuals with dyslexia may not solely arise from figurativeness; instead, they might also originate from difficulties in comprehending novel and implicit meanings. A recent eye tracking study by Egan et al. (2022) investigated reading times for similes in adults with dyslexia. Sentences were manipulated for novelty and figurativeness. Participants with dyslexia experienced greater difficulty compared to the control group in processing novel similes, both in figurative and literal conditions. Importantly, online eye tracking measures indicated that the difficulty was primarily associated with novelty itself rather than figurativeness, as readers with dyslexia demonstrated shorter first-pass reading times for figurative interpretations. Hence, these findings suggest a subtle anomaly in semantic processing when encountering unexpected or novel phrases. Considering inferences, a seminal study conducted by Simmons & Singleton (2000) revealed that students with dyslexia performed similarly to controls on literal questions, while their performance on inferential questions was poorer. This observation indicates that students with dyslexia may have specific impairments in constructing inferences when processing complex texts. As metaphor comprehension entails both the ability to understand novel elements in texts and to make inferences, any specific impairment in figurative language need to be further investigated before being conclusively attributed to the dyslexic profile.

1.2 Individual differences

The three research studies presented in this dissertation included assessments of cognitive abilities that were relevant to dyslexia *per se*, metaphor comprehension, or both. Results were then correlated with the experimental tasks to identify any possible influence of individual differences on metaphor

comprehension. The reasons why not all studies included all measures that have been identified as relevant for metaphor comprehension were that only Study 1 was conducted with an English-speaking sample, and the standardized tests were not always available for the Italian-speaking sample of Study 2 and 3. Second, participants in Italy didn't receive any payment for their time due to restrictions from the local ethics committee, then it was decided to keep the testing session as short as possible and to avoid cognitive overload in participants by limiting the tests carried out in one session. In the next paragraphs we are going to consider each of the recorded measures in our studies.

1.2.1 Reading skills

Skills related to reading were assessed in each of the three studies with different tasks (i.e., reading speed and reading accuracy of words and non-words, rapid automatized naming). In all studies, the group with dyslexia scored significantly lower than the control one in these measures, confirming that – even if other cognitive abilities were sometimes not impaired – reading issues persist in adulthood. Study 3 was the only one that required reading skills to complete the metaphor task, while in the other two studies metaphors were presented auditorily and in isolation. Interestingly, when global reading ability (mean score of word and nonword reading skills) was included as a covariate in the model, the difference between the dyslexia and the control groups in the metaphor task became significant, while no difference in literal comprehension was found. Moreover, the comprehension score in the metaphorical condition was found to be correlated with reading accuracy, working memory, and reading comprehension, while the comprehension score in the literal condition only correlated with reading speed and reading comprehension. These findings suggest that both reading accuracy and working memory play a role in the comprehension of metaphors in longer texts. Specifically, it might be that the more accurate a reader is, the more cognitive resources he or she could dedicate to infer and integrate the metaphorical meaning. This is in line with The Simple View of Reading, according to which difficulties in general written

comprehension in dyslexia can be accounted for by reading speed and accuracy impairments (Gough & Tunmer, 1986).

1.2.2 Executive functions

Working memory was evaluated using the WAIS-IV battery (Wechsler, 2008) across all three studies, either in the English or Italian version. The assessment encompassed both forward and backward digit span tasks to identify any potential distinct contributions.

In Study 1, a distinction was observed between the two groups in terms of forward digit span, while no significant difference was found in backward digit span. This finding contradicts expectations based on prior research on working memory and dyslexia. Nevertheless, Giofrè et al. (2016) emphasized that forward and backward versions of working memory span tasks engage different processes in typically developing and dyslexic children. Their investigation indicated that in those with dyslexia, working memory impairments were more pronounced for forward than for backward digit span. The authors argued that the two task versions measure distinct components of working memory, with dyslexia being more closely associated with dysfunctions in the component represented by phonological short-term memory than with dysfunctions in executive working memory (e.g., Swanson, 1999). Consequently, they proposed that impairments in dyslexia may predominantly concern the maintenance component, as measured by the forward span task, rather than the control component involved in backward digit span tasks. In the context of Study 1, it is also plausible that participants constituted a group of compensated individuals with dyslexia with well-developed strategies to mitigate difficulties in executive functions.

In Study 1, while comprehension accuracy (the offline measure) displayed a significant correlation with backward digit span, forward digit span exhibited a significant correlation with target fixations (dwell time). Interestingly, between group differences emerged only in target fixations, that appeared to be prolonged in those with dyslexia. Our results suggest that individuals with greater working memory capacity not only exhibit improved comprehension but also shorter target fixation times. We interpreted

this outcome as individuals with larger memory spans being capable of more rapidly encoding verbal information. Consequently, upon hearing the entirety of the sentence, they could swiftly redirect their attention to the "correct" picture and formulate their response.

In Study 2, the dyslexia group scored significantly lower than the controls in both forward and backward digit span. However, neither measure of working memory was correlated with the MIE size. This finding appears inconsistent with the proposition by Pierce et al. (2010), who suggested that the magnitude of the MIE is predicted by working memory capacity, theorizing that higher working memory is associated with a smaller MIE. We attributed this disparity to the different working memory measures employed in our study compared to the one used by Pierce et al. (2010), which encompassed both working memory span and inhibitory control, specifically, suppressing proactive interference. Thus, it appears that working memory capacity and inhibitory control play distinct roles in the MIE, with inhibition assuming a more prominent role. Indeed, in our study, the MIE size was correlated with inhibition for high-familiar metaphors. This seems to indicate that less familiar metaphors are more easily rejected and do not require particular inhibitory skills, a result that is in line with a previous study (Di Paola et al., 2019), which suggested increased difficulties in rejecting conventional figurative meaning, that are encoded in our mental lexicon and not newly created as in the novel ones.

In Study 3, participants with dyslexia scored significantly lower than the control group in both forward and backward digit span. To create a more comprehensive working memory measure suitable for inclusion in a complex model of reading comprehension, a mean of forward and backward digit span was calculated. This global working memory measure was found to be correlated with the comprehension score in the metaphorical condition but not in the literal condition; this might indicate that working memory plays a role in the comprehension of metaphors embedded in a context. Interestingly, in the regression model, the effect of global working memory only approached significance, while the effect of digit span forward was significant. As in our Study 1, digit span forward seems to have a more prominent role in the process of metaphor comprehension in dyslexia. The involvement of working memory in metaphoric interpretations, particularly novel ones, and its specific role in suppressing irrelevant

information through the central executive had been already identified in the literature (Mashal, 2013). In general reading comprehension, studies suggest that if local processes are weak, as is the case in dyslexia, working memory resources must be devoted to low levels of processing (i.e., decoding). This leaves fewer resources available for higher-level processing, such as integrating larger units of text and making inferences about the content (Ransby & Lee Swanson, 2003; Cappelli, 2022a). As noticed by Simmons & Singleton (2000), reading comprehension difficulties in people with dyslexia may not be evident when they are tackling shorter texts. Longer passages require information necessary for the formation of integrative inferences to be held for longer in working memory. This likely explains why difficulties with metaphor, as well as a more prominent role of working memory, only emerged in our Study 3, which required reading and understanding complex academic texts. It is plausible that in the metaphorical condition, students used their working memory capacity to process the metaphors and integrate them into a broader and complex context, thereby leaving fewer cognitive resources to comprehend the overall academic text.

1.2.4 Vocabulary

Vocabulary skills were assessed in Study 1 through the PPVT-4 (Dunn & Dunn, 2007). Due to the absence of standardization for an adult Italian population, this test was not employed in Study 2 and 3. The PPVT-4 offers a measure of receptive vocabulary, tapping on vocabulary breadth. It is particularly suitable for individuals with dyslexia as it involves an auditory presentation of a target word, and participants are required to choose the image that best represents the meaning. Contrary to tests of vocabulary depth, which often require participants to explain a concept and may pose challenges for individuals with dyslexia, the PPVT-4 provides a more accessible assessment. This is crucial given the potential issues with word retrieval and discourse organization that individuals with dyslexia may encounter, as highlighted in the evaluation of pragmatic skills by Cappelli et al. (2022).

In alignment with prior literature (refer to Chapter 1, Section 4.3.1), participants with dyslexia in Study 1 did not exhibit significant differences from controls in this measure of vocabulary breadth. Notably, the group with dyslexia included individuals with the three highest vocabulary scores in our sample. Despite these findings, vocabulary did not demonstrate a clear relationship with metaphor processing. Instead, a negative correlation was observed between vocabulary and comprehension accuracy, a result that contradicted expectations. Consequently, definitive conclusions regarding the role of vocabulary in metaphor comprehension among individuals with dyslexia cannot be drawn based on these partial results.

1.2.5 Theory of Mind

Theory of Mind (ToM) skills were evaluated in Study 1. In the Faux Pas task, the dyslexia group exhibited lower scores than the control group specifically in the target stories that demanded ToM skills. However, in our study, ToM did not exhibit any association with measures of novel metaphor processing, but they were correlated with filler idioms processing, whose figurative meaning is encoded in our mental lexicon and does not require on-site construction.

The relation between the capacity to understand others' mental states and the comprehension of non-literal language, especially metaphors, is not straightforward (Bosco et al., 2018; Gernsbacher & Pripas-Kapit, 2012). While some scholars argue that ToM alone may not be sufficient for comprehending metaphorical language (Norbury, 2005), others propose that this process involves grasping how another person perceives the world (Happé, 1993). In the context of individuals with dyslexia, Cardillo et al. (2018) found a correlation between verbal ToM abilities and metaphor comprehension in children. However, findings from Cappelli et al. (2018) for adults align with our results. It is plausible to hypothesize that the relationship between metaphor processing and ToM is more closely intertwined in development and becomes more independent in adulthood.

Recent research also suggests that the influence of Theory of Mind (ToM) varies based on the type of metaphor, with a more significant role for metaphors expressing psychological characteristics compared to those conveying physical attributes (Canal et al., 2022). Physical metaphors involve drawing inferences about physical traits (e.g., "Dancers are butterflies"), while mental metaphors require inferences about the psychological attributes of the subject (e.g., "Teachers are lanterns") and generally convey richer semantic representations (Canal et al., 2022). Lecce et al. (2019) investigated the idea that mental metaphors require greater involvement of ToM compared to physical ones. Although both types necessitate ToM as they involve inferring the speaker's meaning, only mental metaphors directly relate to mental attributes. Findings from the study by Lecce et al. (2019) supported this notion, suggesting that enhanced ToM skills were linked to improved understanding of mental (but not physical) metaphors in childhood. This perspective is further supported by other evidence showing distinct behavior in mental versus physical metaphors in children with neurodevelopmental disorders associated with ToM difficulties, such as autism spectrum disorder (Melogno et al., 2017).

While Study 1 predominantly considered physical metaphors, with no observed differences in accuracy rates, Study 3 primarily focused on mental metaphors describing the emotions of teachers and individuals on the internet. This distinction may have had implications for dyslexia, where ToM abilities seem to be compromised, although limited research has been conducted to draw a definitive conclusion on this matter.

2. APPLICATIONS IN THE FIELD OF EDUCATION

Metaphors have been a longstanding feature in educational settings, aiming to render concepts both engaging and comprehensible (Low, 2008). Educators frequently leverage the analogical nature of metaphors to provide explanations to learners who haven't yet mastered a theory, offering tangible examples that facilitate the visualization and recall of abstract concepts (Duit, 1991). However, research

suggests that for metaphors to effectively function as valuable tools for learning, students should (i) possess a foundational knowledge of the topic, and (ii) have the metaphorical connection explicitly presented (Cameron, 2003; Gentner & Toupin, 1986). In this way, metaphor transforms into an instrument for deeper understanding and memorization, rather than a tool for basic and immediate comprehension. This might in part explain why metaphors caused comprehension challenges in our dyslexia sample in Study 3. Spiro et al. (1989) observed that if a metaphor is introduced superficially, it can generate oversimplified and potentially inaccurate models of the concepts being taught. Furthermore, they suggested that using more than one metaphor could compensate for aspects being backgrounded by the others.

While the results of Study 3 allowed us to identify some comprehension issues when metaphors were included in academic texts, it was interesting to notice that participants with dyslexia appeared to appreciate the versions in the metaphorical condition more than those in the literal one. Drawing definitive conclusions from these partial data is challenging, but they can prompt further reflections based on the potentialities of individuals with dyslexia. Recent studies suggest that individuals with dyslexia may exhibit enhanced fluency and originality, two sub-processes of creative thinking (Cancer & Antonietti, 2020). The processing of novel metaphors requires a high degree of creativity (Abraham et al., 2021; Gold et al., 2012; Kenett et al., 2018), which is dependent on divergent thinking abilities, defined as the potential for creative thought that leads to the generation of original ideas (Runco & Acar, 2012). Therefore, since our data do not suggest that metaphors are entirely detrimental for people with dyslexia, future research should explore alternative ways of using metaphors within this population, particularly in teaching and learning contexts.

2.1 Training metaphorical competences

Specialized training programs could prove beneficial in enhancing students' understanding of metaphors, but existing literature on the topic is relatively sparse and mainly focused on children. Cortés et al. (2018) developed a training that involved 6-year-old children, who were asked to express physical

characteristics through metaphors (e.g., "The t-shirt is a tomato"). Their program resulted in improved metaphor production. Other programs were tailored for children in the Autism Spectrum Disorder (ASD), who often face challenges in metaphor comprehension (Melogno et al., 2017), and employed visual representations such as thinking maps. These maps consist in two main circles for the metaphor's topic and vehicle, with related features in smaller connected circles. Training programs by Mashal & Kasirer (2011), Melogno et al. (2017), and Persicke et al. (2012) proved effective and led to enhanced metaphor comprehension in children with ASD. Within a different approach, Tonini et al. (2022) developed a successful training for typically developing school-aged children. In line with Relevance Theory (Carston, 2012), their program focused on the adjustment of lexical concepts by selecting relevant properties and on the use of context to infer metaphorical meanings. Interestingly, results not only showed improved nominal metaphor comprehension but also increased reading comprehension abilities. These findings are relevant in relation to our Study 3, where metaphor difficulties coincided with reading comprehension challenges, and confirm that inferences such as those involved in metaphor understanding may impact reading comprehension skills. For these reasons, a possible future line of research may involve replicating this training with a sample of children with dyslexia. As far as adults are concerned, a training program addressing the pragmatics of communication in individuals with schizophrenia was developed by Bambini et al. (2022). It included exercises on figurative language, and results showed a final enhanced metaphor comprehension. An adaptation of these trainings to meet the needs of adults with dyslexia might yield promising outcomes, too. This potential is heightened because these programs are grounded in explicit teaching methods, strategically designed to foster metapragmatic awareness. Given that individuals with dyslexia demonstrate enhanced learning outcomes with explicit instruction in developing literacy skills (Moats, 2019), and considered the benefits of enhancing metacognitive awareness for their learning and comprehension strategies (Camahalan, 2006; Sharif et al., 2023), trainings with a specific and explicit focus on understanding metaphors in discourse could be particularly effective for this population.

2.3 Metaphor production

Another potential strategy to encourage the use of metaphors in learning is metaphor generation. Kasirer & Mashal (2017) demonstrated that adults with dyslexia exhibited superior performance in producing metaphors compared to those without dyslexia. A promising avenue for future research could therefore explore whether metaphor generation enhances the memorization of concepts. Numerous studies suggest that learning can be augmented when students critically engage with academic concepts by generating their own metaphors (see BouJaoude & Tamim, 2000). Specifically, students who generate their own analogies not only show improvements in critical thinking and problem-solving skills (Lancor, 2014; Middleton, 1991; Wittrock & Alesandrini, 1990) but also demonstrate greater recall of subject-specific details (Glynn, 1996). Given that students with dyslexia may at times encounter challenges in concept memorization and recall (Menghini et al., 2010), investigating whether metaphors could serve as support for these processes becomes particularly relevant. It is plausible that difficulties arising when metaphors are provided by others (as in our case, the authors of academic texts) may diminish when individuals create their own metaphors to memorize meaningful associations. This approach aligns with constructivist principles (Ackermann, 2001) and experiential learning (Kolb & Fry, 1974), which advocate for active engagement in activities to enhance information retention.

2.3 Reliance on embodiment

A further way to promote experiential learning might be found in the theoretical framework of embodied cognition. Embodied cognition posits that the activity of our mind is grounded in our bodily experience, with concepts mapped within our sensory-motor system (Barsalou, 2010; Lakoff et al., 1999). The role of the body in learning and teaching has roots in traditional pedagogical views, such as those of Dewey and Montessori (Ceciliani, 2021). In the realm of language learning, Asher (1966) introduced the Total Physical Response method, which involved using bodily gestures to memorize new words and structures in a foreign language. Recently, some scholars have delved into the debate about the role of

bodily enactment in language learning, positing that embodied techniques promote better comprehension and retention compared to form-based approaches (Della Putta & Suñer, 2023). Metaphor assumes a foundational role in theories of embodied cognition (refer to Chapter 2, Section 1.4), and it can be hypothesized that exploiting their embodied nature could enhance learning outcomes. An illustration of this idea is found in the work of Kömür & Çimen (2009), who explicitly employed conceptual metaphors to enhance the retention of English phrasal verbs. For example, through the metaphor ANGER IS HEAT, students learned idiomatic expressions like "to be hot-tempered", "to make one's blood boil", and "to burn with indignation". Their results indicated that this explicit training improved memorization and metaphorical awareness. However, the absence of a control group makes it challenging to compare the learning outcomes with a training that did not explicitly use conceptual metaphors.

To date, as far as we know, there are no studies involving individuals with dyslexia in learning interventions that employ embodied cognition as a framework. The sole suggestion in this context is from Daloiso (2020), who proposed to employ the conceptual metaphor WRITING IS TRAVELING to enhance writing skills in students with dyslexia; however, this proposal has not yet been tested experimentally. Nevertheless, this proposition aligns with the idea that metaphor facilitates the concretization of abstract concepts, presenting essential elements of the strategic competence required for composing a text in a foreign language in a more immediate form. Overall, these studies suggest that the embodied and experiential nature of metaphor may lead students to a more profound understanding of the content being taught, but further research is needed to test these hypotheses in the framework of dyslexia.

2.4 Visual metaphors

A concluding consideration revolves around the use of visual metaphors, wherein metaphorical concepts are conveyed through images (Kennedy, 1982). At a first glance, visual metaphors might appear particularly suitable for students with dyslexia, as they do not require decoding components. However, findings from a study by Cardillo et al. (2018) involving children with dyslexia revealed that, when

controlling for vocabulary skills, only the differences in a picture metaphor test remained significant between the dyslexia group and the control group. The authors hypothesized that when children "had to explain the meaning of a metaphor through images, in addition to weaknesses in verbal skills, difficulties in processing and integrating visual information probably emerged" (p. 252). Indeed, visual metaphors demand a higher level of abstraction than verbal metaphors and rely on the activation of language skills for comprehension, as demonstrated in an fMRI study by Ojha et al. (2017). Their results reported significant activation of Broca's and Wernicke's areas (responsible for language comprehension) while looking at visual metaphors, something that did not happen while they were looking at literal images. Moreover, they found that an area related to verbal memory (i.e., the *subgyral* in the right frontal lobe) was activated for both verbal and visual metaphor conditions, and that response times were longer in the latter condition. This suggests that the comprehension of visual metaphors might involve a more complex cognitive process. To the best of our knowledge, besides Cardillo et al. (2018), no other studies have explored visual metaphor comprehension in the context of dyslexia.

Research in education suggests that these types of metaphors can potentially enhance reading comprehension skills (for an extensive review, see Cardarello & Contini, 2012). In this scenario, the visual metaphor needs to be linked and integrated into a text, providing an additional layer of meaning. For instance, Danielson et al. (2015) demonstrated that supplementing a complex expository text with a meaningful visual metaphor improved both learning and information recall. They argued that this enhancement was due to an inductive process of semantic structure mapping triggered by the graphics. The only related evidence we have concerning dyslexia is from a study by Rivero-Contreras et al. (2021), who investigated the impact of visual support on sentence processing at both the text- and word-level. Their results, including eye-movement data, suggest that visual support has a facilitating effect on sentence processing. Therefore, one might infer that visual metaphors, when employed in conjunction with written text, could potentially enhance comprehension in individuals with dyslexia.

3. CONCLUSIONS

The three research studies conducted in this dissertation suggest that challenges in figurative language, particularly in metaphor comprehension, seem to manifest when inferencing and contextual integration skills are required for task completion. These cognitive processes heavily rely on working memory capacity, which tends to be lower in individuals with dyslexia. Consequently, the cognitive demands associated with inferencing the metaphorical meaning, integrating it into context, and simultaneously deciphering the author's intended message (a task that also necessitates Theory of Mind skills) may hinder overall comprehension processes. Based on these findings, we explored potential alternative approaches to introducing metaphors in educational settings or to providing training for individuals with dyslexia on how to "stretch" the meaning of texts.

We believe that avoiding the use of metaphors entirely is not the optimal solution. While it is acknowledged that limiting the use of excessive metaphors can enhance text accessibility, it's crucial to recognize that developing strategies for inferring meaning extends to general reading comprehension abilities. Moreover, within the context of the Italian school curriculum, understanding figurative language use is considered a fundamental skill assessed in the national evaluation known as INVALSI. This evaluation, which appraises the literacy competences of students from primary to higher secondary school, recognizes metaphors as a component that contributes to text complexity, along with identifying lexical relationships between concepts and understanding abstract notions (INVALSI, 2018). This underscores the significance of fostering figurative language comprehension skills to meet academic requirements, an imperative that encompasses students with dyslexia attending our classes.

