The relationship between domain-general cognitive skills and reading comprehension in children

Fatbardha Qehaja Osmani

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Abstract

The aim of this research was to better understand how reading comprehension happens in children. In particular, the main objective was to examine, in detail, the relationship between higher-level comprehension skills and domain-general cognitive skills at a crucial period of development – the time when children are becoming independent readers (8 to 10 years of age). The novelty of this research was that different from previous studies it i) looked at all five higher-level comprehension skills separately and in their relationship to domain-general cognitive skills; ii) examined domain-general cognitive skills simultaneously rather than in isolation; iii) considered the moderating role of the lower-level comprehension skills in this relationship; and iv) provided valuable insight on how reading comprehension is achieved in a language with transparent orthography. The findings demonstrated that higher-level comprehension skills are underpinned by working memory and executive functions in both age groups of children, but their contribution to higher-level comprehension skills increased around the age of 10. Furthermore, the results of this thesis showed that working memory and executive functions significantly interacted with reading fluency in predicting higher-level comprehension skills in both age groups, albeit in the younger group this interaction was present only in necessary inference while in older group this interaction was present only in literal comprehension and comprehension control.

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1.1. General introduction

Reading is an important life-long skill that is required in many everyday tasks and activities, such as studying for a university degree, enjoying a novel, or signing contracts. Reading and comprehending written language is a complex and uniquely human activity (van den Broek & Espin, 2012). It is essential to higher-level cognitive abilities such as learning, problem-solving, reasoning and decision-making (McNamara & Magliano, 2009). Accurate and precise reading comprehension is vital to educational achievement. As children progress through primary school (e.g. 5-8 years old) towards middle school (9-12 years old) they will frequently be required to read and understand many different kinds of texts. This means that children must be skilled readers in order to be successful in school.

Reading comprehension is a complex process that, broadly speaking, comes about in two successive stages. The first is acquiring decoding skill – that is, the ability to translate words from their written form to their acoustic form by using letter-sound knowledge. The second is understanding the author's message (Oakhill & Garnham, 1988). Decoding skill is important because it is the first step that a child takes during the reading process. It enables a child to read the printed words in the text, which is a prerequisite to understanding the meaning of the text. To understand the meaning of the text, a child must be able to link the words he/she identified into whole sentences and paragraphs. By remembering and combining meanings of different sentences and paragraphs of the text, the child extracts the message of the author. Although both stages are important to reading comprehension, the second stage is particularly crucial to the usual function of reading, as knowledge of decoding of individual words without an extraction of a global meaning of the text would be insufficient to understand the meaning of the text.

The focus of the present thesis will largely be on the second of these two core stages, and will seek to investigate the psychological mechanisms that allow children to extract meaning from written text. To extract the meaning from a written text, a child relies on the interaction of three broad groups of cognitive processes. The first group involves *higher-level comprehension skills*, which are responsible for extracting the information explicitly stated in the text and integrate it with information from the child's prior knowledge (Baker, 1989; Barnes, & Bryant, 2001; Cain & Oakhill, 1999; Cain, Oakhill, van den Broek, 1989). The second group involves *lower-level comprehension skills*, which enable the reader to accurately and efficiently read words in the text and access their meaning. The third group comprises *domain-general cognitive skills* which are involved in goal-directed processes and play an important role in the operation of both higher-level and lower-level comprehension skills.

The present thesis focuses on five specific higher-level comprehension skills which together enable a child to understand the text. More specifically, these skills are: *literal comprehension*, which allows the reader to understand information that is explicitly described in the text (e.g. Barnes, Dennis, & Kalvaitis, 1996; Silva & Cain, 2015); *necessary inference*, which enables a reader to work out information implied by the text but not mentioned directly by combining information presented explicitly in the text with the information from the reader's own background knowledge in order to understand the essence of a text (Oakhill, Cain, & Elbro, 2014); *elaborative inference* which allow the reader to work out information that is implicit and is not implied by the text and may not be necessary for comprehension of the essence of the text, but which nevertheless enriches the mental model of the text (Block, Rodgers, & Johnson, 2004; Oakhill & Garnham, 1988); *simile comprehension* which allows the reader to understand figurative or other non-literal statements; and *comprehension control*, which helps the reader to monitor his/her understanding of the text read, and to take steps to address any errors or difficulties in comprehension that arise during the reading process (Dunlosky & Metcalfe, 2009). These five higher-level comprehension skills will be discussed in further detail later in this chapter.