References

Abraham, A., Rutter, B., & Hermann, C. (2021). Conceptual expansion via novel metaphor processing: An ERP replication and extension study examining individual differences in creativity. *Brain and Language*, *221*, 105007. https://doi.org/10.1016/j.bandl.2021.105007

Ackerman, P. T., & Dykman, R. A. (1993). Phonological processes, confrontational naming, and immediate memory in dyslexics. Journal of Learning Disabilities, 26, 597–609.

Ackermann, E. (2001). Piaget's constructivism, Papert's constructionism: What's the difference. *Future of Learning Group Publication*, *5*(3), 438.

Adlof, S. M., & Hogan, T. P. (2018). Understanding dyslexia in the context of developmental language disorders. Language, Speech, and Hearing Services in Schools, 49(4), 762–773. https://doi.org/10.1044/2018_LSHSS-DYSLC-18-0049

Adlof, S. M., Catts, H. W., & Little, T. D. (2006). Should the Simple View of Reading include a fluency component? *Reading and Writing*, 19, 933–958. https://doi.org/10.1007/s11145-006-9024-z

Adlof, S. M., Chan, J., Werfel, K., & Catts, H. W. (2022). Learning to read with a language or hearing impairment. *The Science of Reading: A Handbook*, 460-485.

Al-Azary, H., Gagné, C. L., & Spalding, T. L. (2021). Flute birds and creamy skies: The metaphor interference effect in modifier–noun phrases. *Canadian Journal of Experimental Psychology*, *75*(2), 175–181. https://doi.org/10.1037/cep0000251

Alvarez, J. A., & Emory, E. (2006). Executive function and the frontal lobes: a meta-analytic review. *Neuropsychology review*, *16*, 17-42.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). https://doi.org/10.1176/appi.books.9780890425596

Anderson, R. C., Hiebert, E. H., Scott, J. A., Wilkinson, I. A., Becker, W., & Becker, W. C. (1988). Becoming a nation of readers: The report of the commission on reading. *Education and Treatment of Children*, 389-396.

Andrews, M., Vigliocco, G., & Vinson, D. (2009). Integrating experiential and distributional data to learn semantic representations. *Psychological Review*, *116*(3), 463–498. https://doi.org/10.1037/a0016261

Angold A., Costello E. J., & Erkanli A. (1999). Comorbidity. *The Journal of Child Psychology and Psychiatry and Allied Disciplines*, 40(1), 57-87.

ANVUR (2022). Gli studenti con disabilità e DSA nelle università italiane. Una risorsa da valorizzare.

Arcara, G., & Bambini, V. (2016). A Test for the Assessment of Pragmatic Abilities and Cognitive Substrates (APACS): Normative Data and Psychometric Properties. *Frontiers in Psychology*, *7*. https://www.frontiersin.org/articles/10.3389/fpsyg.2016.00070

Arzouan, Y., Goldstein, A., & Faust, M. (2007). Brainwaves are stethoscopes: ERP correlates of novel metaphor comprehension. *Brain Research*, *1160*, 69–81.

Asher, J. J. (1966). The Learning Strategy of the Total Physical Response: A Review. In *The Modern Language Journal* (Vol. 50, Issue 2, pp. 79–84). https://eric.ed.gov/?id=ED028664

Bacon, A. M., & Handley, S. J. (2010). Dyslexia and reasoning: The importance of visual processes. *British Journal of Psychology*, *101*(3), 433–452. https://doi.org/10.1348/000712609X467314

Bacon, A. M., Parmentier, F. B. R., & Barr, P. (2013). Visuospatial memory in dyslexia: evidence for strategic deficits. *Memory*, 21, 189–209.

Baddeley, A. D. (1986). *Working memory*. Oxford, UK: Clarendon Press.

Baddeley, A. D. (1990). *Human memory: Theory and practice*. Hove, UK: Lawrence Erlbaum Associates Ltd.

Baddeley, A. D. (2000). The episodic buffer: A new component of working memory? *Trends in Cognitive Sciences*, 4 (11), 417-423.

Baddeley, A. D., & Hitch, G. J. (1974). Working memory. In G. Bower (Ed.), *The psychology of learning and motivation* (pp. 47-89). New York: Academic Press.

Baddeley, A. D., Logie, R. H., NimmoSmith, I. , & Brereton, N. (1985). Components of fluent reading. *Journal of Memory and Language*, 24, 199–131.

Bambini, V. (2017). *Il cervello pragmatico*. Carocci Rome. http://nets.iusspavia.it/dox/papers/BUS_Bambini_IlCervelloPragmatico.pdf

Bambini, V., & Resta, D. (2012). Metaphor and Experimental Pragmatics: When Theory Meets Empirical Investigation. *HUMANA.MENTE Journal of Philosophical Studies*, *5*(23), Article 23.

Bambini, V., Agostoni, G., Buonocore, M., Tonini, E., Bechi, M., Ferri, I., Sapienza, J., Martini, F., Cuoco, F., Cocchi, F., Bischetti, L., Cavallaro, R., & Bosia, M. (2022). It is time to address language disorders in

schizophrenia: A RCT on the efficacy of a novel training targeting the pragmatics of communication (PragmaCom). *Journal of Communication Disorders*, *97*, 106196. https://doi.org/10.1016/j.jcomdis.2022.106196

Bambini, V., Bertini, C., Schaeken, W., Stella, A., & Di Russo, F. (2016). Disentangling Metaphor from Context: An ERP Study. *Frontiers in Psychology*, *7*. https://www.frontiersin.org/articles/10.3389/fpsyg.2016.00559

Bambini, V., Gentili, C., Ricciardi, E., Bertinetto, P.M. and Pietrini, P. (2011) Decomposing metaphor processing at the cognitive and neural level through functional magnetic resonance imaging. Brain Research Bulletin 86 (3–4), 203–216.

Bambini, V., Ghio, M., Moro, A., & Schumacher, P. B. (2013). Differentiating among pragmatic uses of words through timed sensicality judgments. *Frontiers in Psychology*, *4*. https://doi.org/10.3389/fpsyg.2013.00938

Bambini, V., Resta, D., & Grimaldi, M. (2014). A dataset of metaphors from the italian literature: Exploring psycholinguistic variables and the role of context. *PLoS ONE*, 9(9). https://doi.org/10.1371/journal.pone.0105634

Banich, M. T. (2009). Executive function: The search for an integrated account. *Current directions in psychological science*, *18*(2), 89-94.

Bar-Kochva, I. (2016). An examination of an intervention program designed to enhance reading and spelling through the training of morphological decomposition in word recognition. Scientific Studies of Reading, 20(2), 163-172.

Barsalou, L. W. (2010). Grounded Cognition: Past, Present, and Future: Topics in Cognitive Science. *Topics in Cognitive Science*, *2*(4), 716–724. https://doi.org/10.1111/j.1756-8765.2010.01115.x

Bates, D. M., Maechler, M., & Bolker, B. (2012). *Lme4: Linear mixed-effects models using S4 classes. R package version 0.999999-0.* [Computer software].

Becker, N., Vasconcelos, M., Oliveira, V., Santos, F. C. D., Bizarro, L., Almeida, R. M. D., ... & Carvalho, M. R. S. (2017). Genetic and environmental risk factors for developmental dyslexia in children: systematic review of the last decade. *Developmental neuropsychology*, *42*(7-8), 423-445.

Bell, L. C., & Perfetti, C. A. (1994). Reading skill: Some adult comparisons. *Journal of Educational Psychology*, 86, 244–255.

Betjemann, R.S. and Keenan, J.M. (2008). Phonological and semantic priming in children with reading disability. *Child Development* 79, 1086–1102.

Biebuyck, B., Martens, G. (2011) Literary Metaphor between Cognition and Narration: The Sandman Revisited. In: Fludernik M, editor. *Beyond Cognitive Metaphor Theory: Perspectives on Literary Metaphor*. New York & Oxon: Routledge (Taylor and Francis). pp. 58–76.

Birch, S., & Chase, C. (2004). Visual and language processing deficits in compensated and uncompensated college students with dyslexia. *Journal of Learning Disabilities*, 37(5), 389–410. https://doi.org/10.1177/00222194040370050301

Bishop, D. V. M., & Snowling, M. J. (2004). Developmental Dyslexia and Specific Language Impairment: Same or Different? *Psychological Bulletin*, *130*, 858–886. https://doi.org/10.1037/0033-2909.130.6.858

Bishop, D.V.M., Jacobs, P.A., Lachlan, K., Wellesley, D., Barnicoat, A., Boyd, P.A., Fryer, A., Middlemiss, P., Smithson, S., Metcalfe, K., Shears, D., Leggett, V., Nation, K. and Scerif, G. (2011) Autism, language and communication in children with sex chromosome trisomies. Archives of Disease in Childhood 96, 954–959.

Black, M. (1962). Models and Metaphors: Studies in Language and Philosophy. In *Models and Metaphors*. Cornell University Press. https://doi.org/10.7591/9781501741326

Blasko, D. G. (1999). Only the tip of the iceberg: Who understands what about metaphor? *Journal of Pragmatics*, *31*(12), 1675–1683. https://doi.org/10.1016/S0378-2166(99)00009-0

Blasko, D. G., & Briihl, D. S. (1997). Reading and Recall of Metaphorical Sentences: Effects of Familiarity and Context. *Metaphor and Symbol*, *12*(4), 261–285. https://doi.org/10.1207/s15327868ms1204_4

Blasko, D. G., & Connine, C. M. (1993). Effects of familiarity and aptness on metaphor processing. *Journal of Experimental Psychology. Learning, Memory, and Cognition*, *19*(2), 295–308. https://doi.org/10.1037//0278-7393.19.2.295

Booth, J. N., Boyle, J. M. E., & Kelly, S. W. (2010). Do tasks make a difference? Accounting for heterogeneity of performance of children with reading difficulties on tasks of executive function: findings from a meta-analysis. *British Journal of Developmental Psychology*, 28, 133–176.

Bosco, F. M., Tirassa, M., & Gabbatore, I. (2018). Why Pragmatics and Theory of Mind Do Not (Completely) Overlap. *Frontiers in Psychology*, *9*. https://www.frontiersin.org/articles/10.3389/fpsyg.2018.01453

Bosco, F. M., Tirassa, M., & Gabbatore, I. (2018). Why Pragmatics and Theory of Mind Do Not (Completely) Overlap. *Frontiers in Psychology*, *9*. https://www.frontiersin.org/articles/10.3389/fpsyg.2018.01453

BouJaoude, S., & Tamim, R. (2000). Analogies Generated by Middle-School Science Students–Types and Usefulness. *School Science Review*, *82*(299), 57–63.

Boulenger, V., Hauk, O., & Pulvermüller, F. (2009). Grasping Ideas with the Motor System: Semantic Somatotopy in Idiom Comprehension. *Cerebral Cortex*, *19*(8), 1905–1914. https://doi.org/10.1093/cercor/bhn217

Bowdle, B. F., & Gentner, D. (2005). The Career of Metaphor. *Psychological Review*, *112*, 193–216. https://doi.org/10.1037/0033-295X.112.1.193

Bradley, L., & Bryant, P. E. (1978). Difficulties in auditory organisation as a possible cause of reading backwardness. *Nature*, *271*(5647), 746-747.

Bransford, J. D., & Johnson, M. K. (1972). Contextual prerequisites for understanding: some investigations of comprehension and recall. *Journal of verbal learning and verbal behavior*, 11(6), 717-726.

Breadmore, H. L., & Carroll, J. M. (2016). Morphological spelling in spite of phonological deficits: Evidence from children with dyslexia and otitis media. *Applied Psycholinguistics*, 37(6), 1439–1460. https://doi.org/10.1017/S0142716416000072

Breznitz, Z. and Meyler, A. (2003). Speed of lower-level auditory and visual processing as a basic factor in dyslexia: Electrophysiological evidence. *Brain and Language* 85 (2), 166–184.

Breznitz, Z., Shaul, S., Horowitz-Kraus, T., Sela, I., Nevat, M., & Karni, A. (2013). Enhanced reading by training with imposed time constraint in typical and dyslexic adults. Nature Communications, 4, 1486.

Brockett, C. A. (1985). *Neuropsychological and Cognitive Components of Creativity and Incubation (mental Flexibility, Ideational Fluency, Spontaneous, Hemispheric Differences)* [Ph.D.]. https://www.proquest.com/docview/303394893/abstract/8B7B3F69222E4C1BPQ/1

Brosnan, M., Demetre, J., Hamill, S., Robson, K., Shepherd, H., & Cody, G. (2002). Executive functioning in adults and children with developmental dyslexia. *Neuropsychologia*, *40*(12), 2144–2155. https://doi.org/10.1016/s0028-3932(02)00046-5

Bruck, M. (1992). Persistence of dyslexics' phonological awareness deficits. *Developmental Psychology*, 28, 874–886.

Brunswick, N., McCrory, E., Price, C. J., Frith, C. D., & Frith, U. (1999). Explicit and implicit processing of words and pseudowords by adult developmental dyslexics. A search for Wernicke's Wortschatz? *Brain*, *122*(10), 1901–1917. https://doi.org/10.1093/brain/122.10.1901

Brysbaert, M., Warriner, A. B., & Kuperman, V. (2014). Concreteness ratings for 40 thousand generally known English word lemmas. *Behavior Research Methods*, *46*(3), 904–911. https://doi.org/10.3758/s13428-013-0403-5

Burani, C. (2010). Word morphology enhances reading fluency in children with developmental dyslexia. *Lingue e Linguaggio*, 9(2), 177–198.

Burani, C., Marcolini, S., & Stella, G. (2002). How early does morpholexical reading develop in readers of a shallow orthography? *Brain and Language*, 81, 568–586. https://doi.org/10.1006/brln.2001. 2548

Burani, C., Marcolini, S., De Luca, M., & Zoccolotti, P. (2008). Morpheme-based reading aloud: Evidence from dyslexic and skilled Italian readers. *Cognition*, 108, 243–262. https://doi.org/10.1016/j.cognition.2007.12.010 PMID: 18262178

Burgess, C., & Chiarello, C. (1996). Neurocognitive Mechanisms Underlying Metaphor Comprehension and Other Figurative Language. *Metaphor and Symbolic Activity*, *11*(1), 67–84. https://doi.org/10.1207/s15327868ms1101_4

Caffarra, P., Vezzadini, G., Francesca, D., Zonato, F., & Venneri, A. (2002). A short version of the Stroop test: Normative data in an Italian population sample. *Nuova Rivista Di Neurologia*, *12*, 111–115.

Caglar-Ryeng, Ø., Eklund, K. and Nergård-Nilssen, T. (2019). Lexical and grammatical development in children at family risk of dyslexia from early childhood to school entry: A cross-lagged analysis. *Journal of Child Language* 46 (6), 1102–1126.

Caglar-Ryeng, Ø., Eklund, K. and Nergård-Nilssen, T. (2020). School-entry language outcomes in late talkers with and without a family risk of dyslexia. *Dyslexia* 27 (1), 29–49.

Cain, K. and Oakhill, J. (2011). Matthew effects in young readers: Reading comprehension and reading experience aid vocabulary development. *Journal of Learning Disabilities* 44 (5), 431–443.

Cain, K., Oakhill, J., & Bryant, P. (2004). Children's reading comprehension ability: Concurrent prediction by working memory, verbal ability, and component skills. *Journal of educational psychology*, *96*(1), 31.

Callens, M., Tops, W., & Brysbaert, M. (2012). Cognitive Profile of Students Who Enter Higher Education with an Indication of Dyslexia. *PLoS ONE*, 7(6), e38081. https://doi.org/10.1371/journal.pone.0038081

Camahalan, F. M. G. (2006). Effects of a Metacognitive Reading Program on the Reading Achievement and Metacognitive Strategies of Students with Cases of Dyslexia. *Reading Improvement*, *43*(2), 77–93.

Cameron, L. (2003). *Metaphor in Educational Discourse*. A&C Black.

Camp, E. (2006). Contextualism, metaphor, and what is said. *Mind & Language*, 21, 280–309. doi:10.1111/j.14680017.2006.00279.x

Canal, P., Bischetti, L., Bertini, C., Ricci, I., Lecce, S., & Bambini, V. (2022). N400 differences between physical and mental metaphors: The role of Theories of Mind. *Brain and Cognition*, 161(February), 105879. https://doi.org/10.1016/j.bandc.2022.105879

Cancer, A., & Antonietti, A. (2018). Rapid Automatized Naming, Verbal Working Memory, and Rhythm Discrimination as Predictors of Reading in Italian Undergraduate Students with and without Dyslexia. Brain Sciences, 8. https://doi.org/10.3390/brainsci8050087

Cancer, A., & Antonietti, A. (2020). Creativity and dyslexia: Theoretical insights and empirical evidence supporting a possible link. In *New frontiers in creativity* (pp. 125–148). Nova Science Publishers.

Cancer, A., Manzoli, S., & Antonietti, A. (2016). The alleged link between creativity and dyslexia: Identifying the specific process in which dyslexic students excel. *Cogent Psychology*, 3(1), 1190309. https://doi.org/10.1080/23311908.2016.1190309

Cappelli, G. (2019). Pragmatic and lexical skills of learners with dyslexia and EFL learning. In M.M. Coppola, F. Di Blasio and S. Francesconi (eds) *Contact Zones: Cultural, Linguistic and Literary Connections in English* (pp. 55–74). Trento: Trento University Press.

Cappelli, G. (2022). The Impact of Dyslexia on Lexico-Semantic Abilities: An Overview. *A Linguistic Approach to the Study of Dyslexia*, *20*, 211-239.

Cappelli, G. (2022a). Reading comprehension in young adult learners of English with and without dyslexia. *Lingue e Linguaggi*, *54*, 195-222.

Cappelli, G., Noccetti, S., Arcara, G., & Bambini, V. (2018). Pragmatic competence and its relationship with the linguistic and cognitive profile of young adults with dyslexia. *Dyslexia*, *24*(3), 294–306. https://doi.org/10.1002/dys.1588

Cappelli, G., Noccetti, S., Simi, N., Arcara, G., & Bambini, V. (2022). Dyslexia and Pragmatic Skills. In *A Linguistic Approach to the Study of Dyslexia*. Multilingual Matters. https://doi.org/10.21832/9781800415973-012

Caravolas, M. (2022). Reading and reading disorders in alphabetic orthographies. *The science of reading: A handbook*, 327-353.

Cardarello, R., & Contini, A. (2012). *Parole immagini metafore. Per una didattica della comprensione*. https://iris.unimore.it/handle/11380/860238

Cardillo, R., Garcia, R. B., Mammarella, I. C., & Cornoldi, C. (2018). Pragmatics of language and theory of mind in children with dyslexia with associated language difficulties or nonverbal learning disabilities. *Applied Neuropsychology: Child*, *7*(3), 245–256. https://doi.org/10.1080/21622965.2017.1297946

Cardinaletti, A. (2018). Test linguistici accessibili per studenti sordi e con DSA: pari opportunità per l'accesso all'università. *Test linguistici accessibili per studenti sordi e con dsa*, 1-327.

Cardinaletti, A., & Volpato, F. (2015). On the comprehension and production of passive sentences and relative clauses by Italian university students with dyslexia. *Structures, Strategies and Beyond*, 279-302.

Cardinaletti, A., Piccoli, E., & Volpato, F. (2022). Dyslexia and syntactic deficits: Overview and a case study of language training of relative clauses. *A Linguistic Approach to the Study of Dyslexia*. Multilingual Matters.

Carlisle, J. F. (1995). Morphological Awareness and Early Reading Achievement. In L. B. Feldman (Ed.), *Morphological Aspects of Language Processing* (pp. 189–209). Hillsdale, NJ: Erlbaum.

Carriedo, N., Corral, A., Montoro, P. R., Herrero, L., Ballestrino, P., & Sebastián, I. (2016). The Development of Metaphor Comprehension and Its Relationship with Relational Verbal Reasoning and Executive Function. *PLOS ONE*, *11*(3), e0150289. https://doi.org/10.1371/journal.pone.0150289

Carston, R. (2010). Lexical pragmatics, ad hoc concepts and metaphor: From a relevance theory perspective. *Italian Journal of Linguistics*, *22*(1), 153–180.

Carston, R. (2012). Metaphor and the literal/non-literal distinction. In K. Allan & K. M. Jaszczolt (Eds.), *The Cambridge Handbook of Pragmatics* (1st ed., pp. 469–492). Cambridge University Press. https://doi.org/10.1017/CBO9781139022453.025

Casalis, S., Colé, P., & Sopo, D. (2004). Morphological awareness in developmental dyslexia. *Annals of Dyslexia*, 54(1), 114–138. https://doi.org/10.1007/s11881-004-0006-z

Catts, H. W., Adlof, S. M., Hogan, T. P., & Weismer, S. E. (2005). Are specific language impair- ment and dyslexia distinct disorders? *Journal of Speech, Language, and Hearing Research*. doi: 10.1044/1092-4388(2005/096).

Catts, H. W., Gillispie, M., Leonard, L. B., Kail, R. V., & Miller, C. A. (2002). The Role of Speed of Processing, Rapid Naming, and Phonological Awareness in Reading Achievement. *Journal of Learning Disabilities*, 35(6), 510–525. https://doi.org/10.1177/00222194020350060301

Catts, H. W., McIlraith, A., Bridges, M. S., & Nielsen, D. C. (2017). Viewing a phonological deficit within a multifactorial model of dyslexia. Reading and Writing: An Interdisciplinary Journal, 30(3), 613–629. https://doi.org/10.1007/s11145-016-9692-2

Cavalli, E., Casalis, S., El Ahmadi, A., Zira, M., Poracchia-George, F. and Colé, P. (2016). Vocabulary skills are well developed in university students with dyslexia: Evidence from multiple case studies. *Research in Developmental Disabilities* 51, 89–102.