Higher-level comprehension skills are known to depend on both lower-level comprehension skills and the domain-general cognitive skills of a reader. Domain-general cognitive skills, as their name implies, are essential for a wide range of cognitive processes. Specifically, when it comes to reading comprehension, these skills play a crucial role in allowing higher-level comprehension skills to be carried out successfully and reliably. The most important domain-general skills for research in reading comprehension are *working memory* and the group of cognitive skills known collectively as *executive functions*. This thesis adopts the view of working memory as a multicomponent model, as defined by Baddeley and Hitch, (1974). However, it also takes into account the executive functions model of Miyake, Friedman, Emerson, Witzki, Howerter, & Wager (2000). It must be noted that the label "working memory" is very often used to refer to one of the three components of Miyake's model; but this distinction will be explained further later in the chapter.

Working memory allows the reader to store and process information explicitly stated in the text. It also provides the means that allow the reader to retrieve relevant information from long-term memory. This way, working memory allows the reader to activate both explicitly stated information and information from their background knowledge, so as to extract the implicit meaning of the text. Executive functions are domain general cognitive skills which chiefly serve to execute goal-directed behaviours (Miyake et al, 2000). A reader typically uses executive functions to update text-relevant information stored in working memory with newly encoded information (Palladino, Cornoldi, DeBeni, & Pazzagllia, 2001). They also allow the reader to suppress information that is not necessary or helpful for their comprehension – for example, information that was previously relevant but has since become irrelevant – as well as allowing the reader to shift attention between perspectives – for example, between explicitly stated information in the text and information they have from previous knowledge (Borella, Carretti, Pelegrina, 2010; Cartwright, 2008; Christopher, Miyake, Keenan, Pennington, DeFries, Wadsworth, Willcutt, & Olson, 2012; Guajardo & Cartwright, 2016).

In this thesis I was interested in better understanding how children achieve reading comprehension, and in particular in understanding how individual differences in working memory and executive functions can influence the performance of higher-level comprehension skills (i.e. literal comprehension, necessary inference, elaborative inference, simile comprehension and comprehension control). In subsequent sections of this chapter, I will review the research looking at the development of each of these skills. However, to understand how these skills contribute to reading comprehension, it’s first necessary to understand how reading as a whole happens. Therefore, in the next section I will present an overview of the key theoretical framework that underpins research in this area.

1.2. A theoretical framework for reading comprehension

One of the most influential theoretical frameworks to provide an integrated account of reading comprehension is the *Construction-Integration Model* (CI) (Kintsch, 1988, 1998). I have chosen this model as the overarching framework for the research reported in this thesis, as it provides a comprehensive account of the processes involved in reading comprehension, by which it allows us to understand how a reader accomplishes the task of reading comprehension.

This model posits that reading comprehension has two distinct phases: the *construction phase* and the *integration phase*. In order to read successfully, the reader progresses through the construction phase first, followed by the integration phase. In the construction phase the reader constructs two levels of comprehension: a) a surface level and b) a text-base level. First the reader converts words from their written form to an acoustic form, and thus is able to identify their meanings and the syntactic function that each word plays in a sentence. As a result, by the end of the construction phase, the reader is able to identify the main ideas derived from the words and sentences in the text. However, understanding at this point is relatively shallow: at this stage, these ideas are not necessarily integrated or even connected with each other. This represents the surface level of the construction phase. Second, when the reader starts connecting ideas between different sentences and paragraphs he/she builds a text-base level, which as its name implies is a representation level that requires comprehension of explicit information of the text. However, this level of understanding may not always be sufficient; in many instances, to achieve a full understanding of the text, a reader will need to integrate information from the construction phase with additional information, either from their background, or from earlier in the text.

In the integration phase, the reader deepens their understanding of the text, by integrating the (relatively superficial) information they've just extracted from the text, into a broader narrative context, known as a mental model for the text. The integration phase takes information explicitly stated in the text and combines it with the reader's existing knowledge – for example, the perception that a reader has of a character in the text they're reading. This process is known as inference generation, and it enables the reader to create this representation of the situation described by the text, which is a mental model for the text read. The mental model is the cognitive representation of the situation which represents what the text is about (van Dijk & Kintsch, 1993). Thanks to their mental model, the reader is able to understand why certain events happened in the story, by extracting information from the surface level and text-base level and re-interpreting this information through their own existing knowledge.

Kinstch's CI model provides a rich and highly specified account of how reading comprehension is achieved, by extracting basic information first, and then working to incorporate each piece of new information successively into a coherent single model of the meaning of the text. However, there is a further important theoretical perspective that needs to be taken into account when seeking to explain specifically how reading comprehension is achieved. That perspective concerns what standard of understanding a reader seeks to achieve when reading a text. The Landscape Model (van den Broek, Young, & Linderholm. 1999) posits that in an attempt to seek deep understanding from the text, readers must set a minimum threshold of comprehension, also known as standard of coherence. According to this model, standard of coherence refers to readers' implicit and explicit criteria for comprehension. Thus, readers who have a high standard of coherence will be more likely to focus on understanding the text at a relatively deep level, by deploying more extensive cognitive resources to extract meaning from the text. Conversely, readers with a low standard of coherence will likely focus on understanding the text at a relatively shallow level, by deploying fewer cognitive resources to construct a mental model for the text. Standard of coherence is a potentially highly important aspect of the process of reading comprehension, as readers with different standards of coherence could go about reading a single text in quite different ways, and using potentially different domain-general cognitive skills to build their mental model of the text. Therefore, while this thesis principally focuses on the CI model of Kintsch when seeking to explain how reading comprehension occurs, it will also consider standard of coherence as a potentially important explanatory factor.

To comprehend written text, readers will ultimately need to use their lower-level comprehension skills as well as their higher-level comprehension skills. Lower-level comprehension skills and higher-level comprehension skills are cognitive processes that underpin reading comprehension (e.g., Fender, 2001; Grabe, 2009; Koda, 1992; Nassaji, 2003). Lower-level comprehension skills refer to the reader's ability to draw on knowledge at the word level and sentence level, in order to decode or recognize printed words, and to access their meanings. To understand a simple text, the reader must first retrieve the meanings of the individual words, and then combine these words into phrases and sentences. By doing so he/she will be able to build a representation in which specific word meanings and the syntactic form of sentences are retained (Cain, 2009). This retention of word meanings and syntactic structure are the first step that the reader takes in an attempt to understand the meaning of the text. However, decoding words and identifying their meanings are not sufficient for a successful comprehension of a written text: a number of studies have found that a child could have good lower-level comprehension skills yet at the same time fail to make sense of a text he or she is reading (Barnes, Huber, Johnston, & Dennis,2007; Oakhill, 1993). To fully extract the meaning from the text, the reader will have to use his/her higher-level comprehension skills, which allow him/her to use the knowledge gained at the word level (i.e. identifying the printed words and accessing their meanings), and then to combine this knowledge across all sentences and paragraphs of the text. Therefore, higher-level comprehension skills are crucial to the construction of a coherent mental model for the text. An overview of the main skills involved in word level, text based and mental model processing will be presented in the following sections.

1.3. Lower-level comprehension skills

Lower-level comprehension skills are critical first components of reading comprehension. They enable the reader to identify individual words accurately and efficiently, as well as to understand the meanings of the words they read. Children with poor lower-level comprehension skills will likely find it difficult to focus on the process of extracting the meaning from the text read. These skills are the foundation blocks of all reading, and are particularly important when children first learn to read – before the process of word recognition has become more automatic and thus less effortful. In the first and second year of schooling (typically, when children are 6 or 7 years old), these lower-level skills have been shown to have a strong and direct impact on reading comprehension (Adlof, Catts, & Little, 2006; Perfetti, 1985).