Cavalli, E., Duncan, L. G., Elbro, C., ElAhmadi, A., & Colé, P. (2017). Phonemic-Morphemic dissociation in university students with dyslexia: An index of reading compensation? *Annals of Dyslexia*, 67, 63–84. https://doi.org/10.1007/s11881-016-0138-y PMID: 27739013.

Ceciliani, A. (2021). Maria Montessori and Embodied Education: Current proposal in preschool education. *Ricerche Di Pedagogia e Didattica*, *16*(2). https://cris.unibo.it/bitstream/11585/837085/1/Ceciliani%20%20Maria%20Montessori%20and%20Embodied%20Education.pdf

Cersosimo, R., Engelhardt, P. E., & Domaneschi, F. (forthcoming). *Novel metaphor processing in dyslexia: Evidence from a visual world eye tracking study*.

Chahboun, S., Kvello, Ø., & Page, A. G. (2021). Extending the Field of Extended Language: A Literature Review on Figurative Language Processing in Neurodevelopmental Disorders. *Frontiers in Communication*, *6*, 661528. https://doi.org/10.3389/fcomm.2021.661528

Chakravarty, A. (2009). Artistic talent in dyslexia. A hypothesis. *Medical Hypotheses*, 73(4), 569–571. https://doi.org/10.1016/ j.mehy.2009.05 .034.

Chen, A., Wijnen, F., Koster, C. and Schnack, H. (2017). Individualized early prediction of familial risk of dyslexia: A study of infant vocabulary development. *Frontiers in Psychology* 8, Article 156, 1–13.

Chiappe, D. L., & Chiappe, P. (2007). The role of working memory in metaphor production and comprehension. *Journal of Memory and Language*, *56*(2), 172–188. https://doi.org/10.1016/j.jml.2006.11.006

Chiappe, D., Kennedy, J. M., & Smykowski, T. (2003). Reversibility, Aptness, and the Conventionality of Metaphors and Similes. *Metaphor and Symbol*, *18*(2), 85–105. https://doi.org/10.1207/S15327868MS1802_2

Chinn, S.J. and Crossmann, M. (1995) Stress factors in the adolescent. In T.R. Miles and V. Varma (eds) *Dyslexia and Stress* (pp. 49–54). London: Whurr Publishers.

Cho, S., Holyoak, K. J., & Cannon, T. D. (2007). Analogical reasoning in working memory: Resources shared among relational integration, interference resolution, and maintenance. *Memory & Cognition*, *35*(6), 1445–1455. https://doi.org/10.3758/BF03193614

Chouinard, B., & Cummine, J. (2016). All the world's a stage: Evaluation of two stages of metaphor comprehension in people with autism spectrum disorder. *Research in Autism Spectrum Disorders*, *23*, 107–121. https://doi.org/10.1016/j.rasd.2015.12.008

Chouinard, B., Volden, J., Hollinger, J., & Cummine, J. (2019). Spoken metaphor comprehension: Evaluation using the metaphor interference effect. *Discourse Processes*, *56*(3), 270–287. https://doi.org/10.1080/0163853X.2018.1455166

Clark, E. V. (1982). The young word maker: A case study of innovation in the child's lexicon. In E. Wanner & L. Gleitman (Eds.), *Language Acquisition: The State of the Art* (pp. 390–425). Cambridge: Cambridge University Press.

Clark, H. H., & Lucy, P. (1975). Understanding what is meant from what is said: A study in conversationally conveyed requests. *Journal of Verbal Learning and Verbal Behavior*, *14*(1), 56–72. https://doi.org/10.1016/S0022-5371(75)80006-5

Cohen, R. L., Netley, C., & Clarke, M. A. (1984). On the generality of the short-term memory/reading ability relationship. *Journal of Reading Disabilities*, 17 , 218-221.

Cole, R. (2009) *How to Be a Super Reader*. London: Piactus.

Collins, A.M. and Loftus, E.F. (1975). A spreading activation theory of semantic processing. *Psychological Review* 82, 407–428.

Columbus, G., Sheikh, N. A., Côté-Lecaldare, M., Häuser, K., Baum, S. R., & Titone, D. (2015). Individual differences in executive control relate to metaphor processing: An eye movement study of sentence reading. *Frontiers in Human Neuroscience*, 8, 1057. https://doi.org/10.3389/fnhum.2014.01057

Compton, D. L. (2021). Focusing Our View of Dyslexia Through a Multifactorial Lens: A Commentary». *Learning Disability Quarterly,* 44(3), 225–30. https://doi.org/10.1177/0731948720939009.

Contini, A. (2012). La metafora come strumento cognitivo. In Cardarello, R., & Contini, A. (Eds.). *Parole immagini metafore. Per una didattica della comprensione.* Parma: Edizioni Junior-Spaggiari.

Cooper, R. (2009) Evaluation of a SuperReading course with dyslexic adults. *Journal of Inclusive Practice in Further and Higher Education* 1 (2), 4–21.

Cooper, R. (2012) Updating the evidence of the impact of SuperReading on dyslexic students. *Journal of Inclusive Practice in Further and Higher Education* 4 (1), 26–4.

Cornoldi, C. Montesano, L. & Valenti, A. (2020). LSC-SUA. *Prove di lettura, comprensione del testo, scrittura e calcolo*. Trento: Erickson.

Cortés, A. I. R., Cobos, F. J. M., & Tarbox, J. (2018). Teaching Children to Create Metaphorical Expressions. *International Journal of Psychology*.

Costenaro, V., & Pesce, A. (2012). Dyslexia and the Phonological Deficit Hypothesis: Developing Phonological Awareness in Young English Language Learners. *El.Le*, 1, 581-604.

Craik, F. I. M., & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behavior*, *11*(6), 671–684. https://doi.org/10.1016/S0022-5371(72)80001-X

Daloiso, M. (2020). Disturbi specifici dell'apprendimento e produzione scritta in lingua straniera: Riflessioni nella prospettiva della linguistica educativa. *Italiano LinguaDue*, *12*(1), 261–270.

Danielson, R. W., Schwartz, N. H., & Lippmann, M. (2015). Metaphorical graphics aid learning and memory. *Learning and Instruction*, *39*, 194–205.

de Jong, P.F. (1998). Working memory deficits of reading- disabled children. *Journal of Experimental Child Psychology*, 70, 75–96.

De Luca, M., Di Pace, E., Judica, A., Spinelli, D., Zoccolotti, P. (1999). Eye movement patterns in linguistic and non-linguistic tasks in developmental surface dyslexia. *Neuropsychologia*, 37, 1407–1420.

Deacon, S. H., Cook, K., & Parrila, R. (2012). Identifying high-functioning dyslexics: Is self-report of early reading problems enough? *Annals of Dyslexia*, 62, 120–134. https://doi.org/10.1007/ s11881-012-0068-2

Deacon, S. H., Parrila, R., & Kirby, J. R. (2008). A review of the evidence on morphological processing in dyslexics and poor readers: A strength or weakness? In G. Reid, A. Fawcett, F. Manis, & L. Siegel (Eds.), *The Sage Handbook of Dyslexia* (pp. 212–237). Sage Publications.

Deacon, S., Tong, X., & Mimeau, C. (2019). Morphological and semantic processing in developmental dyslexia. In L. Verhoeven, C. Perfetti, & K. Pugh (Eds.), *Developmental dyslexia across languages and writing systems* (pp. 327–349). Cambridge University Press.

Decker, S. N. (1989). Cognitive processing rates among disabled and normal reading young adults: A nine year follow-up study. *Reading and Writing: An Interdisciplinary Journal,* 2, 123–134.

DeFries, J. C., & Alarcón, M. (1996). Genetics of specific reading disability. *Developmental Disabilities Research Reviews*, *2*(1), 39–47.

Del Sette, P., Bambini, V., Bischetti, L., & Lecce, S. (2020). Longitudinal associations between theory of mind and metaphor understanding during middle childhood. *Cognitive Development*, 56, Article 100958. https://doi.org/10.1016/j. cogdev.2020.100958

Dell'Orletta F., Montemagni S., Venturi G. "READ-IT: assessing readability of Italian texts with a view to text simplification". In: *SLPAT '11 – SLPAT '11 Proceedings of the Second Workshop on Speech and Language Processing for Assistive Technologies* (Edimburgo, UK, 30 Luglio 2011). Proceedings, pp. 73 – 83. Association for Computational Linguistics Stroudsburg, PA, USA, 2011.

Della Putta, P. A., & Suñer, F. (2023). Using the body to activate the brain: Research trends and issues. *Review of Cognitive Linguistics. Published under the Auspices of the Spanish Cognitive Linguistics Association*, *21*(1), 1–8. https://doi.org/10.1075/rcl.00124.del

Dellai F., Lipparini S., Cornoldi C. e Englaro G. (2014). Il corso longitudinale della dislessia. Risultati di un follow-up a 7 anni di distanza su un gruppo di studenti con dislessia. *Dislessia*, vol. 11, n. 3, pp. 281-294.

Denckla, M. B., & Rudel, R. G. (1976). Rapid "automatized" naming (R.A.N): Dyslexia differentiated from other learning disabilities. *Neuropsychologia*, *14*(4), 471–479. https://doi.org/10.1016/0028-3932(76)90075-0

Desai, R. H., Conant, L. L., Binder, J. R., Park, H., & Seidenberg, M. S. (2013). A piece of the action: Modulation of sensory-motor regions by action idioms and metaphors. *NeuroImage*, *83*, 862–869. https://doi.org/10.1016/j.neuroimage.2013.07.044

Di Paola, S., Domaneschi, F., & Pouscoulous, N. (2020). Metaphorical developing minds: The role of multiple factors in the development of metaphor comprehension. *Journal of Pragmatics*, *156*, 235–251. https://doi.org/10.1016/j.pragma.2019.08.008

Di Paola, S., Marocchini, E., Mazzone, M., & Domaneschi, F. (2019). 'Some words are mosquitos in the night'—Literalness in Metaphor Interpretation. *Tonini, E., Bischetti, L., Ervas, F., Domaneschi, F., Bambini, V., Book of Abstracts - XPRAG.It 2019*. https://osf.io/https://osf.io/y76av

Di Ricco, S., Cecci, C., Ciucci, E. (2016). Le metafore degli insegnanti: guide, equilibristi, giardinieri e altro ancora. *Psicologia dell'Educazione*, n. 1/2016.

Di Sano, S., Saggino, A., Barbieri, M.S. and Surial, L. (2013) *Children's Communication Check list - Adattamento italiano (2nd edn). Firenze: Giunti OS*.

Diamanti, V., Benaki, A., Mouzaki, A., Ralli, A., Antoniou, F., Papaioannou, S., et al. (2018). Development of early morphological awareness in Greek: Epilinguistic versus metalinguistic and inflectional versus derivational awareness. *Applied Psycholinguistics*, 39, 545–567. https://doi.org/10.1017/S0142716417000522.

Diamond, A. (2012). Executive Functions. *Annual review of psychology*. 64. 10.1146/annurev-psych-113011-143750.

Dickman, E. (2017). Do we need a new definition of dyslexia? *The Examiner (International Dyslexia Association)*, *6*(1). https://dyslexiaida.org/do-we-need-a-new-definition-of-dyslexia/.

Dirks, E., Spyer, G., van Lieshout, E. C., & de Sonneville, L. (2008). Prevalence of combined reading and arithmetic disabilities. *Journal of Learning Disabilities*, *41*(5), 460–473. doi: 10.1177/ 0022219408321128.

Domaneschi, F. & Bambini, V. (2020) Pragmatic competence. In E. Fridland and C. Pavese (eds) *The Routledge Handbook of Philosophy of Skill and Expertise* (pp. 419–430). London: Routledge.

Doyle, N. & McDowall, A. (2015). Is coaching an effective adjustment for dyslexic adults?. *Coaching: an International Journal of Theory Research and Practice*, *8*, 154-168.

DSM-5. 2010. A-13 dyslexia. APA DSM-5 development. http://www.dsm5.org/ProposedRevisions/Pages/proposedrevision.aspx?rid=84

Duff, D., Tomblin, J.B. and Catts, H. (2015). The influence of reading on vocabulary growth: A case for a Matthew effect. *Journal of Speech, Language, and Hearing Research,* 58 (3), 853–864.

Duit, R. (1991). The role of analogies and metaphors in learning science. *Science Education*, *75*, 649–672. https://doi.org/10.1002/sce.3730750606

Dulcinati, G., Mazzarella, D., & Pouscoulous, N. (2014). *Processing metaphor: The role of conventionality, familiarity and dominance*. 17.

Duncan, J., Johnson, R., Swales, M., Freer, C. (1997). Frontal lobe deficits after head injury: Unity and diversity of function. *Cognitive Neuropsychology*;14(5):713–741.

Duncan, L. G., Seymour, P. H., & Hill, S. (2000). A small-to-large unit progression in metaphonological awareness and reading? *Quarterly Journal of Experimental Psychology* A, 53, 1081–1104. https://doi.org/10.1080/713755936 PMID: 11131814.

Dunn, L. M., & Dunn, D. M. (2007). *Peabody Picture Vocabulary Test (4th ed.)*. Pearson.

Duval, C., Piolino, P., Bejanin, A., Eustache, F., & Desgranges, B. (2011). Age effects on different components of theory of mind. *Consciousness and Cognition*, *20*(3), 627–642. https://doi.org/10.1016/j.concog.2010.10.025

Eden, G. F., Jones, K. M., Cappell, K., Gareau, L., Wood, F. B., Zeffiro, T. A., Dietz, N. A. E., Agnew, J. A., & Flowers, D. L. (2004). Neural Changes following Remediation in Adult Developmental Dyslexia. Neuron, 44(3), 411-422.

Eden, G. F., VanMeter, J. W., Rumsey, J. M., & Zeffiro, T. A. (1996). The visual deficit theory of developmental dyslexia. *NeuroImage*, *4*, 108–117. https://doi.org/10.1006/nimg.1996.0061

Egan, C., Payne, J. S., & Jones, M. W. (2023). The impact of phonological relatedness on semantic congruency judgements in readers with dyslexia: Evidence from behavioural judgements, event related potentials and pupillometry. *Neuropsychologia*, 184, 108548. https://doi.org/10.1016/j.neuropsychologia.2023.108548

Egan, C., Siyanova-Chanturia, A., Warren, P., & Jones, M. W. (2022). As clear as glass: How figurativeness and familiarity impact simile processing in readers with and without dyslexia. *Quarterly Journal of Experimental Psychology*. https://doi.org/10.1177/17470218221089245

Egilsdóttir, S. E. (2015). *The Relationship Between Theory of Mind, Dyslexia, and Social Communication Skills* [Thesis]. https://skemman.is/handle/1946/21853

Elbro, C. (1996). Early linguistic abilities and reading development: A review and a hypothesis. *Reading and Writing*, *8*, 453-485.

Elbro, C., & Arnbak, E. (1996). The role of morpheme recognition and morphological awareness in dyslexia. *Annals of Dyslexia*, 46, 209–240. https://doi.org/10.1007/BF02648177 PMID: 24234273

Evans, M. A., & Gamble, D. L. (1988). Attribute saliency and metaphor interpretation in school-age children. *Journal of Child Language*, *15*(2), 435–449.

Everatt, J., Bradshaw, M.F., Hibbard, P.B., Lages, M. (1997). Visual processing deficits and dyslexia. *Perception,* 26: 1330–1330.

Everatt, J., Warner, J., Miles, T. R., & Thomson, M. E. (1997). The incidence of Stroop interference in dyslexia. *Dyslexia*, *3*(4), 222-228.

Faccioli, C., Peru, A., Rubini, E., & Tassinari, G. (2008). Poor readers but compelled to read: Stroop effects in developmental dyslexia. *Child Neuropsychology*, *14*(3), 277–283. https://doi.org/10.1080/09297040701290040

Fawcett, A.J. and Nicolson, R.I. (1998) *The Dyslexia Adult Screening Test (DAST)*. Sidcup: The Psychological Corporation.

Felton, R. H., Naylor, C. E., & Wood, F. B. (1990). Neuropsychological profile of adult dyslexics. *Brain and Language*, 39, 485–497.

Fernández-Modamio, M., Arrieta-Rodríguez, M., Bengochea-Seco, R., Santacoloma-Cabero, I., Gómez de Tojeiro-Roce, J., García-Polavieja, B., González-Fraile, E., Martín-Carrasco, M., Griffin, K., & Gil-Sanz, D. (2018). Faux-Pas Test: A Proposal of a Standardized Short Version. *Clinical Schizophrenia & Related Psychoses*, *aop*, CSRP.FEAR.061518. https://doi.org/10.3371/CSRP.FEAR.061518

Ferrara, M., Camia, M., Cecere, V., Villata, V., Vivenzio, N., Scorza, M. and Padovani, R. (2020) Language and pragmatics across neurodevelopmental disorders: An investigation using the Italian version of CCC-2. *Journal of Autism and Developmental Disorders* 50, 1295–1309.

Ferreira, F. (2003). The misinterpretation of noncanonical sentences. *Cognitive psychology*, *47*(2), 164-203.

Ferrer, E., Shaywitz, B. A., Holahan, J. M., Marchione, K. E., Michaels, R., & Shaywitz, S. E. (2015). Achievement gap in reading is present as early as first grade and persists through adolescence. *The Journal of Pediatrics*, 167(5), 1121–1125. https://doi.org/10.1016/j.jpeds.2015.07.045

Fletcher, J. M., Lyon, G. R., Fuchs, L. S., & Barnes, M. A. (2018). *Learning disabilities: From identification to intervention*. Guilford Publications.

Follmer, D. J. (2018). Executive function and reading comprehension: A meta-analytic review. *Educational Psychologist*, *53*(1), 42-60.

Foorman, B. R., Petscher, Y., & Herrera, S. (2018). Unique and common effects of decoding and language factors in predicting reading comprehension in grades 1–10. *Learning and Individual Differences*, 63, 12–23. https://doi.org/10.1016/j.lindif.2018.02.011

Fostick, L., & Revah, H. (2018). Dyslexia as a multi-deficit disorder: Working memory and auditory temporal processing. *Acta psychologica*, *183*, 19-28.

Franceschini S., Mascheretti S., Bertoni S., Trezzi V., Andreola C., Gori S. e Facoetti A. (2018). Sluggish dorsally-driven inhibition of return during orthographic processing in adults with dyslexia. *Brain and Language*, vol. 179, pp. 1-10.

Frank, C. K. (2018). Reviving pragmatic theory of theory of mind. *Aims Neuroscience*, *5*(2), 116.

Freitas, P. V., da Mota, M., & Deacon, S. H. (2018). Morphological awareness, word reading, and reading comprehension in Portuguese. *Applied Psycholinguistics*, 39(3), 507–525. https://doi.org/10. 1017/S0142716417000479

Friedman, N. P., Miyake, A., Robinson, J. L., & Hewitt, J. K. (2011). Developmental trajectories in toddlers' self-restraint predict individual differences in executive functions 14 years later: a behavioral genetic analysis. *Developmental psychology*, *47*(5), 1410.

Friedman, N. P., Miyake, A., Young, S. E., DeFries, J. C., Corley, R. P., & Hewitt, J. K. (2008). Individual differences in executive functions are almost entirely genetic in origin. *Journal of experimental psychology: General*, 137(2), 201.

Frith, U. (1999). Paradoxes in the definition of dyslexia. *Dyslexia*, *5*(4), 192-214.

Galuschka, K., Görgen, R., Kalmar, J., Haberstroh, S., Schmalz, X., & Schulte-Körne, G. (2020). Effectiveness of spelling interventions for learners with dyslexia: A meta-analysis and systematic review. Educational Psychologist, 55(1), 1-20.

Garon, N., Bryson, S. E., & Smith, I. M. (2008). Executive function in preschoolers: a review using an integrative framework. *Psychological bulletin*, *134*(1), 31.

Gathercole, S. E. (1994). The children's test of nonword repetition: A test of phonological working memory. *Memory*, 2 (2), 103-127.

Gathercole, S. E., Willis, C., Emslie, H., & Baddeley, A. D. (1991). The influences of number of syllables and wordlikeness on children's repetition of nonwords. *Applied Psycholinguistics*, 12 , 349-367.

Gennari, S.P. & MacDonald, M.C. (2008). Semantic indeterminacy in object relative clauses. *Journal of Memory and Language*, 58, 161–187.

Gentner, D., & Bowdle, B. (2008). Metaphor as structure-mapping. *The Cambridge Handbook of Metaphor and Thought*, *109*, 128.

Gentner, D., & Clement, C. (1988). Evidence for Relational Selectivity in the Interpretation of Analogy and Metaphor. In G. H. Bower (Ed.), *Psychology of Learning and Motivation* (Vol. 22, pp. 307–358). Academic Press. https://doi.org/10.1016/S0079-7421(08)60044-4

Gentner, D., & Toupin, C. (1986). Systematicity and surface similarity in the development of analogy. *Cognitive Science*, *10*(3), 277–300. https://doi.org/10.1016/S0364-0213(86)80019-2

Georgiou, G. K., Martinez, D., Vieira, A. P. A., Antoniuk, A., Romero, S., & Guo, K. (2022). A meta-analytic review of comprehension deficits in students with dyslexia. *Annals of Dyslexia*, 72(2), 204–248. https://doi.org/10.1007/s11881-021-00244-y

Georgiou, G. K., Papadopoulos, T. C., Zarouna, E., & Parrila, R. (2012). Are auditory and visual processing deficits related to developmental dyslexia?. *Dyslexia*, *18*(2), 110-129.

Gernsbacher, M. A., & Pripas-Kapit, S. R. (2012). Who's Missing the Point? A Commentary on Claims that Autistic Persons Have a Specific Deficit in Figurative Language Comprehension. *Metaphor and Symbol*, *27*(1), 93–105. https://doi.org/10.1080/10926488.2012.656255

Gernsbacher, M. A., Keysar, B., Robertson, R. R., & Werner, N. K. (2001). The role of suppression and enhancement in understanding metaphors. *Journal of Memory and Language*, *45*(3), 433–450.

Gerrig, R. J., & Healy, A. F. (1983). Dual processes in metaphor understanding: Comprehension and appreciation. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 9, 667–675. doi:10.1037/0278-7393.9.4.667

Giazitzidou, S., & Padeliadu, S. (2022). Contribution of morphological awareness to reading fluency of children with and without dyslexia: Evidence from a transparent orthography. *Annals of Dyslexia*, 72(3), 509–531. https://doi.org/10.1007/s11881-022-00267-z

Gibbs Jr, R. W. (1984). Literal meaning and psychological theory. *Cognitive Science*, *8*(3), 275–304.

Gibbs Jr, R. W. (1990). Comprehending figurative referential descriptions. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *16*(1), 56.

Gibbs Jr, R. W. (2005). *Embodiment and cognitive science*. Cambridge University Press.

Gibbs Jr, R. W., & Tendahl, M. (2006). Cognitive effort and effects in metaphor comprehension: Relevance theory and psycholinguistics. *Mind & Language*, 21(3), 379-403.

Gibson, E. (1998). Linguistic complexity: Locality of syntactic dependencies. *Cognition*, 68,1–76.

Gildea, P., & Glucksberg, S. (1983). On understanding metaphor: The role of context. *Journal of Verbal Learning and Verbal Behavior*, 22, 577–590. doi:10.1016/S0022-5371(83)90355-9

Giofrè, D., Stoppa, E., Ferioli, P., Pezzuti, L., & Cornoldi, C. (2016). Forward and backward digit span difficulties in children with specific learning disorder. *Journal of Clinical and Experimental Neuropsychology*, *38*(4), 478–486. https://doi.org/10.1080/13803395.2015.1125454

Giora, R. (2003). *On our mind: Salience, context, and figurative language.* Oxford University Press.

Glucksberg, S. (1989). Metaphors in Conversation: How Are They Understood? Why Are They Used? *Metaphor and Symbolic Activity*, *4*(3), 125–143. https://doi.org/10.1207/s15327868ms0403_2

Glucksberg, S. (2003). The psycholinguistics of metaphor. *Trends in Cognitive Sciences*, 7(2), 92–96. https://doi.org/10.1016/S1364-6613(02)00040-2

Glucksberg, S. (2008). How metaphors create categories–quickly. *The Cambridge Handbook of Metaphor and Thought*, 67–83.

Glucksberg, S., & Haught, C. (2006). On the Relation Between Metaphor and Simile: When Comparison Fails. *Mind & Language*, *21*(3), 360–378. https://doi.org/10.1111/j.1468-0017.2006.00282.x

Glucksberg, S., & Keysar, B. (1990). Understanding metaphorical comparisons: Beyond similarity. *Psychological Review*, *97*, 3–18. https://doi.org/10.1037/0033-295X.97.1.3

Glucksberg, S., & McGlone, M. S. (2001). *Understanding figurative language: From metaphor to idioms*. Oxford University Press. https://books.google.com/books?hl=it&lr=&id=-

UpnDAAAQBAJ&oi=fnd&pg=PR8&dq=Glucksberg,+S.+(2001).+Understanding+Figurative+Language.&ots=NTQwOVujii&sig=E2KMXP0BW8GEBwnDsf76_Mdnh98

Glucksberg, S., Gildea, P., & Bookin, H. B. (1982). On understanding nonliteral speech: Can people ignore metaphors? *Journal of Verbal Learning and Verbal Behavior*, *21*(1), 85–98. https://doi.org/10.1016/S0022-5371(82)90467-4

Glucksberg, S., McGlone, M. S., & Manfredi, D. (1997). Property attribution in metaphor comprehension. *Journal of Memory and Language*, *36*(1), 50–67.

Glynn, S. M. (1996). *Effects of instructions to generate analogies on students' recall of science text*. National Reading Research Center.

Gold, R., Faust, M., & Ben-Artzi, E. (2012). Metaphors and verbal creativity: The role of the right hemisphere. *Laterality*, *17*(5), 602–614. https://doi.org/10.1080/1357650X.2011.599936

Gold, R., Faust, M., & Goldstein, A. (2010). Semantic integration during metaphor comprehension in Asperger syndrome. *Brain and Language*, *113*(3), 124–134. https://doi.org/10.1016/j.bandl.2010.03.002

Görgen, R., De Simone, E., Schulte-Körne, G., & Moll, K. (2021). Predictors of reading and spelling skills in German: The role of MA. *Journal of Research in Reading*, 44(1), 210–227. https://doi.org/ 10.1111/1467-9817.12343

Goswami U. (2014). Sensory theories of developmental dyslexia: three challenges for research. *Nature reviews. Neuroscience*, *16*(1), 43–54. https://doi.org/10.1038/nrn3836

Goswami, U. (2002). Phonology, reading development and dyslexia: A cross-linguistic perspective. *Annals of Dyslexia, 52,* 141–163. https://doi.org/10.1007/s11881-002-0010-0

Gottardo, A., Siegel L.S. and Stanovich, K.E. (1997) The assessment of adults with reading difficulties: What can we learn from experimental tasks? *Journal of Research in Reading*, 20(1), 42 –54.

Gough, P. B., & Tunmer, W. E. (1986). Decoding, Reading, and Reading Disability. *Remedial and Special Education*, *7*(1), 6–10. https://doi.org/10.1177/074193258600700104

Goulandris, N. K., Snowling, M. J., & Walker, I. (2000). Is dyslexia a form of specific language impairment? A comparison of dyslexic and language impaired children as adolescents. *Annals of Dyslexia,* 50(1), 103–120. https://doi.org/10.1007/s11881-000-0019-1

Gould, J. H., & Glencross, D. J. (1990). Do children with a specific reading-disability have a general serial ordering deficit? *Neuropsychologia* , 28 (3), 271-278.

Gray, S. H., Ehri, L. C., & Locke, J. L. (2018). Morpho-phonemic analysis boosts word reading for adult struggling readers. *Reading and Writing*, 31(1), 75-98.

Greenberg, D., Wise, J. C., Morris, R., Fredrick, L. D., Rodrigo, V., Nanda, A. O., & Pae, H. K. (2011). A Randomized Control Study of Instructional Approaches for Struggling Adult Readers. Journal of Research on Educational Effectiveness, 4(2), 101-117.

Greven, C. U., Rijsdijk, F. V., Asherson, P., & Plomin, R. (2012). A longitudinal twin study on the association between ADHD symptoms and reading. *Journal of child Psychology and Psychiatry*, *53*(3), 234–242. doi: 10.1111/j.1469-7610.2011.02445.x.

Grice, P. (1991). *Studies in the Way of Words*. Harvard University Press.

Griffiths, C. C. B. (2007). Pragmatic Abilities in Adults With and Without Dyslexia: A Pilot Study. *Dyslexia*, 239(February), 234–239. https://doi.org/10.1002/dys

Griffiths, C.B. (2007) Pragmatic abilities in adults with and without dyslexia: A pilot study. *Dyslexia* 13, 276–296.

Grigorakis, I., & Manolitsis, G. (2019). Early morphological awareness and learning to read morphologically complicated words in Greek: A longitudinal study. In the Research Group of the University Complutense of Madrid "ECOLE" (Ed.), 20th European Conference on Literacy. *Working together to encourage equity through literacy communities: A challenge of the 21st century*. 3–6 July 2017 (pp. 892–908). University Complutense of Madrid.

Guo, Y., Roehrig, A. D., & Williams, R. S. (2011). The relation of morphological awareness and syntactic awareness to adults' reading comprehension: Is vocabulary knowledge a mediating variable? *Journal of Literacy Research: A Publication of the Literacy Research Association*, 43(2), 159–183.

Guyer, B. P., & Sabatino, D. (1989). The Effectiveness of a Multisensory Alphabetic Phonetic Approach With College Students Who Are Learning Disabled. Journal of Learning Disabilities, 22(7), 430-434.

Haft, S.L., Myers, C.A. Hoeft, F. (2016). Socioemotional and cognitive resilience in children with reading disabilities. *Current Opinion in Behavioral Sciences* 10, 133–141.

Hairston, W. D., Burdette, J. H., Flowers, D. L., Wood, F. B., & Wallace, M. T. (2005). Altered temporal profile of visual-auditory multisensory interactions in dyslexia. *Experimental brain research*, *166*(3-4), 474–480. https://doi.org/10.1007/s00221-005-2387-6

Hale, J. (2001). A probabilistic early parser as a psycholinguistic model. *Proceedings of the second meeting of the North American Chapter of the Association for Computational Linguistics on Language technologies*, Pittsburgh PA, USA, pp. 1–8.

Hanly, S., & Vandenberg, B. (2010). Tip-of-the-Tongue and Word Retrieval Deficits in Dyslexia. *Journal of Learning Disabilities*, *43*(1), 15–23. https://doi.org/10.1177/0022219409338744

Happé, F. G. E. (1993). Communicative competence and theory of mind in autism: A test of relevance theory. *Cognition*, *48*(2), 101–119. https://doi.org/10.1016/0010-0277(93)90026-R

Hargreaves, I., Pexman, P., Johnson, J., & Zdrazilova, L. (2012). Richer concepts are better remembered: Number of features effects in free recall. *Frontiers in Human Neuroscience*, *6*. https://www.frontiersin.org/articles/10.3389/fnhum.2012.00073

Hartung, F., Kenett, Y. N., Cardillo, E. R., Humphries, S., Klooster, N., & Chatterjee, A. (2020). Context matters: Novel metaphors in supportive and non-supportive contexts. *NeuroImage*, 212, 116645. doi:10.1016/j.neuroimage.2020.116645

Hatcher, J., Snowling, M. J., & Griffiths, Y. M. (2002). Cognitive assessment of dyslexic students in higher education. *British journal of educational psychology*, *72*(1), 119-133.

Helland, T. & Asbjørnsen, A. (2000). Executive functions in dyslexia. *Child Neuropsychology*, 6, 37–48.

Helland, T., & Asbjørnsen, A. (2003). Visual-sequential and visuospatial skills in dyslexia: Variations according to language comprehension and mathematics skills. *Child Neuropsychology*, 9 (3), 208-220.

Hennessey, N.W., Deadman, A. and Williams, C. (2012). Semantic effects on word naming in children with developmental dyslexia. *Journal of Research in Reading,* 35, 267–286.

Hermann, I., Haser, V., Van Elst, L. T., Ebert, D., MüLler-Feldmeth, D., Riedel, A., & Konieczny, L. (2013). Automatic metaphor processing in adults with Asperger syndrome: A metaphor interference effect task. *European Archives of Psychiatry and Clinical Neuroscience*, *263*(SUPPL.2). https://doi.org/10.1007/s00406-013-0453-9

Highnam, C., Wegmann, J., & Woods, J. (1999). Visual and verbal metaphors among children with typical language and language disorders. *Journal of Communication Disorders*, *32*(1), 25–35.

Hills, T.T., Maouene, M., Maouene, J., Sheya, A. and Smith, L.B. (2009). Categorical structure among shared features in networks of early learned nouns. *Cognition* 112, 381–396.

Holyoak, K. J. (2012). Analogy and Relational Reasoning. In K. J. Holyoak & R. G. Morrison (Eds.), *The Oxford Handbook of Thinking and Reasoning* (p. 0). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199734689.013.0013

Holyoak, K. J. (2019). *The spider's thread: Metaphor in mind, brain, and poetry*. Cambridge, MA: MIT Press. doi:10.7551/ mitpress/11119.001.0001

Holyoak, K. J., & Stamenković, D. (2018). Metaphor comprehension: A critical review of theories and evidence. *Psychological Bulletin*, 144(6), 641–671. https://doi.org/10.1037/bul0000145

Horowitz-Kraus, T. (2016). Improvement of the Error-detection Mechanism in Adults with Dyslexia Following Reading Acceleration Training. Dyslexia, 22(2), 173-189.

Huettig, F., Lachmann, T., Reis, A. and Petersson, K.M. (2018). Distinguishing cause from effect. Many deficits associated with developmental dyslexia may be a consequence of reduced and suboptimal reading experience. Language, Cognition and Neuroscience 33 (3), 333–350.

Hull, R., Martin, R. C., Beier, M. E., Lane, D., & Hamilton, A. C. (2008). Executive function in older adults: a structural equation modeling approach. *Neuropsychology*, *22*(4), 508.

Hulme, C., & Snowling, M. J. (2009). *Developmental disorders of language learning and cognition*. Wiley-Blackwell.

Hulme, C., & Snowling, M. J. (2014). The interface between spoken and written language: developmental disorders. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences*, *369*(1634), 20120395. https://doi.org/10.1098/rstb.2012.0395

Hyönä, J., Olson, R.K. (1995). Eye fixation patterns among dyslexic and normal readers: Effects of word length and word frequency. *Journal of Experimental Psychology*, 21, 1430–1440.

Ingesson, S. (2006). Stability of IQ measures in teenagers and young adults with developmental dyslexia. *Dyslexia*, 12(2), 81–95. https://doi.org/ 10.1002/dys.306.

Inhoff, A. W., Lima, S. D., & Carroll, P. J. (1984). Contextual effects on metaphor comprehension in reading. *Memory & Cognition*, 12, 558–567. doi:10.3758/BF03213344

Jacobs, A. M., & Kinder, A. (2017). The brain is the prisoner of thought: A machine-learning assisted quantitative narrative analysis of literary metaphors for use in Neurocognitive Poetics. *Metaphor and Symbol,* 32, 139–160. doi:10.1080/10926488.2017.1338015

Jacobs, A. M., & Kinder, A. (2018). What makes a metaphor literary? Answers from two computational studies. *Metaphor and Symbol*, 33, 85–100. doi:10.1080/10926488.2018.1434943

Janus, R. A., & Bever, T. G. (1985). Processing of metaphoric language: An investigation of the three-stage model of metaphor comprehension. *Journal of Psycholinguistic Research*, *14*, 473–487.

Jednoróg, K., Marchewka, A., Tacikowski, P. and Grabowska, A. (2010). Implicit phonological and semantic processing in children with developmental dyslexia: Evidence from event related potentials. *Neuropsychologia* 48 (9), 2447–2457.

Jeffries, S., & Everatt, J. (2003). Differences between dyspraxics and dyslexics in sequence learning and working memory. Dyspraxia Foundation Professional Journal , 2 ,1221.

Jeffries, S., & Everatt, J. (2004). Working memory: Its role in dyslexia and other specific learning difficulties. *Dyslexia*, *10*(3), 196–214. https://doi.org/10.1002/dys.278

Jimenez, J. E., Garcia, E., Estevez, A., Diaz, A., Guzman, R., Hernandez-Valle, I., et al. (2004). An Evaluation of Syntactic-Semantic Processing in Developmental Dyslexia. Electronic Journal of Research in Educational Psychology, 2, 127–142.

Joanisse, M. F., Manis, F. R., Keating, P., & Seidenberg, M. S. (2000). Language deficits in dyslexic children: Speech perception, phonology, and morphology. *Journal of experimental child psychology*, *77*(1), 30-60.

Johnston, A., Bruno, A., Watanabe, J., Quansah, B., Patel, N., Dakin, S., & Nishida, S. (2008). Visually-based temporal distortion in dyslexia. *Vision Research, 48*(17), 1852–1858. https://doi.org/10.1016/j.visres.2008.04.029

Jorm, A. F. (1983). Specific reading retardation and working memory: A review. *British Journal of Psychology*, 74 , 311-342.

Just, M. A., & Carpenter, P. A. (1992). A capacity theory of comprehension: Individual differences in working memory. *Psychological Review*, 99, 122–149.

Kapoula, Z., Lê, T. T., Bonnet, A., Bourtoire, P., Demule, E., Fauvel, C., ... & Yang, Q. (2010). Poor Stroop performances in 15-year-old dyslexic teenagers. *Experimental brain research*, *203*, 419-425.

Kasirer, A., & Mashal, N. (2014). Verbal creativity in autism: Comprehension and generation of metaphoric language in high-functioning autism spectrum disorder and typical development. *Frontiers in Human Neuroscience*, *8*. https://www.frontiersin.org/articles/10.3389/fnhum.2014.00615

Kasirer, A., & Mashal, N. (2017). Comprehension and Generation of Metaphoric Language in Children, Adolescents, and Adults with Dyslexia. *Dyslexia*, *23*(2), 99–118. https://doi.org/10.1002/dys.1550

Katz, A., Paivio, A., Marschark, M., & Clark, J. (1988). Norms for 204 literary and 260 nonliterary metaphors on 10 psychological dimensions. *Metaphor and Symbolic Activity*, 3, 191–214. doi:10.1207/s15327868ms0304_1

Kazmerski, V. A., Blasko, D. G., & Dessalegn, B. G. (2003). ERP and behavioral evidence of individual differences in metaphor comprehension. *Memory and Cognition*, *31*(5), 673–689. https://doi.org/10.3758/BF03196107

Kazmerski, V. A., Blasko, D. G., & Dessalegn, B. G. (2003). ERP and behavioral evidence of individual differences in metaphor comprehension. *Memory and Cognition*, *31*(5), 673–689. https://doi.org/10.3758/BF03196107

Kelly, M. S., Best, C. T., & Kirk, U. (1989). Cognitive processing deficits in reading disabilities: A prefrontal cortical hypothesis. *Brain and Cognition*, *11*(2), 275-293.

Kemp N., Parrila R.K. e Kirby J.R. (2009). Phonological and orthographic spelling in high functioning adult dyslexics. *Dyslexia*, vol. 15, n. 2, pp. 105-128.

Kendeou, P., McMaster, K. L., & Christ, T. J. (2016). Reading comprehension: Core components and processes. *Policy Insights from the Behavioral and Brain Sciences*, *3*(1), 62-69.

Kenett, Y. N., Gold, R., & Faust, M. (2018). Metaphor Comprehension in Low and High Creative Individuals. *Frontiers in Psychology*, *9*, 482. https://doi.org/10.3389/fpsyg.2018.00482

Kennedy, J. M. (1982). Metaphor in Pictures. *Perception*, *11*(5), 589–605. https://doi.org/10.1068/p110589

Keysar, B. (1989). On the functional equivalence of literal and metaphorical interpretations in discourse. *Journal of Memory and Language*, *28*(4), 375–385. https://doi.org/10.1016/0749-596X(89)90017-X

Kibby, M. Y., Marks, W., Morgan, S., & Long, C. J. (2004). Specific impairment in developmental reading disabilities: A working memory approach. Journal of Learning Disabilities, 37 (4), 349 363.

Kibby, M.Y., Marks, W., Morgan, S., Long, C.J. (2004). Specific Impairment in Developmental Reading Disabilities. *Journal of Learning Disabilities*, 37, 349–363.

Kintsch, W. (1986). Learning from text. *Cognition and instruction*, *3*(2), 87-108.

Kintsch, W. (2000). Metaphor comprehension: A computational theory. *Psychonomic Bulletin & Review*, *7*(2), 257–266. https://doi.org/10.3758/BF03212981

Kirby, J. R., & Bowers, P. N. (2017). Morphological instruction and literacy: Binding phonological, orthographic, and semantic features of words. In K. Cain, D. L. Compton, & R. K. Parrila (Eds.), *Theories of reading development* (pp. 437–462). John Benjamins Publishing Company.

Kolb, D., & Fry, R. (1974). Toward an Applied Theory of Experiential Learning. *Theories of Group Process*.

Kömür, Ş., & Çimen, Ş. S. (2009). *Using Conceptual Metaphors in Teaching Idioms in a Foreign language Context*.

Korkman, M., Kirk, U. and Kemp, S. (2007) *NEPSY–II*. San Antonio, TX: Pearson.

Korkman, M., Kirk, U., & Kemp, S. (2007). *NEPSY–II*. Pearson.

Kormos, J., & Smith, A. M. (2012). *Teaching languages to students with specific learning differences* (Vol. 8). Multilingual matters.

Koster, C., Been, P.H. and Diepstra, H.D. (2005). Differences at 17 months: Productive familial risk for dyslexia and typically developing infants. *Journal of Speech Language and Hearing Research* 48 (2), 426–438.

Kroneisen, M., & Erdfelder, E. (2011). On the plasticity of the survival processing effect. *Journal of Experimental Psychology. Learning, Memory, and Cognition*, *37*(6), 1553–1562. https://doi.org/10.1037/a0024493

Kudo, M. F., Lussier, C. M., & Swanson, H. L. (2015). Reading disabilities in children: A selective meta-analysis of the cognitive literature. Research in Developmental Disabilities, 40, 51– 62. http://dx.doi.org/10 .1016/j.ridd.2015.01.002

Kumari, S., Pyata, R., Afreen, B. and Paithankar, P.S. (2016) Pragmatic skills in children with different types of learning disability: A comparative study. *Language in India* 16 (9), 225–233.

Kutas, M., & Hillyard, S. A. (1980). Event-related brain potentials to semantically inappropriate and surprisingly large words. *Biological psychology*, *11*(2), 99-116.