There are three lower-level comprehension skills that are particularly crucial to reading comprehension in children: *word decoding*, *reading fluency* and *vocabulary knowledge*. Word recognition is the ability to read words correctly and effortlessly (Ehri, 2006). Reading fluency refers to the ability to process words quickly and accurately (LaBerge & Samuels, 1974). Vocabulary knowledge is the ability to understand the meaning of the words read. In the following sections a detailed description of each of the lower-level comprehension skills will be presented, along with current findings on their contribution to higher-level comprehension skills.

1.3.1. Word decoding. Word decoding, or the ability to convert the written form of a word into its acoustic form, is a vital first step in reading comprehension. This is mainly achieved by looking at the printed word in the page, identifying the sound of each letter of the word, breaking it into syllables and then converting all this into a phonological sound.

This skill is obviously essential to reading comprehension, since the basic ability to accurately convert printed words into their phonological form is the first step on which all subsequent comprehension is based. Word decoding is usually assessed with tasks that require children to read isolated words one at a time by saying each word aloud. Word decoding happens via one of two routes, one known as the non-lexical route and the other known as the lexical route (Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001). The non-lexical route is the ability to translate letters and letter patterns into a phonological sound (Coltheart et al., 2001). When encountering an unfamiliar word in the text, readers need to convert the letters of the word into their corresponding sounds. But to do this, readers must first know how letters typically symbolize sounds in words. Therefore, this type of word reading is more important for beginning readers, because they know fewer words than more experienced readers, and therefore spend more of their time reading words letter by letter (Kneopke, Richter, Isberner, - Naummann, & Neeb, 2014).

The second route, the lexical route, involves the automatic recognition of the whole written word, without needing to rely on the rules about the order and combinations of letters in the word. This is achieved by readers retrieving information about familiar words from their memory. It is a more rapid and efficient way of recognizing a word than sounding a word out letter by letter. Typically, when readers encounter words they have seen before, they use the lexical route by directly mapping these form of words onto an existing mental representation of the word form. Indeed, as children become more proficient at converting letters into sounds, they use the lexical route more and more. Ehri (2005a) refers to this way of decoding words as “sight word reading”, with the word *sight* indicating that mere sight of that word activates that word in memory. The sight word reading, is considered to be the best way that enables the reading to operate most efficiently (see Ehri, 2005). This because the ability to recognize words by sight happens automatically, while converting letters into sounds is more effortful and attention is shifted to this process until the word is successfully decoded.

From a developmental point of view, a major part of reading development is the shift in how children decode the written form of words, from the non-lexical route in which children decode words letter by letter, to the lexical route recognizing words as whole units. However, the extent to which readers adopt one or other means of word decoding can greatly vary depending on the characteristics of the language involved - specifically, depending on the *orthographic depth* of the language. Orthographic depth refers to the mapping of graphemes to phonemes in a language – that is, whether the same letters always convert to the same sounds, or whether one letter (or combination of letters) can be sounded out in multiple different ways. Both word recognition routes, the lexical and the non-lexical, are affected by a language's orthographic depth. Languages which have a consistent conversion between graphemes and phonemes are said to have transparent orthographies (e.g. Finish, Italian, Dutch, Albanian). Languages which don't have a consistent conversion between graphemes and phonemes are said to have opaque orthography (e.g. English). Because the English language has an opaque orthography, and therefore contains many inconsistencies and irregularities in how graphemes are converted to phonemes, empirical findings show that decoding words via the non-lexical route is more difficult in English than in other European languages such as German, French or Spanish (e.g. Frith, Wimmer & Landerl, 1998; Goswami, Wombert, & de Barrera, 1998). That is because in the English language, graphemes do not always correspond to a single phoneme and as such requires from young readers and people learning to read to rely on orthographical decoding, by memorizing spelling patterns in order to build up a lexicon of words that they can access easily (Wimmer & Goswami, 1994).