Laasonen, M., Service, E., & Virsu, V. (2001). Temporal order and processing acuity of visual, auditory, and tactile perception in developmentally dyslexic young adults. Cognitive, Affective & Behavioral Neuroscience, 1(4), 394–410. https://doi.org/10.3758/CABN.1.4.394

Lacey, S., Stilla, R., & Sathian, K. (2012). Metaphorically feeling: Comprehending textural metaphors activates somatosensory cortex. *Brain and Language*, *120*(3), 416–421. https://doi.org/10.1016/j.bandl.2011.12.016

Lai, V. T., Curran, T., & Menn, L. (2009). Comprehending conventional and novel metaphors: An ERP study. *Brain Research*, *1284*, 145–155.

Lakoff, G. (1993). The contemporary theory of metaphor. In A. Ortony (Ed.), *Metaphor and Thought* (2nd ed., pp. 202–251). Cambridge University Press. https://doi.org/10.1017/CBO9781139173865.013

Lakoff, G. (1994). What is a conceptual system. *The Nature and Ontogenesis of Meaning*, 41–90.

Lakoff, G., & Johnson, M. (1980). *Metaphors We Live By*. University of Chicago Press.

Lakoff, G., & Turner, M. (1989). *More than cool reason: A field guide to poetic metaphor.* Chicago, IL: University of Chicago Press.

Lakoff, G., & Turner, M. (1989). *More than Cool Reason*. University of Chicago Press.

Lakoff, G., Johnson, M., & Sowa, J. F. (1999). Review of Philosophy in the Flesh: The embodied mind and its challenge to Western thought. *Computational Linguistics*, *25*(4), 631–634.

Lam, K.-H. and Ho, C.S.-H. (2014) Pragmatic skills in Chinese dyslexic children: Evidence from a parental checklist. *Asia Pacific Journal of Developmental Differences* 1, 4–19.

Lam, K., Suk-Han Ho, C., The University of Hong Kong, & Psychology Department, Room C661, 6/F The Jockey Club Tower, Centennial Campus, The University of Hong Kong, Pokfulam Road, Hong Kong. (2014). Pragmatic Skills in Chinese Dyslexic Children: Evidence from a Parental Checklist. *Asia Pacific Journal of Developmental Differences*, *1*(1), 4–19. https://doi.org/10.3850/S2345734114000027

Lami L., Palmieri A., Solimando M.C. e Pizzoli C. (2009). Profilo cognitivo e delle abilità di lettura in dislessici evolutivi con e senza ritardo di linguaggio diventati giovani adulti. *Dislessia*, vol. 6, n. 1, pp. 77-92.

Lancor, R. A. (2014). Using Student-Generated Analogies to Investigate Conceptions of Energy: A multidisciplinary study. *International Journal of Science Education*, *36*(1), 1–23. https://doi.org/10.1080/09500693.2012.714512

Landerl, K., & Moll, K. (2010). Comorbidity of learning disorders: Prevalence and familial trans- mission. *Journal of child Psychology and Psychiatry*, *51*(3), 287–294. doi: 10.1111/j.1469-7610. 2009.02164.x.

Landerl, K., Fussenegger, B., Moll, K. and Willburger, E. (2009). Dyslexia and dyscalculia: Two learning disorders with different cognitive profiles. *Journal of Experimental Child Psychology* 103, 309–324.

Lastrucci, E. (2019). *Insegnare a comprendere*. Roma, Anicia.

Law, J. M., Wouters, J., & Ghesquière, P. (2015). Morphological awareness and its role in compensation in adults with dyslexia. Dyslexia, 21, 254–272. https://doi.org/10.1002/dys.1495 PMID: 25620091.

Leardini, A. (2009). Inseguendo l'Isola Valbruna, l'Atlantide dell'Adriatico. *La Repubblica*, 19 agosto 2009.

Lecce, S., Ronchi, L., Sette, P. D., Bischetti, L., & Bambini, V. (2019). Interpreting physical and mental metaphors: Is Theory of Mind associated with pragmatics in middle childhood? *Journal of Child Language*, *46*(2), 393–407. https://doi.org/10.1017/S030500091800048X

Lefly, D. L., & Pennington, B. F. (1991). Spelling errors and reading fluency in compensated adult dyslexics. *Annals of Dyslexia*, 41, 143–162.

Lefly, D. L., & Pennington, B. F. (2000). Reliability and validity of the adult reading history questionnaire. *Journal of Learning Disabilities*, *33*(3), 286–296. https://doi.org/10.1177/002221940003300306

Lemaire, B., & Bianco, M. (2003). Contextual effects on metaphor comprehension: Experiment and simulation. In F. Detje, D. Dörner, & H. Schaub (Eds.), *Proceedings of the 5th international conference on cognitive modelling* (pp. 153–158). Bamberg, Germany: Universitäts-Verlag.

Lenth, R. (2022). *emmeans: Estimated Marginal Means, aka Least-Squares Means.* (1.8.2.) [Computer software]. https://CRAN.R-project.org/package=emmeans

Leslie, A. M., & Frith, U. (1988). Autistic children's understanding of seeing, knowing and believing. *British Journal of Developmental Psychology*, *6*(4), 315–324. https://doi.org/10.1111/j.2044-835X.1988.tb01104.x

Levesque, K. C., Breadmore, H. L., & Deacon, S. H. (2021). How morphology impacts reading and spelling: Advancing the role of morphology in models of literacy development. *Journal of Research in Reading*, 44(1), 10–26. https://doi.org/10.1111/1467-9817.12313

Li, P., Farkas, I. and MacWhinney, B. (2004). Early lexical development in a self-organizing neural network. *Neural Networks* 17, 1345–1362.

Li, X. H., Jing, J., Zou, X. B., Huang, X., Jin, Y., Wang, Q. X., Chen, X. B., Yang, B. R., & Yang, S. Y. (2009). Picture perception in Chinese dyslexic children: An eye-movement study. *Chinese Medical Journal*, *122*(3), 267–271. https://doi.org/10.3760/cma.j.issn.0366-6999.2009.03.006

Li, X., Wang, K., Wang, F., Tao, Q., Xie, Y., & Cheng, Q. (2013). Aging of theory of mind: The influence of educational level and cognitive processing. *International Journal of Psychology*, *48*(4), 715–727. https://doi.org/10.1080/00207594.2012.673724

Linderholm, T., Cong, X., & Zhao, Q. (2009). Differences in low and high working-memory capacity readers' cognitive and metacognitive processing patterns as a function of reading for different purposes. *Reading Psychology*, 29,61–85.

Livingstone, M. S., Rosen, G. D., Drislane, F. W., & Galaburda, A. M. (1991). Physiological and anatomical evidence for a magnocellular defect in developmental dyslexia. *Proceedings of the National Academy of Sciences of the United States of America*, *88*(18), 7943–7947. https://doi.org/10.1073/pnas.88.18.7943

Lorusso, M. L. (2009). *APL Medea–Abilità pragmatiche nel linguaggio [APL Medea – Pragmatics abilities in language]*. Giunti OS.

Lorusso, M. L., & Toraldo, A. (2023). Revisiting Multifactor Models of Dyslexia: Do They Fit Empirical Data and What Are Their Implications for Intervention? *Brain Sciences,* 13(2), 328. https://doi.org/10.3390/brainsci13020328

Lorusso, M.L. (2009) *APL Medea: Abilità Pragmatiche nel Linguaggio Medea*. Florence: Giunti OS.

Lovegrove, W. J., Bowling, A. Badcock, D., & Blackwood, M. (1980). Specific Reading Disability: Differences in Contrast Sensitivity as A Function of Spatial Frequency. *Science,* 210, 439.

Lovitt, C.T. (1989) *Introduction to Learning Disability*. Newton, MA: Allyn & Bacon.

Low, G. D. (2008). Metaphor in Education. In R. Gibbs (Ed.), *The Cambridge handbook of metaphor and thought* (pp. 212–231). Cambridge University Press. http://www.scopus.com/inward/record.url?scp=35649000851&partnerID=8YFLogxK

Lowe, M. R. (2003). Dyslexia, a different ability: A phenomenological study. *Dissertation Abstracts International: Section B*, 63, 4376.

Lyon, G.R., Shaywitz, S.E., & Shaywitz, B.A. (2003). A definition of dyslexia. *Annals of Dyslexia*, *53*, 1–14. https://doi.org/10.1007/s11881-003-0001-9.

Lyytinen, H., Ahonen, T., Eklund, K., Guttorm, T.K., Laakso, M.L., Leinonen, S., Leppäinen, P.H.T., Lyytinen, P., Poikkeus, A.M., Puolakanaho, P., Richardson, U. and Viholainen, H. (2001). Developmental

pathways of children with and without familial risk for dyslexia during the first years of life. *Developmental Neuropsychology* 20 (2), 535–554.

Lyytinen, H., Aro, M., Eklund, K., Erskine, J., Guttorm, T., Laakso, M.L., Leppänen, P.H.T., Lyytinen, P., Poikkeus, A.M. and Torppa, M. (2004). The development of children at familial risk for dyslexia: Birth to early school age. *Annals of Dyslexia* 54 (2), 184–220.

Majeed, N. M., Hartanto, A., & Tan, J. J. X. (2021). Developmental dyslexia and creativity: A meta-analysis. *Dyslexia*, *27*(2), 187–203. https://doi.org/10.1002/dys.1677

Mann, V. A., Shankweiler, D. P., & Smith, S. T. (1984). The association between comprehension of spoken sentences and early reading ability: The role of phonetic representation. *Journal of Child Language*, 11, 627–643.

Martin, J., Frauenfelder, U. H., & Colé, P. (2014). Morphological awareness in dyslexic university students. Applied Psycholinguistics, 35, 1213–1233. https://doi.org/10.1017/S0142716413000167.

Marzocchi, G.M., Oosterlaan, J., Zuddas, A., Cavolina, P., Geurts, H., Redigolo, D., Vio, C. and Sergeant, J.A. (2008). Contrasting deficits on executive functions between ADHD and reading disabled children. *Journal of Child Psychology and Psychiatry* 49, 543–552.

Mashal, N. (2013). The role of working memory in the comprehension of unfamiliar and familiar metaphors. *Language and Cognition*, *5*(4), 409–436. https://doi.org/10.1515/langcog-2013-0024

Mashal, N., & Faust, M. (2009). Conventionalisation of novel metaphors: A shift in hemispheric asymmetry. *Laterality: Asymmetries of Body, Brain and Cognition*, *14*(6), 573–589. https://doi.org/10.1080/13576500902734645

Mashal, N., & Kasirer, A. (2011). Thinking maps enhance metaphoric competence in children with autism and learning disabilities. *Research in Developmental Disabilities*, *32*(6), 2045–2054. https://doi.org/10.1016/j.ridd.2011.08.012

Mastroianni, B. (2016). *Cacciatori, guerrieri, contadini. Come stiamo online?*. http://www.brunomastro.it/2016/06/cacciatori-guerrieri-contadini.html

McArthur, G. M., Hogben, J. H., Edwards, V. T., Heath, S. M., & Mengler, E. D. (2000). On the "specifics" of specific reading disability and specific language impairment. *The Journal of Child Psychology and Psychiatry and Allied Disciplines*, *41*(7), 869-874.

McArthur, G., Sheehan, Y., Badcock, N. A., Francis, D. A., Wang, H. C., Kohnen, S., Banales, E., Anandakumar, T., Marinus, E., & Castles, A. (2018). Phonics training for English-speaking poor readers. Cochrane Database of Systematic Reviews, 11, CD009115.

McArthur, G.M., Hogben, J.H., Edwards, V.T., Heath, S.M. and Mengler, E.D. (2000). On the 'specifics' of specific reading disability and specific language impairment. *Journal of Child Psychology and Psychiatry,* 41 (7), 869–874.

McCabe, D. P., Roediger, H. L., McDaniel, M. A., Balota, D. A., & Hambrick, D. Z. (2010). The relationship between working memory capacity and executive functioning: Evidence for a common executive attention construct. *Neuropsychology*, 24(2), 222–243. https://doi.org/10.1037/a0017619

McGlone, M. S., & Manfredi, D. A. (2001). Topic-vehicle interaction in metaphor comprehension. *Memory & Cognition*, 29, 1209–1219. doi:10.3758/BF03206390

McGrath, L. M., Pennington, B. F., Shanahan, M. A., Santerre-Lemmon, L. E., Barnard, H. D., Willcutt, E. G., ... & Olson, R. K. (2011). A multiple deficit model of reading disability and attention-deficit/hyperactivity disorder: Searching for shared cognitive deficits. *Journal of Child Psychology and Psychiatry*, *52*(5), 547-557.

McLean, G. M., Stuart, G. W., Coltheart, V., & Castles, A. (2011). Visual temporal processing in dyslexia and the magnocellular deficit theory: the need for speed?. *Journal of Experimental Psychology: Human Perception and Performance*, *37*(6), 1957.

McLoughlin, D., & Leather, C. (2013). *The dyslexic adult: Interventions and outcomes-an evidence-based approach*. John Wiley & Sons.

McLoughlin, D., Fitzgibbon, G., & Young, V. (1994). *Adult dyslexia: assessment, counselling and training*. London: Whurr.

McLoughlin, D., Leather, C. and Stringer, P. (2002) *The Adult Dyslexic: Interventions and Outcomes*. London: Whurr Publishers.

Melby-Lervåg, M., Lyster, S. A. H., & Hulme, C. (2012). Phonological skills and their role in learning to read: a meta-analytic review. *Psychological bulletin*, *138*(2), 322.

Melloni, C., & Vender, M. (2022). Morphological awareness in developmental dyslexia: Playing with nonwords in a morphologically rich language. *Plos One*, 17(11), e0276643. https://doi.org/10.1371/journal.pone.0276643

Melloni, C., & Vender, M. (2020). *Phonological Processing and Nonword Repetition: A Critical Tool for the Identification of Dyslexia in Bilingualism. An Anthology of Bilingual Child Phonology*. Bristol: Multilingual Matters.

Melogno, S., Pinto, M. A., & Di Filippo, G. (2017). Sensory and Physico-Psychological Metaphor Comprehension in Children with ASD: A Preliminary Study on the Outcomes of a Treatment. *Brain Sciences*, *7*(7), Article 7. https://doi.org/10.3390/brainsci7070085

Meltzer, L. (1991). Problem-solving strategies and academic performance in learning disabled students: do subtypes exist? In L. V. Feagans, E. J. Short, & L. J. Meltzer (Eds.), *Subtypes of learning disabilities: theoretical perspectives and research* (pp. 163–188). Hillsdale, NJ: Lawrence Erlbaum Associates.

Menashe, S., Leshem, R., Heruti, V., Kasirer, A., Yair, T., & Mashal, N. (2020). Elucidating the role of selective attention, divergent thinking, language abilities, and executive functions in metaphor generation. *Neuropsychologia*, *142*. https://doi.org/10.1016/j.neuropsychologia.2020.107458

Menghini, D., Carlesimo, G. A., Marotta, L., Finzi, A., & Vicari, S. (2010). Developmental dyslexia and explicit long-term memory. *Dyslexia*, *16*(3), 213.

Menghini, D., Finzi, A., Carlesimo, G. A., & Vicari, S. (2011). Working memory impairment in children with developmental dyslexia: is it just a phonological deficit? *Developmental Neuropsychology*, 36, 199–213.

Mengisidou, M., Marshall, C. R., & Stavrakaki, S. (2020). Semantic fluency difficulties in developmental dyslexia and developmental language disorder (DLD): Poor semantic structure of the lexicon or slower retrieval processes? *International Journal of Language & Communication Disorders*, *55*(2), 200–215. https://doi.org/10.1111/1460-6984.12512

Metsala, J. L., & Walley, A. C. (1998). Spoken vocabulary growth and the segmental restructuring of lexical representations: Precursors to phonemic awareness and early reading ability. In J. L. Metsala & L. C. Ehri (Eds.), *Word Recognition in Beginning Literacy* (pp. 89–120). Mahwah, NJ: Erlbaum.

Middleton, J. L. (1991). Student-generated analogies in biology. *The American Biology Teacher*, 42–46.

Mielnik, A., Łockiewicz, M. and Bogdanowicz, M. (2015). Semantic and phonological verbal fluency in students with dyslexia. *Acta Neuropsychologica* 13, 253–266.

Miles, T.R., Thierry, G., Roberts, J. and Schiffeldrin, J. (2006). Verbatim and gist recall of sentences by dyslexic and non-dyslexic adults. *Dyslexia* 12, 177–194.

Miller-Shaul, S. (2005). The characteristics of young and adult dyslexics readers on reading and reading related cognitive tasks as compared to normal readers. *Dyslexia*, 11(2), 132–151. https://doi.org/10.1002/dys.290

Miyake A., & Friedman N. P. (2012). The nature and organization of individual differences in executive functions: Four general conclusions. *Current Directions in Psychological Science*, 21(1), 8–14. https://doi.org/10.1177/0963721411429458

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The Unity and Diversity of Executive Functions and Their Contributions to Complex "Frontal Lobe" Tasks: A Latent Variable Analysis. *Cognitive Psychology*, 41(1), 49–100. https://doi.org/10.1006/cogp.1999.0734

Miyake, A., Friedman, N. P., Rettinger, D. A., Shah, P., & Hegarty, M. (2001). How are visuospatial working memory, executive functioning, and spatial abilities related? A latent-variable analysis. *Journal of experimental psychology: General*, *130*(4), 621.

Moats, L. (2019). Structured literacy: Effective instruction for students with dyslexia and related reading difficulties. *Perspectives on Language and Literacy*, *45*(2), 9–11.

Moll, K. (2022). Comorbidity of Reading Disorders. *The Science of Reading: A Handbook*, 439-459.

Moll, K., Snowling, M. J., & Hulme, C. (2020). Introduction to the special issue "comorbidities between reading disorders and other developmental disorders". *Scientific Studies of Reading*, *24*(1), 1-6.

Monsell, S. (2003). Task switching. *Trends in Cognitive Sciences*, 7, 134–140.

Montag, J.L., Jones, M.N. and Smith, L.B. (2015). The words children hear: Picture books and the statistics for language learning. *Psychological Science* 26 (9), 1489–1496.

Montesano, L., & Valenti, A. (2020). Disturbi specifici dell'apprendimento nel giovane adulto. In *LSC-SUA. Prove di lettura, comprensione del testo, scrittura e calcolo* (pp. 11-27). Erickson.

Moojen, S. M. P., Gonçalves, H. A., Bassôa, A., Navas, A. L., de Jou, G., & Miguel, E. S. (2020). Adults with dyslexia: How can they achieve academic success despite impairments in basic reading and writing abilities? The role of text structure sensitivity as a compensatory skill. *Annals of Dyslexia*, *70*(1), 115–140. https://doi.org/10.1007/s11881-020-00195-w

Morton, J., & Frith, U. (1995). Causal modeling: A structural approach to developmental psychopathology.

Nagy, W. E., Diakidoy, I. A. N., & Anderson, R. C. (1993). The acquisition of morphology: Learning the contribution of suffixes to the meanings of derivatives. *Journal of Literacy Research*, 25, 155–170. https://doi.org/10.1080/10862969309547808.

Närhi, V., Räsänen, P., Metsäpelto, R.-L., & Ahonen, T. (1997). Trail making test in assessing children with reading disabilities: a test of executive functions or content information. *Perceptual and Motor Skills*, 84, 1355–1362.

Nation, K. (2009). Form–meaning links in the development of visual word recognition. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 364, 3665–3674. https://doi.org/10.1098/ rstb.2009.0119

Nicolson, R. I., & Fawcett, A. J. (1990). Automaticity: A Framework for Dyslexia Research?. *Cognition*, *35*, 159-182.

Nicolson, R., Fawcett, A. J., & Dean, P. (2001). Dyslexia, development and the cerebellum. *Trends in Neurosciences*, *24*(9), 515–516. https://doi.org/10.1016/s0166-2236(00)01923-8

Nippold, M. A., & Sullivan, M. P. (1987). Verbal and Perceptual Analogical Reasoning and Proportional Metaphor Comprehension in Young Children. *Journal of Speech, Language, and Hearing Research*, *30*(3), 367–376. https://doi.org/10.1044/jshr.3003.367

Nobre, A.D.P. and Salles, J.F.D. (2016). Lexical–semantic processing and reading: Relations between semantic priming, visual word recognition and reading comprehension. *Educational Psychology* 36, 753–770.

Norbury, C. F. (2005). The relationship between theory of mind and metaphor: Evidence from children with language impairment and autistic spectrum disorder. *British Journal of Developmental Psychology*, *23*(3), 383–399. https://doi.org/10.1348/026151005X26732

Norbury, C. Frazier. (2005). The relationship between theory of mind and metaphor: Evidence from children with language impairment and autistic spectrum disorder. *British Journal of Developmental Psychology*, *23*(3), 383–399. https://doi.org/10.1348/026151005X26732

Norton, E. S., & Wolf, M. (2012). Rapid Automatized Naming (RAN) and Reading Fluency: Implications for Understanding and Treatment of Reading Disabilities. *Annual Review of Psychology*, *63*(November 2011), 427–452. https://doi.org/10.1146/annurev-psych-120710-100431

Noveck, I. A., Bianco, M., & Castry, A. (2001). The Costs and Benefits of Metaphor. *Metaphor and Symbol*, *16*(1–2), 109–121. https://doi.org/10.1080/10926488.2001.9678889

Novelli, G., Papagno, C., Capitani, E., & Laiacona, M. (1986). Tre test clinici di ricerca e produzione lessicale. Taratura su sogetti normali. *Archivio di psicologia, neurologia e psichiatria*.

Oakhill, J., Cain, K., & Elbro, C. (2014). *Understanding and teaching reading comprehension: A handbook*. Routledge.

Obidziński, M. and Nieznański, M. (2017). False memory for orthographically versus semantically similar words in adolescents with dyslexia: A fuzzy-trace theory perspective. *Annals of Dyslexia* 67 (3), 318–332.

Ojha, A., Indurkhya, B., & Lee, M. (2017). Is language necessary to interpret visual metaphors? *Metaphor in Communication, Science and Education*, *36*, 61.

Olkoniemi, H., Ranta, H., & Kaakinen, J. K. (2016). Individual differences in the processing of written sarcasm and metaphor: Evidence from eye movements. *Journal of Experimental Psychology: Learning Memory and Cognition*, *42*(3), 433–450. https://doi.org/10.1037/xlm0000176

Ortony, A. (1979). Beyond literal similarity. *Psychological Review*, *86*, 161–180. https://doi.org/10.1037/0033-295X.86.3.161

Ortony, A., Schallert, D. L., Reynolds, R. E., & Antos, S. L. (1978). Interpreting metaphors and idioms: Some effects of context on comprehension. *Journal of Verbal Learning and Verbal Behavior*, 17, 465–477. doi:10.1016/S00225371(78)90283-9

Ouellette, G., & Beers, A. (2010). A not-so-simple view of reading: How oral vocabulary and visual-word recognition complicate the story. *Reading and Writing*, 23(2), 189–208.

Ouellette, G., & Shaw, E. (2014). Oral vocabulary and reading comprehension: An intricate affair. *L'Année Psychologique*, 114(04), 623–645.

Ozernov-Palchik, O., Yu, X., Wang, Y., Gaab, N. (2016). Lessons to be learned: How a comprehensive neurobiological framework of atypical reading development can inform educational practice. *Curr. Opin. Behav. Sci.*, 10, 45–58.

Palmer, S. E. (2000). Phonological recoding deficit in working memory of dyslexic teenagers. *Journal of Research in Reading*, 23, 28–40.

Parrila, R., Georgiou, G. K., & Papadopoulos, T. C. (2020). Dyslexia in a consistent orthography: Evidence from reading-level match design. *Dyslexia*, 26(4), 343–358. https://doi.org/10.1002/dys.1650

Parrila, R., Georgiou, G., & Corkett, J. (2007). University students with a significant history of reading difficulties: What is and what is not compensated? *Exceptionality Education Canada*, 17(2), 195–220. https://doi.org/10.5206/eei.v17i2.7604

Pedersen, H. F., Fusaroli, R., Lauridsen, L. L., & Parrila, R. (2016). Reading Processes of University Students with Dyslexia – An Examination of the Relationship between Oral Reading and Reading Comprehension. *Dyslexia*, 22(4), 305–321. https://doi.org/10.1002/dys.1542

Pennington, B. (2006). From single to multiple deficit models of developmental disorders. *Cognition* 101 (2), 385–413.

Pennington, B. F. (1990). The genetics of dyslexia. *Child Psychology & Psychiatry & Allied Disciplines, 31(2), 193–201*. https://doi.org/10.1111/j.1469-7610.1990.tb01561.x

Pennington, B. F. (2006). From single to multiple deficit models of developmental disorders. *Cognition*, *101*(2), 385–413. https://doi.org/10.1016/j.cognition.2006.04.008

Pennington, B. F., McGrath, L. M., & Peterson, R. L. (2019). *Diagnosing learning disorders: From* science to practice: Guilford Publications.

Pennington, B. F., Santerre-Lemmon, L., Rosenberg, J., MacDonald, B., Boada, R., Friend, A., Leopold, D. R., Samuelsson, S., Byrne, B., Willcutt, E. G., & Olson, R. K. (2012). Individual prediction of dyslexia by single versus multiple deficit models. *Journal of Abnormal Psychology*, *121*, 212–224. https://doi.org/10.1037/a0025823

Pennington, B.F. (2006). From single to multiple deficit models of developmental disorders. *Cognition, 101*, 385–413.

Pennington, B.F., Santerre-Lemmon, L., Rosenberg, J., MacDonald, B., Boada, R., Friend, A., Leopold, D.R., Samuelsson, S., Byrne, B., Willcutt, E.G., et al. (2012). Individual prediction of dyslexia by single versus multiple deficit models. *J. Abnorm. Psychol,* 121, 212–224.

Perfetti, C. (2007). Reading ability: Lexical quality to comprehension. *Scientific Studies of Reading*, 11(4), 357–383. https://doi.org/10.1080/10888430701530730

Persicke, A., Tarbox, J., Ranick, J., & St. Clair, M. (2012). Establishing metaphorical reasoning in children with autism. *Research in Autism Spectrum Disorders*, *6*(2), 913–920. https://doi.org/10.1016/j.rasd.2011.12.007

Peterson, R. L., & Pennington, B. F. (2015). Developmental dyslexia. *Annual Review of Clinical Psychology*, 11, 283–307. https://doi.org/10.1146/annurev-clinpsy-032814-112842

Pierce, R. S., MacLaren, R., & Chiappe, D. L. (2010). The role of working memory in the metaphor interference effect. *Psychonomic Bulletin and Review*, *17*(3), 400–404. https://doi.org/10.3758/PBR.17.3.400

Pilkington, A. (2000). *Poetic Effects: a Relevance Theory Perspective*. Amsterdam/Philadelphia: John Benjamins Publishing Company.

Plucker, J. A., Karwowski, M., & Kaufman, J. C. (2020). Intelligence and Creativity. In R. J. Sternberg (Ed.), *The Cambridge Handbook of Intelligence* (2nd ed., pp. 1087–1105). Cambridge University Press. https://doi.org/10.1017/9781108770422.046

Poljac, E., Simon, S. Ringlever, L., Kalcik, D., Groen, W. B., Buitelaar, J. K., et al. (2010). Impaired task switching performance in children with dyslexia but not in children with autism. *Quarterly Journal of Experimental Psychology*, 63, 401–416.

Pouscoulous, N., & Tomasello, M. (2020). Early birds: Metaphor understanding in 3-year-olds. *Journal of Pragmatics*, *156*, 160–167. https://doi.org/10.1016/j.pragma.2019.05.021

Prandi, M. (2021). *Le metafore tra le figure: una mappa ragionata*. Utet Università.

Prat, C. S., Mason, R. A., & Just, M. A. (2012). An fMRI investigation of analogical mapping in metaphor comprehension: The influence of context and individual cognitive capacities on processing demands. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *38*(2), 282–294. https://doi.org/10.1037/a0026037

Pringle-Morgan, W. (1896). A case of congenital word blindness. *British Medical Journal*, *2*, 1378. doi: 10.1136/bmj.2.1871.1378.

Protopapas, A., Archonti, A., & Skaloumbakas, C. (2007). Reading ability is negatively related to Stroop interference. *Cognitive Psychology*, *54*(3), 251-282.

Proulx, M. J., & Elmasry, H. M. (2015). Stroop interference in adults with dyslexia. *Neurocase*, *21*(4), 413–417. https://doi.org/10.1080/13554794.2014.914544

Provazza, S., Adams, A. M., Giofrè, D., & Roberts, D. J. (2019). Double Trouble: Visual and Phonological Impairments in English Dyslexic Readers. *Frontiers in psychology*, *10*, 2725.

Prutting, C.A. and Kittchner, D.M. (1987) A clinical appraisal of the pragmatic aspects of language. *Journal of Speech & Hearing Disorders* 52 (2), 105–119.

Pynte J, Besson M, Robichon FH, Poli J (1996) The Time-Course of Metaphor Comprehension: An Event-Related Potential Study. *Brain Lang* 316: 293–316.

Ramus, F. (2003). Theories of developmental dyslexia: Insights from a multiple case study of dyslexic adults. *Brain*, *126*(4), 841–865. https://doi.org/10.1093/brain/awg076

Ramus, F. & Szenkovits, G., (2008). What Phonological Deficit? *Quarterly Journal of Experimental Psychology,* 61,1. 129-141.

Ramus, F., & Ahissar, M. (2012). Developmental dyslexia: The difficulties of interpreting poor performance, and the importance of normal performance. *Cognitive neuropsychology*, *29*(1-2), 104-122.

Ramus, F., & Szenkovits, G. (2008). What phonological deficit? *The Quarterly Journal of Experimental Psychology,* 61(1), 129–141.

Ramus, F., Marshall, C. R., Rosen, S., & van der Lely, H. K. (2013). Phonological deficits in specific language impairment and developmental dyslexia: Towards a multidimensional model. *Brain*, *136*(2), 630-645.

Ramus, F., Rosen, S., Dakin, S. C., Day, B. L., Castellote, J. M., White, S., Frith, U. (2003). Theories of Developmental Dyslexia: Insights from A Multiple Case Study of Dyslexic Adults. *Brain, 126*, 841-865.

Ransby, M. J., & Lee Swanson, H. (2003). Reading Comprehension Skills of Young Adults with Childhood Diagnoses of Dyslexia. *Journal of Learning Disabilities*, 36(6), 538–555. https://doi.org/10.1177/00222194030360060501

Ransby, M. J., & Swanson, H. L. (2004). Reading comprehension skills of young adults with childhood diagnoses of dyslexia. *Journal of Learning Disabilities*, 36 (6), 538-555.

Rapp, A. M., Mutschler, D. E., & Erb, M. (2012). Where in the brain is nonliteral language? A coordinate-based meta-analysis of functional magnetic resonance imaging studies. *NeuroImage*, *63*(1), 600–610. https://doi.org/10.1016/j.neuroimage.2012.06.022

Rasamimanana, M., Barbaroux, M., Colé, P., & Besson, M. (2020). Semantic compensation and novel word learning in university students with dyslexia. *Neuropsychologia*, *139*(June 2019). https://doi.org/10.1016/j.neuropsychologia.2020.107358

Read, J. (2004). Plumbing the depths: How should the construct of vocabulary knowledge be defined. In B. Laufer and P. Bogaards (eds) *Vocabulary in a Second Language: Selection, Acquisition and Testing* (pp. 209–227). Amsterdam: John Benjamins.

Recanati, F. (2004). *Literal meaning*. Cambridge University Press. https://books.google.com/books?hl=it&lr=&id=ItPyx3ftrIIC&oi=fnd&pg=PP9&dq=Recanati,+F.+(2004). +Literal+Meaning&ots=QMP-2BrKYF&sig=0D2L-i0tkuGp_7z0_DN14dWNKHY

Reis, A., Araújo, S., Morais, I. S., & Faísca, L. (2020). Reading and reading-related skills in adults with dyslexia from different orthographic systems: A review and meta-analysis. *Annals of Dyslexia*, 70(3), 339–368. https://doi.org/10.1007/s11881-020-00205-x

Reiter, A., Tucha, O., & Lange, K. W. (2005). Executive functions in children with dyslexia. *Dyslexia*, *11*(2), 116-131.

Rello, L., & Baeza-Yates, R. (2017). How to present more readable text for people with dyslexia. *Universal Access in the Information Society*, *16*(1), 29–49. https://doi.org/10.1007/s10209-015-0438-8

Reyna, V.F. (2012). A new intuitionism: Meaning, memory, and development in fuzzy-trace theory. *Judgment and Decision Making* 7, 332–359.

Richards, I. A. (1936). *The Philosophy of Rhetoric*. Oxford University Press.

Riddick, B., Farmer, M. and Sterling, C. (1997) *Students and Dyslexia: Growing Up with a Specific Learning Difficulty*. London: Whurr Publishers.

Rinaldi, M.C., Marangolo, P. and Lauriola, M. (2006) *BLED – Batteria sul Linguaggio dell'emisfero Destro SantaLucia*. Firenze: Giunti.

Rinaldi, W. (2000). Pragmatic comprehension in secondary school-aged students with specific developmental language disorder. *International Journal of Language & Communication Disorders*, *35*(1), 1–29. https://doi.org/10.1080/136828200247223

Rispens, J. E., McBride-Chang, C., & Reitsma, P. (2008). Morphological awareness and early and advanced word recognition and spelling in Dutch. *Reading and Writing*, 21(6), 587–607. https://doi.org/10.1007/ s11145-007-9077-7

Rivero-Contreras, M., Engelhardt, P. E., & Saldaña, D. (2021). An experimental eye tracking study of text adaptation for readers with dyslexia: Effects of visual support and word frequency. *Annals of Dyslexia*, *71*(1), 170–187. https://doi.org/10.1007/s11881-021-00217-1

Robertson, E. K., & Joanisse, M. F. (2010). Spoken sentence comprehension in children with dyslexia and language impairment: The roles of syntax and working memory. *Applied Psycholinguistics*, *31*(1), 141-165.

Robichon, F., Besson, M. and Habib, M. (2002). An electrophysiological study of dyslexic and control adults in a sentence reading task. *Biological Psychology* 59, 29–53.

Rochelle, K. S. H., Witton, C., & Talcott, J. B. (2009). Symptoms of hyperactivity and inattention can mediate deficits of postural stability in developmental dyslexia. *Experimental Brain Research*, *192*(4), 627–633. https://doi.org/10.1007/s00221-008-1568-5

Rohrer, D., Wixted, J.T., Salmon, D.P. and Butters, N. (1995). Retrieval from semantic memory and its implications for Alzheimer's disease. *Journal of Experimental Psychology: Learning, Memory, and Cognition,* 21, 1127–1139.

Roodenrys, S., & Stokes, J. (2001). Serial recall and nonword repetition in reading disabled children. *Reading and Writing: An Interdisciplinary Journal*, 14 , 379-394.

Rose, T. and Rouhani, P. (2012). Influence of verbal working memory depends on vocabulary: Oral reading fluency in adolescents with dyslexia. *Mind, Brain, and Education,* 6 (1), 1–9.

Rothou, K. M., & Padeliadu, S. (2014). Inflectional morphological awareness and word reading and reading comprehension in Greek. *Applied Psycholinguistics*, 36(4), 1007–1027. https://doi.org/10.1017/S0142716414000022

Rubio Fernández, P. (2007). Suppression in metaphor interpretation: Differences between meaning selection and meaning construction. *Journal of Semantics*, *24*(4), 345–371. https://doi.org/10.1093/jos/ffm006

Runco, M. A., & Acar, S. (2012). Divergent Thinking as an Indicator of Creative Potential. *Creativity Research Journal*, *24*(1), 66–75. https://doi.org/10.1080/10400419.2012.652929

Rüsseler, J., Becker, P., Johannes, S., & Mu ¨ nte, T. F. (2007). Semantic, syntactic, and phonological processing of written words in adult developmental dyslexic readers: An event-related brain potential study. *BMC Neuroscience*, 8, 52.

Sabatini, J. P., Shore, J., Holtzman, S., & Scarborough, H. S. (2011). Relative Effectiveness of Reading Intervention Programs for Adults With Low Literacy. Journal of Research on Educational Effectiveness, 4(2), 118-133.

Saksida, A., Iannuzzi, S., Bogliotti, C., Chaix, Y., Démonet, J.-F., Bricout, L., Billard, C., Nguyen-Morel, M.A., Le Heuzey, M.F., Soares-Boucaud, I., George, F., Ziegler, J. C., & Ramus, F. (2016). Phonological skills, visual attention span, and visual stress in developmental dyslexia. *Developmental Psychology, 52*(10), 1503–1516.

Samuelsson, S., & Lundberg, I. (2003). The impact of environmental factors on components of reading and dyslexia. *Annals of dyslexia*, 201-217.

Santulli, F. and Scagnelli, M. (2017) The improvement of silent reading strategies through Super Reading. *The Journal of Inclusive Practice in Further and Higher Education* 9 (1), 88–100.

Savill, N., Ellis, A.W. and Jefferies, E. (2017). Newly-acquired words are more phonologically robust in verbal short-term memory when they have associated semantic representations. *Neuropsychologia,* 98, 85–97.

Scagnelli, M., Ciuffo, M., Baradello, A. and Santulli, F. (2018) Super Reading: Ulteriori prove di efficacia rilevate con i test di valutazione per l'adulto. *Dislessia* 15 (1), 35–51.

Schiff, R., Cohen, M., Marton, R. and Sasson, A. (2019). Auditory morphological knowledge in adults with dyslexia: The importance of semantic information. *Scientific Studies of Reading,* 23 (4), 317–333.

Schuchardt, K., Maehler, C., & Hasselhorn, M. (2008). Working memory deficits in children with specific learning disorders. *Journal of Learning Disabilities*, 41, 514–523.

Schulz, E., Maurer, U., van der Mark, S., Bucher, K., Brem, S., Martin, E. and Brandeis, D. (2008). Impaired semantic processing during sentence reading in children with dyslexia: Combined fMRI and ERP evidence. *Neuroimage.* 41 (1), 153–168.

Schumacher, P. B. (2014). Content and context in incremental processing:"the ham sandwich" revisited. *Philosophical Studies*, *168*, 151–165.

Searle, J. R. (1993). Metaphor. In A. Ortony (Ed.), *Metaphor and Thought* (2nd ed., pp. 83–111). Cambridge University Press. https://doi.org/10.1017/CBO9781139173865.008

Shamay-Tsoory, S. G., Harari, H., Aharon-Peretz, J., & Levkovitz, Y. (2010). The role of the orbitofrontal cortex in affective theory of mind deficits in criminal offenders with psychopathic tendencies. *Cortex*, *46*(5), 668–677. https://doi.org/10.1016/j.cortex.2009.04.008

Shankweiler, D., & Crain, S. (1986). Language mechanisms and reading disorder: A modular approach. *Cognition*, *24*(1–2), 139–168. https://doi.org/10.1016/0010-0277(86)90008-9.

Share, D. L., & Stanovich, K. E. (1995). Accommodating individual differences in critiques: Replies to our commentators. *Issues in Education: Contributions from Educational Psychology*, *1*, 105–121.

Sharif, F., Johari Fard, R., & Borna, M. R. (2023). The Effectiveness of Metacognitive Knowledge and Skills Program on Visual and Auditory Dyslexia in Students with Learning Disabilities. *Health Education and Health Promotion*, *11*(4), 1001–1006.

Shaywitz S.E., Shaywitz B.A., Fulbright R.K., Skudlarski P., Mencl W.E., Constable R.T., Pugh K.R., Holahan J.M., Marchione K.E., Fletcher J.M., Lyon G.R. e Gore J.C. (2003). Neural systems for compensation and persistence: Young adult outcome of childhood reading disability. *Biological Psychiatry*, vol. 54, n. 1, pp. 25-33.

Shechter, A., Lipka, O., & Katzir, T. (2018). Predictive models of word reading fluency in Hebrew. *Frontiers in Psychology*, 9, 1882. https://doi.org/10.3389/fpsyg.2018.01882

Shepard, R. N. (1978). Externalization of mental images and the act of creation. *Visual Learning, Thinking, and Communication*, 133–189.

Shields, J., Varley, R., Broks, P., & Simpson, A. (1996). SOCIAL COGNITION IN DEVELOPMENTAL LANGUAGE DISORDERS AND HIGH-LEVEL AUTISM. *Developmental Medicine & Child Neurology*, *38*(6), 487–495. https://doi.org/10.1111/j.1469-8749.1996.tb12109.x

Shiran, A., & Breznitz, Z. (2011). The effect of cognitive training on recall range and speed of information processing in the working memory of dyslexic and skilled readers. Journal of Neurolinguistics, 24(5), 524-537.

Siegel, L. S. (1988). Evidence that IQ scores are irrelevant to the definition and analysis of reading disability. *Canadian Journal of Psychology/Revue canadienne de psychologie, 42*(2), 201–215. https://doi.org/10.1037/h0084184

Simi, N. (2021). *Developmental Dyslexia and Anaphora Resolution in English L1/L2: The Effect of Referent Abstractness*. Cambridge Scholars Publishing.

Simmons, F., & Singleton, C. (2000). The reading comprehension abilities of dyslexic students in higher education. *Dyslexia*, 6(3), 178–192. https://doi.org/10.1002/1099-0909(200007/09)6:3<178::AID-DYS171>3.0.CO;2-9

Smith-Spark, J. H. (2000). *Memory in adult dyslexics: an exploration of the working memory system Unpublished PhD thesis*. UK: University of Sheffield.

Smith-Spark, J. H., & Fisk, J. E. (2007). Working memory functioning in developmental dyslexia. *Memory*, 15(1), 34–56. https://doi.org/10.1080/09658210601043384

Smith-Spark, J. H., Fisk, J. E., Fawcett, A. J., & Nicolson, R. I. (2003). Central executive impairments in adult dyslexics: evidence from phonological and visuospatial working memory performance. *European Journal of Cognitive Psychology*, 15, 567–587.

Smith-Spark, J. H., Henry, L. A., Messer, D. J., Edvardsdottir, E., & Ziecik, A. P. (2016). Executive functions in adults with developmental dyslexia. *Research in Developmental Disabilities*, 53–54, 323–341. https://doi.org/10.1016/j.ridd.2016.03.001

Smith, S. T., Macaruso, P., Shankwieler, D., & Crain, S. (1989). Syntactic comprehension in young poor readers. *Applied Psycholinguistics*, 10, 429–454.

Snowling, M. (1998). Dyslexia as a Phonological Deficit: Evidence and Implications. *Child Psychology and Psychiatry Review*, *3*(1), 4–11. https://doi.org/10.1111/1475-3588.00201

Snowling, M. (2000). *Dyslexia* (2nd ed.). Oxford: Blackwell.

Snowling, M. J. (1981). Phonemic Deficits in Developmental Dyslexia. *Psychological Research, 43*(2), 219–234.

Snowling, M. J. (2001). From language to reading and dyslexia. *Dyslexia*, 7, 37–46.

Snowling, M. J. (2006). *Language Skills and Learning to Read: The Dyslexia Spectrum*. In M. J. Snowling & J. Steakhouse (Eds.), *Dyslexia - Speech and Language,* (p. 1-14). Whurr Publishers.

Snowling, M. J. (2013). Early identification and interventions for dyslexia: A contemporary view. *Journal of Research in Special Educational Needs*, 13(1), 7-14.

Snowling, M. J., & Melby-Lervåg, M. (2016). Oral language deficits in familial dyslexia: A meta-analysis and review. *Psychological Bulletin*, 142(5), 498–545. https://doi.org/10.1037/bul0000037

Snowling, M. J., Chiat, S., & Hulme, C. (1991). Words, nonwords, and phonological processes: Some comments on Gathercole, Willis, Emslie, and Baddeley. *Applied Psycholinguistics*, 12 , 369-373.

Snowling, M., Hayiou-Thomas, M., Nash, H. M., & Hulme, C. (2020). Dyslexia and Developmental Language Disorder: Comorbid disorders with distinct effects on reading comprehension. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, 61(6), 672–680. https://doi.org/10.1111/jcpp.13140

Snowling, M.J. & Hulme, C. (2012). Annual research review: The nature and classification of reading disorders: A commentary on proposals for DSM-5. *Journal of Child Psychology and Psychiatry* 53 (5), 593–607.

Snowling, M.J. & Melby-Lervag, M. (2016). Oral language deficits in familial dyslexia: A meta-analysis and review. *Psychological Bulletin,*142, 498–545.

Song, S., Su, M., Kang, C., Liu, H., Zhang, Y., McBride-Chang, C., Tardif, T., Li, H., Liang, W., Zhang, Z. and Shu, H. (2015). Tracing children's vocabulary development from preschool through the school-age years: An 8-year longitudinal study. *Developmental Science* 18, 119–131.

Sperber, D., & Wilson, D. (2008). A deflationary account of metaphors. *The Cambridge Handbook of Metaphor and Thought*, *84*, 105.

Spiro, R. J., Feltovich, P. J., Coulson, R. L., & Anderson, D. K. (1989). Multiple analogies for complex concepts: Antidotes for analogy-induced misconception in advanced knowledge acquisition. In *Similarity and analogical reasoning* (pp. 498–531). Cambridge University Press. https://doi.org/10.1017/CBO9780511529863.023

St Clair-Thompson, H. L., & Allen, R. J. (2013). Are forward and backward recall the same? A dual-task study of digit recall. *Memory & Cognition*, *41*(4), 519–532. https://doi.org/10.3758/s13421-012-0277-2

Stafura, J.Z. and Perfetti, C.A. (2017). Integrating word processing with text comprehension. In K. Cain, D.L. Compton and R.K. Parrila (eds) *Theories of Reading Development* (pp. 9–31). Amsterdam: John Benjamins.

Stamenković, D., Ichien, N., & Holyoak, K. J. (2019). Metaphor comprehension: An individual-differences approach. *Journal of Memory and Language*, 105, 108–118. https://doi.org/10.1016/j.jml.2018.12.003

Stamenković, D., Ichien, N., & Holyoak, K. J. (2020). Individual Differences in Comprehension of Contextualized Metaphors. *Metaphor and Symbol*, *35*(4), 285–301. https://doi.org/10.1080/10926488.2020.1821203

Stanovich, K. E., & Siegel, L. S. (1994). Phenotypic performance profile of children with reading disabilities: A regression-based test of the phonological-core variable-difference model. *Journal of Educational Psychology*, *86*, 24–53. https://doi.org/10.1037/0022-0663.86.1.24

Stanovich, K.E. (1991). Discrepancy Definitions of Reading Disability: Has Intelligence Led Us Astray? *Reading Research Quarterly*, 26, 7–29.

Steen, G. (2015). Developing, testing and interpreting Deliberate Metaphor Theory. *Journal of Pragmatics*, 90, 67–72. https://doi.org/10.1016/j.pragma.2015.03.013

Steen, G. J., Dorst, A. G., Herrmann, J. B., Kaal, A. A., & Krennmayr, T. (2010). Metaphor in usage. *Cognitive Linguistics*, *21*(4), 765–796. https://doi.org/10.1515/COGL.2010.024

Stein, J. (2001). The magnocellular theory of developmental dyslexia. *Dyslexia (Chichester, England)*, *7*(1), 12–36. https://doi.org/10.1002/dys.186

Stein, J. (2001). The sensory basis of reading problems. Developmental Neuropsychology, 20(2), 509–534. https://doi.org/10.1207/S15326942DN2002_4

Stein, J. (2023). Theories about Developmental Dyslexia. *Brain Sciences*, 13(2), 208. https://doi.org/10.3390/brainsci13020208

Stein, J., & Walsh, V. (1997). To see but not to read; the magnocellular theory of dyslexia. *Trends in neurosciences*, *20*(4), 147–152. https://doi.org/10.1016/s0166-2236(96)01005-3

Stella, M., & Engelhardt, P. E. (2021). Comprehension and Eye Movements in the Processing of Subject- and Object-Relative Clauses: Evidence from Dyslexia and Individual Differences. *Brain Sciences*, 11(7), 915. https://doi.org/10.3390/brainsci11070915

Sternberg, R. J. (2020). What's Wrong with Creativity Testing? *The Journal of Creative Behavior*, *54*(1), 20–36. https://doi.org/10.1002/jocb.237

Stoet, G., Markey, H., & Lopez, B. (2007). Dyslexia and attentional shifting. *Neuroscience Letters*, 427, 61–65.

Stoicescu, I., Sevcenco, A., & Avram, L. (2021). *The acquisition of scalar implicatures: A clinical marker of developmental dyslexia in Romanian?*

Stone, V. E., Baron-Cohen, S., & Knight, R. T. (1998). Frontal Lobe Contributions to Theory of Mind. *Journal of Cognitive Neuroscience*, *10*(5), 640–656. https://doi.org/10.1162/089892998562942

Stuss, D. T., & Alexander, M. P. (2000). Executive functions and the frontal lobes: a conceptual view. *Psychological research*, *63*(3-4), 289-298.

Suárez-Coalla, P., Martínez-García, C., & Cuetos, F. (2017). Morpheme-based reading and writing in Spanish children with dyslexia. *Frontiers in Psychology*, 8, 1952. https://doi.org/10.3389/fpsyg.2017.01952

Swanson, H. L. (1992). The modifiability and generality of working memory in skilled and less skilled readers. Journal of Educational Psychology, 86 , 473 488.

Swanson, H. L. (1999). Reading comprehension and working memory in learning-disabled readers: Is the phonological loop more important than the executive system? Journal of Experimental Child Psychology, 72 ,131.

Swanson, H. L., & Ashbaker, M. H. (2000). Working memory, short-term memory, speech rate, word recognition and reading comprehension in learning disabled readers: Does the executive system have a role? *Intelligence*, 28(1), 1–30. https://doi.org/10.1016/S0160-2896(99)00025-2

Swanson, H. L., & Hsieh, C. J. (2009). Reading disabilities in adults: A selective meta-analysis of the literature. *Review of educational Research*, *79*(4), 1362-1390.

Swanson, H. L., & Sachse-Lee, C. (2001). A subgroup analysis of working memory in children with reading disabilities: Domain-general or domain-specific deficiency. Journal of Learning Disabilities, 34 (3), 249 263.

Swanson, H. L., Ashbaker, M. H., & Lee, C. (1996). Learning-disabled readers' working memory as a function of processing demands. *Journal of Experimental Child Psychology*, 61 , 242-275.

Swanson, H.L. (2012). Adults with reading disabilities: Converting a meta-analysis to practice. Journal of Learning Disabilities 45 (1), 17–30.

Swanson, H.L. and Hsieh, C.J. (2009). Reading disabilities in adults: A selective meta-analysis of the literature. Review of Educational Research 79 (4), 1362–1390.

Tallal, P. (1984). Temporal or phonetic processing deficit in dyslexia? That is the question. *Applied Psycholinguistics*, 5, 167–169.

Tallal, P., Miller, S., & Fitch, R. H. (1993). Neurobiological basis of speech: A case for the preeminence of temporal processing. *Annals of the New York Academy of Sciences*, *682*, 27–47. https://doi.org/10.1111/j.1749-6632.1993.tb22957.x

Tamis-LeMonda, C.S., Bornstein, M.H. and Baumwell, L. (2001). Maternal responsiveness and children's achievement of language milestones. Child Development 72 (3), 748–767.

Tanenhaus, M. K., Spivey-knowlton, M. J., Eberhard, K. M., Sedivy, J. C., Tanenhaus, M. K., Spivey-knowlton, M. J., Eberhard, K. M., & Sedivy, J. C. (1995). Integration of Visual and Linguistic Information in Spoken Language Comprehension Published by: American Association for the Advancement of Science Stable URL : http://www.jstor.org/stable/2888637 JSTOR is a not-for-profit service that helps scholars , r. *Science*, *268*(5217), 1632–1634.

Teuber, H. L. (1972). Unity and diversity of frontal lobe functions. *Acta neurobiologiae experimentalis*, *32*(2), 615-656.

Thibodeau, P. H., & Durgin, F. H. (2011). Metaphor Aptness and Conventionality: A Processing Fluency Account. *Metaphor and Symbol*, *26*(3), 206–226. https://doi.org/10.1080/10926488.2011.583196

Tilstra, J., McMaster, K., Van den Broek, P., Kendeou, P., & Rapp, D. (2009). Simple but complex: Components of the Simple View of Reading across grade levels. *Journal of Research in Reading*, 32(4), 383–401. https://doi.org/10.1111/j.14679817.2009.01401.x

Tonini, E., Lecce, S., Del Sette, P., Bianco, F., Canal, P., & Bambini, V. (2022). Efficacy and benefits of the MetaCom training to promote metaphor comprehension in typical development. *First Language*, 014272372210812. https://doi.org/10.1177/01427237221081201

Torppa, M., Georgiou, G., Lerkkanen, M., Niemi, P., Poikkeus, A., & Nurmi, J. (2016). Examining the Simple View of Reading in a transparent orthography: A longitudinal study from Kindergarten to Grade 3. *Merrill-Palmer Quarterly*, 62(2), 179–206. https://doi.org/10.13110/merrpalmquar1982.62.2.0179

Tressoldi, P. E., Stella, G., & Faggella, M. (2001). The development of reading speed in Italians with dyslexia: A longitudinal study. *Journal of learning disabilities*, *34*(5), 414-417.

Trick, L., & Katz, A. N. (1986). The Domain Interaction Approach to Metaphor Processing: Relating Individual Differences and Metaphor Characteristics. *Metaphor and Symbolic Activity*, *1*(3), 185–213. https://doi.org/10.1207/s15327868ms0103_3

Tunmer, W.E., Hoover, W.A. (1992). *Cognitive and Linguistic Factors in Learning to Read*, Taylor & Francis Group: Oxfordshire, UK, pp. 175–214.

Urgesi, C., Campanella, F. and Fabbro, F. (2011) *NEPSY-II. Contributo alla Taratura Italiana*. Firenze: Giunti OS.

Vail, P. L. (1990). Gifts, talents, and the dyslexias: Wellsprings, springboards, and finding Foley's rocks. *Annals of Dyslexia*, 40(1), 117. https://doi.org/10.1007/BF02648137.

Valdois, S. (2022). The visual-attention span deficit in developmental dyslexia: Review of evidence for a visual-attention-based deficit. *Dyslexia*, 28, 397–415.

Van der Kleij, S.W., Segers, E., Groen, M.A. and Verhoeven, L. (2017). Response to intervention as a predictor of long-term reading outcomes in children with dyslexia.

Van Der Schoot, M., Licht, R., Horsley, T. M., & Sergeant, J. A. (2005). Effects of stop signal modality, stop signal intensity and tracking method on inhibitory performance as determined by use of the stop signal paradigm. *Scandinavian journal of psychology*, *46*(4), 331-341.

Van der Sluis, S., De Jong, P. F., & Van der Leij, A. (2007). Executive functioning in children, and its relations with reasoning, reading, and arithmetic. *Intelligence*, *35*(5), 427-449.

van Heuven, W. J. B., Mandera, P., Keuleers, E., & Brysbaert, M. (2014). Subtlex-UK: A New and Improved Word Frequency Database for British English. *Quarterly Journal of Experimental Psychology*, *67*(6), 1176–1190. https://doi.org/10.1080/17470218.2013.850521

van Rijthoven, R., Kleemans, T., Segers, E. and Verhoeven, L. (2018). Beyond the phonological deficit: Semantics contributes indirectly to decoding efficiency in children with dyslexia. *Dyslexia* 24 (4), 309–321.

van Viersen, S., de Bree, E.H., Verdam, M., Krikhaar, E., Maassen, B., van der Leij, A. and de Jong, P.F. (2017). Delayed early vocabulary development in children at family risk of dyslexia. *Journal of Speech, Language, and Hearing Research* 60 (4), 937–949.

van Viersen, S., de Bree, E.H., Zee, M., Maassen, B., van der Leij, A. and de Jong, P.F. (2018). Pathways into literacy: The role of early oral language abilities and FR for dyslexia. *Psychological Science* 29 (3), 418–428.

Van Witteloostuijn, M., Boersma, P., Wijnen, F., & Rispens, J. (2021). Grammatical performance in children with dyslexia: The contributions of individual differences in phonological memory and statistical learning. *Applied Psycholinguistics*, 42(3), 791–821. https://doi.org/10.1017/S0142716421000102

Varvara, P., Varuzza, C., Sorrentino, A. C. P., Vicari, S., & Menghini, D. (2014). Executive functions in developmental dyslexia. *Frontiers in Human Neuroscience*, 8(120).

Vellutino, F. R. (1979). *Dyslexia: Theory and research*. Cambridge, MA: MIT Press.

Vellutino, F. R., Fletcher, J. M., Snowling, M. J., & Scanlon, D. M. (2004). Specific reading disability (dyslexia): What have we learned in the past four decades?. *Journal of child psychology and psychiatry*, *45*(1), 2-40.

Vender, M. (2017). *Disentangling Dyslexia*. Peter Lang.

Vender, M., Mantione, F., Savazzi, S., Delfitto, D., & Melloni, C. (2017). Inflectional morphology and dyslexia: Italian children's performance in a nonword pluralization task. *Annals of Dyslexia*, 67(3), 401426. https://doi.org/10.1007/s11881-017-0152-8

Vender, M., Melloni, C., & Delfitto, D. (2022). The effectiveness of reading intervention in adults with developmental dyslexia: A systematic review. *Italian journal of linguistics*, 34(1), 189-232.

Verwoerd, J., Wessel, I., & de Jong, P. J. (2009). Individual differences in experiencing intrusive memories: The role of the ability to resist proactive interference. *Journal of Behavior Therapy and Experimental Psychiatry*, *40*(2), 189–201. https://doi.org/10.1016/j.jbtep.2008.08.002

Volpato, F. (2010). The acquisition of relative clauses and phi-features: evidence from hearing and hearing-impaired populations. PhD Dissertation. Ca' Foscari University of Venice.

Wadsworth, S. J., DeFries, J. C., Willcutt, E. G., Pennington, B. F., & Olson, R. K. (2015). The Colorado longitudinal twin study of reading difficulties and ADHD: Etiologies of comorbidity and stability. *Twin Research and Human Genetics*, *18*(6), 755–761. doi: 10.1017/thg.2015.66.

Wagenmakers, E.-J. (2007). A practical solution to the pervasive problems ofp values. *Psychonomic Bulletin & Review*, *14*(5), 779–804. https://doi.org/10.3758/BF03194105

Wagner, R. K., & Torgesen, J. K. (1987). The nature of phonological processing and its causal role in the acquisition of reading skills. *Psychological Bulletin*, *101*(2), 192–212. https://doi.org/10.1037/ 0033-2909.101.2.192.

Wagner, R. K., Zirps, F. A., & Wood, S. G. (2022). Developmental dyslexia. *The science of reading: A handbook*, 416-438.

Wallach, G. and Liebergott, J. (1984) Who shall be called 'learning disabled': Some new directions. In G. Wallach and K. Butler (eds) Language Learning Disabilities in School-age Children (pp. 1–14). Baltimore, MD: Williams & Wilkin.

Waltz, J. A., Lau, A., Grewal, S. K., & Holyoak, K. J. (2000). The role of working memory in analogical mapping. *Memory & Cognition*, *28*(7), 1205–1212. https://doi.org/10.3758/BF03211821

Wang, L.-C., & Yang, H.-M. (2015). Diverse Inhibition and Working Memory of Word Recognition for Dyslexic and Typically Developing Children. *Dyslexia*, *21*(2), 162–176. https://doi.org/10.1002/dys.1490

Wang, L.-C., Tasi, H.-J., & Yang, H.-M. (2012). Cognitive inhibition in students with and without dyslexia and dyscalculia. *Research in Developmental Disabilitie*s, 33, 1453–1461.

Webb, S. (2013). Depth of vocabulary knowledge. In C.A. Chapelle (ed.) *The Encyclopedia of Applied Linguistics* (pp. 346 –354). London: Blackwell.

Wechsler, D. (2008). *Wechsler Adult Intelligence Scale (4th ed.)*. TX: Pearson Assessment.

Weiland, H., Bambini, V., & Schumacher, P. B. (2014). The role of literal meaning in figurative language comprehension: Evidence from masked priming ERP. *Frontiers in Human Neuroscience*, *8*. https://www.frontiersin.org/articles/10.3389/fnhum.2014.00583

West, T. G. (2009). *In the mind's eye: Creative visual thinkers, gifted dyslexics, and the rise of visual technologies*. Amherst, NY: Prometheus Books. Test of creativity and divergent thinking.

Wilcockson, T. D. W., Mardanbegi, D., Sawyer, P., Gellersen, H., Xia, B., & Crawford, T. J. (2019). Oculomotor and inhibitory control in dyslexia. *Frontiers in Systems Neuroscience*, *12*(January), 1–10. https://doi.org/10.3389/fnsys.2018.00066

Wilson, A. M., & Lesaux, N. K. (2001). Persistence of Phonological Processing Deficits in College Students with Dyslexia Who Have Age-Appropriate Reading Skills. *Journal of Learning Disabilities*, 34(5), 394–400. https://doi.org/10.1177/002221940103400501

Wilson, D., & Sperber, D. (2012). *Meaning and relevance*. Cambridge University Press. https://books.google.com/books?hl=it&lr=&id=aXchAwAAQBAJ&oi=fnd&pg=PR8&dq=Meaning+and+Relevance.+Cambridge,+Cambridge+University+Press.&ots=21s9Fmo8oE&sig=TX4F0eJ69zK50WqvwZwt3f2yHuI

Wilson, N. L., & Gibbs Jr., R. W. (2007). Real and Imagined Body Movement Primes Metaphor Comprehension. *Cognitive Science*, *31*(4), 721–731. https://doi.org/10.1080/15326900701399962

Winner, E., Rosenstiel, A. K., & Gardner, H. (1976). The development of metaphoric understanding. *Developmental Psychology*, *12*(4), 289–297. https://doi.org/10.1037/0012-1649.12.4.289

Wiseheart, R., Altmann, L. J. P., Park, H., & Lombardino, L. J. (2009). Sentence comprehension in young adults with developmental dyslexia. *Annals of Dyslexia*, 59(2), 151–167. https://doi.org/10.1007/s11881-009-0028-7

Wittrock, M. C., & Alesandrini, K. (1990). Generation of Summaries and Analogies and Analytic and Holistic Abilities. *American Educational Research Journal*, *27*(3), 489–502. https://doi.org/10.3102/00028312027003489

Wolf, M. and Segal, D. (1999). Retrieval rate, accuracy and vocabulary elaboration (RAVE) in reading-impaired children: A pilot intervention programme. Dyslexia 5 (1), 1–27.

Wolf, M., & Bowers, P. G. (1999). The double-deficit hypothesis for the developmental dyslexias. *Journal of Educational Psychology*, *91*(3), 415–438. https://doi.org/10.1037/0022-0663.91.3.415

Wolf, M., Bowers, P. G. (1999). The double-deficit hypothesis for the developmental dyslexias. *Journal of Educational Psychology, 91,* 415–438.

Xiao, X.Y. and Ho, C.S.H. (2014). Weaknesses in semantic, syntactic and oral language expression contribute to reading difficulties in Chinese dyslexic children. *Dyslexia,* 20 (1), 74–98.

Yewchuk, C. (1983). Learning disabled/gifted children: Characteristic features. *Mental Retardation and Learning Disability Bulletin*, 11(3), 128–133.

Zeffiro, T., & Eden, G. (2000). The neural basis of developmental dyslexia. *Annals* of Dyslexia, 50(1), 1–30. https://doi.org/10.1007/s11881-000-0015-5

Ziatas, K., Durkin, K., & Pratt, C. (1998). Belief term development in children with autism, Asperger syndrome, specific language impairment, and normal development: Links to theory of mind development. *The Journal of Child Psychology and Psychiatry and Allied Disciplines*, *39*(5), 755–763.

Appendix

APPENDIX A

Items and norming for Study 1.

Items	Item n	Fam.	Apt.	Conv.	Picture	Concr(Y)	Freq(Y)	Literal corr.
The cake with the snow	1	2,6	3,8	3,6	4,83	4,85	1599	The cake with the icing sugar
The coffee with the mountain	2	1,47	2,67	2,07	3,97	4,96	1805	The coffee with the cream
The teeth with the window	3	1,4	2,67	2,2	4,1	4,86	4386	The teeth with the gap
The throat with the flames	4	1,9	3,27	2,57	4,27	4,67	461	The throat with the sore throat
The plant with the pimples	5	1,33	2	1,43	3,2	4,77	85	The plant with the cherries
The cup with the ears	6	2,5	3,23	3	4,53	5	1632	The cup with the handles
The book with the wings	removed	1,67	2,6	2,6	2,6	4,86	1032	The book with the cover
The eyes with the curtains	7	1,13	2,03	1,63	3	4,82	525	The eyes with the eyelids
The bike with the chair	removed	3,8	5,23	4,47	5,93	4,58	2511	The bike with the bike seat
The sock with the peephole	8	2,83	4,27	3,83	4,77	4,74	24	The sock with the hole
The apple with the guest	9	1,93	3,83	3,07	4,73	3,83	2037	The apple with the worm
The desert with the rest area	10	1,67	3,13	2,9	4,4	3,72	3821	The desert with the oasis
The car with the backpack	11	1,67	3,27	2,77	4,37	4,96	186	The car with the box on top
The kitten with the socks	removed	4,93	5,37	5,47	6,07	4,91	458	The kitten with the white paws
The carrot with the hair	12	2,2	3,63	2,93	4,9	4,97	7831	The carrot with the leaves
The bottle with the belly	13	1,63	3,1	2,9	4,03	4,8	794	The round bottle
The tower with the hat	14	2,03	3,63	3,1	4,63	4,88	3273	The tower with the pointy roof
The tree with the arms	15	2,1	3,67	3,63	4,83	4,96	3336	The tree with the branches

The glass with the antennae	16	1,27	2,17	1,77	3,87	4,75	122	The glass with the straws
The mobile phone with the coat	practice	1,97	3,63	2,87	4,27,	4,97	2146	The mobile phone with the cover

APPENDIX B

Items for Study 2.

Item n.	sentence	condition
1	Quegli eserciti sono dighe	M_LF
2	Quei maestri sono lanterne	M_LF
3	Quelle tasche sono banche	M_LF
4	Quei portinai sono archivi	M_LF
5	Quei giocatori sono elefanti	M_LF
6	Quelle malattie sono cecchini	M_LF
7	Quelle carezze sono balsami	M_LF
8	Quei bambini sono fontane	M_LF
9	Quelle canzoni sono droghe	M_LF
10	Quelle fanciulle sono rose	M_LF
11	Quelle voci sono trombe	M_HF
12	Quei professori sono enciclopedie	M_HF
13	Quegli avvocati sono squali	M_HF
14	Quelle automobili sono frecce	M_HF
15	Quelle borse sono macigni	M_HF
16	Quei ricordi sono spine	M_HF
17	Quelle acconciature sono cespugli	M_HF
18	Quei banchieri sono vampiri	M_HF
19	Quelle città sono giungle	M_HF
20	Quei giornalisti sono avvoltoi	M_HF
21	Quelle voci sono squali	SC_HF
22	Quei professori sono spine	SC_HF
23	Quegli avvocati sono frecce	SC_HF
24	Quelle automobili sono avvoltoi	SC_HF
25	Quelle borse sono trombe	SC_HF
26	Quei ricordi sono vampiri	SC_HF
27	Quelle acconciature sono enciclopedie	SC_HF
28	Quei banchieri sono cespugli	SC_HF
29	Quelle città sono macigni	SC_HF
30	Quei giornalisti sono giungle	SC_HF
31	Quegli eserciti sono archivi	SC_LF
32	Quei maestri sono dighe	SC_LF
33	Quelle tasche sono cecchini	SC_LF
34	Quei portinai sono rose	SC_LF
35	Quei giocatori sono balsami	SC_LF
36	Quelle malattie sono fontane	SC_LF

37	Quelle carezze sono lanterne	SC_LF
38	Quei bambini sono droghe	SC_LF
39	Quelle canzoni sono elefanti	SC_LF
40	Quelle fanciulle sono banche	SC_LF
41	Quegli utensili sono forchette	LIT_T
42	Quei frutti sono mele	LIT_T
43	Quelle armi sono spade	LIT_T
44	Quegli uccelli sono canarini	LIT_T
45	Quei veicoli sono automobili	LIT_T
46	Quei giocattoli sono lego	LIT_T
47	Quei fiori sono violette	LIT_T
48	Quegli alberi sono ciliegi	LIT_T
49	Quei pesci sono trote	LIT_T
50	Quei serpenti sono vipere	LIT_T
51	Quei politici sono sindaci	LIT_T
52	Quei questionari sono verifiche	LIT_T
53	Quei dispositivi sono tablet	LIT_T
54	Quelle danze sono riti	LIT_T
55	Quelle barche sono sottomarini	LIT_T
56	Quegli insetti sono api	LIT_T
57	Quegli indumenti sono cappotti	LIT_T
58	Quegli edifici sono residenze	LIT_T
59	Quelle case sono appartamenti	LIT_T
60	Quegli animali sono cani	LIT_T
61	Quei vegetali sono carote	LIT_T
62	Quegli attrezzi sono martelli	LIT_T
63	Quelle ragazze sono cantanti	LIT_T
64	Quelle piogge sono temporali	LIT_T
65	Quegli strumenti sono chitarre	LIT_T
66	Quelle scarpe sono sandali	LIT_T
67	Quelle parole sono insulti	LIT_T
68	Quei cibi sono pietanze	LIT_T
69	Quelle pizze sono carboidrati	LIT_T
70	Quei legumi sono lenticchie	LIT_T
71	Quei formaggi sono fontine	LIT_T
72	Quelle signore sono attrici	LIT_T
73	Quelle gemme sono rubini	LIT_T
74	Quelle luci sono lampadine	LIT_T
75	Quelle penne sono biro	LIT_T
76	Quei robot sono umanoidi	LIT_T
77	Quelle navi sono crociere	LIT_T
78	Quei medici sono chirurghi	LIT_T
79	Quegli artisti sono pittori	LIT_T

80	Quegli artigiani sono falegnami	LIT_T
81	Quelle unghie sono artigli	LIT_T
82	Quelle buste sono lettere	LIT_T
83	Quelle erbe sono ortiche	LIT_T
84	Quelle piante sono olivi	LIT_T
85	Quei polmoni sono organi	LIT_T
86	Quelle pietre sono perle	LIT_T
87	Quei trucchi sono mascara	LIT_T
88	Quei motori sono diesel	LIT_T
89	Quei misuratori sono righelli	LIT_T
90	Quelle acque sono laghi	LIT_T
91	Quei fiumi sono affluenti	LIT_T
92	Quei topi sono ratti	LIT_T
93	Quelle finestre sono oblò	LIT_T
94	Quei cestini sono spazzatura	LIT_T
95	Quelle moto sono scooter	LIT_T
96	Quelle musiche sono sigle	LIT_T
97	Quei cartelli sono insegne	LIT_T
98	Quei pali sono antenne	LIT_T
99	Quei negozi sono farmacie	LIT_T
100	Quegli uffici sono studi	LIT_T
101	Quei versi sono rime	LIT_T
102	Quelle torte sono crostate	LIT_T
103	Quei dolci sono tiramisù	LIT_T
104	Quelle patate sono tuberi	LIT_T
105	Quei gioielli sono anelli	LIT_T
106	Quelle chiese sono cattedrali	LIT_T
107	Quei biglietti sono scontrini	LIT_T
108	Quelle bottiglie sono damigiane	LIT_T
109	Quegli orologi sono cucù	LIT_T
110	Quelle bibite sono birre	LIT_T
111	Quei cetacei sono delfini	LIT_T
112	Quelle caramelle sono liquirizie	LIT_T
113	Quei soldati sono fanti	LIT_T
114	Quei fuochi sono incendi	LIT_T
115	Quelle monete sono dollari	LIT_T
116	Quelle matite sono pastelli	LIT_T
117	Quelle candele sono lumini	LIT_T
118	Quegli spettacoli sono musical	LIT_T
119	Quei funghi sono porcini	LIT_T
120	Quegli studenti sono allievi	LIT_T
121	Quei frutti sono api	LIT_F
122	Quelle penne sono lampadine	LIT_F

123	Quei gioielli sono damigiane	LIT_F
124	Quelle chiese sono delfini	LIT_F
125	Quelle caramelle sono falegnami	LIT_F
126	Quelle navi sono righelli	LIT_F
127	Quelle musiche sono dollari	LIT_F
128	Quegli utensili sono violette	LIT_F
129	Quegli uffici sono scooter	LIT_F
130	Quei versi sono fanti	LIT_F
131	Quei topi sono birre	LIT_F
132	Quegli orologi sono pastelli	LIT_F
133	Quei funghi sono oblò	LIT_F
134	Quei cibi sono cantanti	LIT_F
135	Quelle armi sono crociere	LIT_F
136	Quei formaggi sono trote	LIT_F
137	Quei legumi sono carote	LIT_F
138	Quelle monete sono sottomarini	LIT_F
139	Quei serpenti sono verifiche	LIT_F
140	Quei negozi sono tuberi	LIT_F
141	Quelle finestre sono liquirizie	LIT_F
142	Quelle piante sono chitarre	LIT_F
143	Quelle erbe sono sandali	LIT_F
144	Quei cetacei sono incendi	LIT_F
145	Quei polmoni sono lettere	LIT_F
146	Quelle unghie sono ciliegi	LIT_F
147	Quegli indumenti sono lenticchie	LIT_F
148	Quelle signore sono anelli	LIT_F
149	Quei giocattoli sono residenze	LIT_F
150	Quei pali sono pietanze	LIT_F
151	Quegli attrezzi sono perle	LIT_F
152	Quei vegetali sono tablet	LIT_F
153	Quei questionari sono chirurghi	LIT_F
154	Quei cartelli sono forchette	LIT_F
155	Quelle danze sono appartamenti	LIT_F
156	Quelle acque sono antenne	LIT_F
157	Quei politici sono carboidrati	LIT_F
158	Quelle luci sono olivi	LIT_F
159	Quei fiori sono tiramisù	LIT_F
160	Quelle buste sono temporali	LIT_F

APPENDIX C

Materials for Study 3. Text A and B, comprehension tasks A and B.

Text A – Metaphorical condition

La ricerca qui presentata intende indagare gli atteggiamenti delle persone che interagiscono online. I commenti lasciati sui social network sono diventati oggetto di analisi, perché permettono di esplorare i sentimenti e le reazioni delle persone che scrivono dietro ad uno schermo. Negli ultimi anni, infatti, si è sviluppata una vera e propria branca della linguistica chiamata "analisi del discorso" che, in seguito all'impulso di Bachtin (1988), vede ogni parola come segnaposto dei sentimenti di chi scrive.

Uno studio di Mastroianni (2016) ha mostrato come l'atteggiamento delle persone online sia cambiato negli anni. In una prima epoca il Web era un territorio difficile e ostile, adatto solo ai più esperti, quelli capaci di usare gli strumenti giusti. Era l'epoca dei cacciatori. L'epoca in cui tra newsgroup, forum, siti e chat specializzate c'era chi era capace di reperire contenuti e utilizzarli a vantaggio suo e di chi gli stava attorno.

Poi è arrivato il Web 2.0 e non solo è iniziata la possibilità di interagire meglio, ma soprattutto gli strumenti sono diventati più semplici, tanto da permettere a ciascuno di diffondere online i propri pensieri, le proprie idee, le proprie opinioni. Così è iniziata l'epoca dei guerrieri: i più portati all'alterco hanno cominciato a mettere in mostra le loro capacità di difesa (della comunità di consenso) e di attacco (degli "altri" con opinioni diverse).

Mentre questo accadeva, però, c'era chi vedeva le cose in modo diverso. Fin dall'inizio, infatti, c'è stata una popolazione discreta e laboriosa, che ha visto il Web per quello che è: un terreno da coltivare. I contadini digitali, mentre gli altri nemmeno se ne accorgevano, avevano capito che litigi e dispute non erano la soluzione; bensì, ciò che contava era la qualità del cibo offerto alle persone. Solo grazie a loro, si potrà giungere a un modo più evoluto di vivere la rete.

Text A – Literal condition

La ricerca qui presentata intende indagare gli atteggiamenti delle persone che interagiscono online. I commenti lasciati sui social network sono diventati oggetto di analisi, perché permettono di esplorare i sentimenti e le reazioni delle persone che scrivono dietro ad uno schermo. Negli ultimi anni, infatti, si è sviluppata una vera e propria branca della linguistica chiamata "analisi del discorso" che, in seguito all'impulso di Bachtin (1988), vede ogni parola come indicatore dei sentimenti di chi scrive.

Uno studio di Mastroianni (2016) ha mostrato come l'atteggiamento delle persone online sia cambiato negli anni. In una prima epoca il Web era un territorio difficile e ostile, adatto solo ai più esperti, quelli capaci di usare gli strumenti giusti. Era l'epoca di chi sapeva trovare le informazioni. L'epoca in cui tra newsgroup, forum, siti e chat specializzate c'era chi era capace di reperire contenuti e utilizzarli a vantaggio suo e di chi gli stava attorno.

Poi è arrivato il Web 2.0 e non solo è iniziata la possibilità di interagire meglio, ma soprattutto gli strumenti sono diventati più semplici, tanto da permettere a ciascuno di diffondere online i propri pensieri, le proprie idee, le proprie opinioni. Così è iniziata l'epoca dei prevaricatori: i più portati all'alterco hanno cominciato a mettere in mostra le loro capacità di difesa (della comunità di consenso) e di attacco (degli "altri" con opinioni diverse).

Mentre questo accadeva, però, c'era chi vedeva le cose in modo diverso. Fin dall'inizio, infatti, c'è stata una popolazione discreta e laboriosa, che ha visto il Web per quello che è: un'opportunità di creazione. I creativi digitali, mentre gli altri nemmeno se ne accorgevano, avevano capito che litigi e dispute non erano la soluzione; bensì, ciò che contava era la qualità dei contenuti offerti alle persone. Solo grazie a loro, si potrà giungere a un modo più evoluto di vivere la rete.

Text A (both conditions) – Questions

La disciplina dell'analisi del discorso:
a) serve per aiutare le persone a esprimere le proprie emozioni nel contesto del Web.
b) utilizza le parole contenute nei commenti per elaborarne di nuovi da diffondere online.
c) identifica in ogni commento concetti chiave che riconducono a un preciso stato d'animo.

Inizialmente, il Web avvantaggiava:
a) chi aveva l'abilità di sapere come muoversi in questo nuovo mezzo.
b) chi riusciva a danneggiare gli altri impossessandosi delle informazioni.
c) chi non sapeva usarlo e rimaneva quindi fuori dalle sue dinamiche.

Nel passaggio dalla prima epoca del Web al Web 2.0:
a) si è assistito alla scomparsa di newsgroup e forum.
b) si è assistito alla diffusione dei primi computer a prezzi accessibili.
c) si è assistito alla nascita dei social network.

Con l'avvento del Web 2.0:
a) la diffusione dei social network ha danneggiato la qualità della comunicazione.
b) la minore complessità degli strumenti ha permesso a più persone di esprimersi online.
c) la condivisione di idee personali ha modificato le opinioni della gente.

Il confronto tra gruppi differenti dopo l'avvento del Web 2.0:
a) ha dato spazio anche a coloro che comunicano in modo aggressivo.
b) ha fatto sì che le idee differenti si uniformassero in una sola.
c) ha irrimediabilmente influenzato le visioni politiche dei cittadini.

La popolazione "discreta e laboriosa":
a) ha saputo utilizzare il web in maniera produttiva.
b) ha deciso di evitare di utilizzare il web perché troppo violento.
c) ha imparato come gestire le discussioni con gli altri utenti.

Secondo l'autore, è evidente che:
a) chi riesce a difendere la propria comunità di consenso si distingue dagli altri.
b) chi sa produrre spunti interessanti e genuini si distingue dagli altri.
c) chi è in grado di attaccare le idee diverse dalla propria si distingue dagli altri.

Un modo evoluto di vivere la rete:
a) sarà raggiungibile con numerose discussioni, siano esse aggressive o pacifiche.
b) sarà raggiungibile solo se il progresso ci porterà a dialogare al di fuori del Web.
c) sarà raggiungibile grazie a coloro che riescono a stimolare la riflessione.

Text B – Metaphorical condition

Il presente studio intende esplorare l'identità professionale dei docenti e le emozioni associate al modo in cui essi vivono la propria attività lavorativa. L'analisi di entrambe le componenti viene condotta di pari passo poiché, come spiega Britzman (1993), l'identità non è legata al ruolo assegnato, a ciò che la persona deve fare, quanto piuttosto all'investimento, a ciò che la persona sente. A questo fine sono utili i racconti autobiografici, che sono il faro dei nostri sentimenti interiori.

Una ricerca etnografica di Gao (2008) ha analizzato i messaggi scambiati tra docenti cinesi in un forum su Internet, aperto a riflessioni su tematiche educative. Alcuni insegnanti affermano di sentirsi ingegneri dell'anima degli studenti, percependo la grande responsabilità nella formazione degli ideali delle nuove generazioni.

Del tutto diversa è la percezione di altri insegnanti intervistati, i quali si sentono bachi da seta. Riconoscono infatti il peso di portare valore nella società odierna, a cui si aggiungono le consistenti difficoltà che il mondo della scuola vive e le limitazioni imposte dalla mancanza di investimenti su questo settore. Il loro momento di trasformazione in farfalla è però percepito come lontano nel tempo.

Nelle interviste, infine, i docenti hanno spesso dichiarato di sentirsi soli, di non ricevere supporti esterni, di vivere in conflitto con un'opinione pubblica che sminuisce la loro identità professionale. Alcuni si definiscono infatti operai nella produzione seriale di prodotti per il mercato. A risentirne è senza dubbio la qualità della formazione, che subisce questa frustrazione connessa con altre emozioni che non favoriscono un apprendimento positivo, come la rabbia, il risentimento e il dubbio sul senso del proprio lavoro.

Il valore della ricerca di Gao, in un contesto dove ci sono poche alternative per esprimere pubblicamente il proprio disappunto, risiede nel fatto che Internet abbia fornito un modo per far sentire la propria voce.

Text B – Literal condition

Il presente studio intende esplorare l'identità professionale dei docenti e le emozioni associate al modo in cui essi vivono la propria attività lavorativa. L'analisi di entrambe le componenti viene condotta di pari passo poiché, come spiega Britzman (1993), l'identità non è legata al ruolo assegnato, a ciò che la persona deve fare, quanto piuttosto all'investimento, a ciò che la persona sente. A questo fine sono utili i racconti autobiografici, che rivelano i nostri sentimenti interiori.

Una ricerca etnografica di Gao (2008) ha analizzato i messaggi scambiati tra docenti cinesi in un forum su Internet, aperto a riflessioni su tematiche educative. Alcuni insegnanti affermano di sentirsi responsabili della crescita spirituale degli studenti, percependo la grande responsabilità nella formazione degli ideali delle nuove generazioni.

Del tutto diversa è la percezione di altri insegnanti intervistati, i quali si sentono produttori di qualcosa di prezioso. Riconoscono infatti il peso di portare valore nella società odierna, a cui si aggiungono le consistenti difficoltà che il mondo della scuola vive e le limitazioni imposte dalla mancanza di investimenti su questo settore. Il loro momento di trasformazione in positivo è però percepito come lontano nel tempo.

Nelle interviste, infine, i docenti hanno spesso dichiarato di sentirsi soli, di non ricevere supporti esterni, di vivere in conflitto con un'opinione pubblica che sminuisce la loro identità professionale. Alcuni ritengono infatti di dover seguire processi macchinosi e ripetitivi per alimentare il mercato. A risentirne è senza dubbio la qualità della formazione, che subisce questa frustrazione connessa con altre emozioni che non favoriscono un apprendimento positivo, come la rabbia, il risentimento e il dubbio sul senso del proprio lavoro.

Il valore della ricerca di Gao, in un contesto dove ci sono poche alternative per esprimere pubblicamente il proprio disappunto, risiede nel fatto che Internet abbia fornito un modo per far sentire la propria voce.

Text B (both conditions) – Questions

Lo studio dei racconti autobiografici:
a) permette la creazione di racconti che suscitano emozioni in chi li legge.
b) consente di esplorare le emozioni profonde di chi è portato a raccontare.
c) dà la possibilità di identificare i limiti del vivere il proprio lavoro con eccessiva emotività.

I primi insegnanti menzionati nella ricerca di Gao:
a) ritengono che la formazione di uno studente debba considerare anche il pensiero religioso.
b) appaiono preoccupati dell'eccessiva responsabilità a loro assegnata.
c) riconoscono di avere un ruolo nello sviluppo dell'identità degli studenti.

Coloro che riconoscono il peso di portare valore nella società:
a) si sentono sminuiti, ma speranzosi.
b) si sentono importanti, ma fragili.
c) si sentono felici, ma arrabbiati.

Portare valore nella società odierna è reso più pesante:
a) dalla mancanza di riconoscimento da parte delle istituzioni.
b) dal graduale abbassamento degli stipendi.
c) dal fatto che non si tratti di una responsabilità degli insegnanti.

È lontano nel tempo:
a) il momento in cui gli insegnanti si ribelleranno contro il sistema.
b) il momento in cui gli studenti entreranno nel mondo del lavoro.
c) il momento in cui lo status dell'insegnante cambierà.

Alcuni insegnanti hanno la sensazione di fornire al mercato:
a) ore straordinarie di formazione non adeguatamente pagate.
b) una moltitudine di servizi educativi di elevata qualità.
c) grandi numeri di studenti formati in maniera non adeguata.

La frustrazione degli insegnanti colpisce in particolar modo:
a) le famiglie degli insegnanti, che li percepiscono in difficoltà.
b) gli studenti, che non beneficiano di un apprendimento sereno.
c) gli insegnanti stessi, che non sono invogliati a formarsi.

Secondo l'autore, la ricerca di Gao è importante perché:
a) proviene da un territorio in cui vige censura politica delle idee.
b) dà voce anche agli insegnanti appartenenti a ceti sociali inferiori.
c) riesce a far esprimere le emozioni degli insegnanti in maniera inconscia.

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