Both routes, lexical and non-lexical routes, play important roles in reading comprehension in languages with transparent orthographies. For example, although lexical word recognition was a stronger predictor of reading comprehension as compared to non-lexical decoding in 8- and 9-year-old German-speaking children, the contribution of non-lexical decoding was also substantial and did not decrease with age (Koneke, 2016). This shows that although developing readers use the lexical route by retrieving words from their memory, they still also make regular use of non-lexical routes (plausibly to confirm that grapho-phonemic connections are correct). Koneke suggests that because of the high orthographical transparency of German words, both younger and more experienced readers tend to draw on *both* routes to decode words, plausibly because the non-lexical route is relatively effortless (see also Righter et al., 2013; Tunmer & Chapman, 2012).

1.3.2. Reading fluency. Reading fluency refers to the ability to translate text from its written form into its phonological equivalent, with speed and accuracy (Adams, 1990). It is achieved when a reader effortlessly moves from processing one word to processing the next word. To assess reading fluency tasks with isolated words are introduced to children in which they are required to read each word one at a time as quickly as possible within 1 minute time. Reading fluency is a reflection of word recognition accuracy, and is an important skill in reading comprehension, particularly for younger children; decoding words is typically more effortful for younger readers than older readers, since they recognise fewer words, and thus rely more heavily on letter-by-letter decoding to read words. As such, the better a child's reading fluency, the less effort it takes him/her to extract meaning from a text, and the more cognitive resources are available for other aspects of reading. Therefore, greater fluency means that the child can read more efficiently, devoting fewer resources to lower-level reading processes. As a result, better fluency means the child can focus more resources on higher-order aspects of reading.

The importance of reading fluency for comprehension is easy to see, as a range of studies clearly show that fluency predicts reading comprehension at a range of ages. For example, Cutting and Scarborough (2006) tested 7- to 15-year-old children to examine the relationship between basic reading skills and reading comprehension. Additionally, they also used a reading fluency task to investigate whether reading fluency mediated this relationship. The authors observed that reading fluency mediated the relationship between word recognition/decoding and reading comprehension, explaining an additional 6% of the variance in reading comprehension. Similar findings were found in a study examining reading comprehension in 9-year-old children, alongside a range of reading fluency tasks (Klauda & Guthrie, 2008). In this study, children who demonstrated the highest performance in reading comprehension also showed fast reading of isolated words. Reading fluency also predicts reading comprehension between the age of 14 and 17 (Tilstra, McMaster, van den Broek, Kendou, & Rapp, 2009). Therefore, reading fluency is an important lower-level comprehension skill, enabling the reader to use resources efficiently in decoding words, and therefore to free up additional cognitive resources for higher-level aspects of reading comprehension.

Reading fluency develops more quickly in languages with transparent orthographies – that is, languages with regular mapping between graphemes and phonemes (Seymour, Aro, Erskine, 2003). Thus, learning to read words in English is more challenging than in other languages with transparent orthographies (Ellis, Natsume, Stavropolou, Hoxhallari, van Daal, Polyzoe, & Petalas, 2004). In support of this view, in a study comparing readers of Albanian (a language with highly transparent orthography), Welsh (a language with transparent orthography) and English (a language with opaque orthography), it was found that Albanian-speaking children become skilled in reading fluency and accuracy earlier than Welsh- and English-speaking children (Hoxhallari, van Daal, & Ellis, 2004). Similar findings showing that reading fluency develops earlier in more transparent languages than in more opaque languages were also observed in a cross-language comparison study (Seymour et al., 2003). In this study, the authors examined reading fluency in 5- to 6-year-old children in 14 different European languages. Their aim was to understand whether there are differences in reading accuracy and efficiency between languages with different transparency of orthographies. In line with their hypothesis, the study revealed that children reading in transparent orthographic languages (Greek, Finnish, German, Italian, Spanish) developed their ability to read accurately and efficiently earlier (by around the age of 6) than children who were acquiring reading in orthographically less transparent languages (Danish, Portuguese and French).

It is not entirely surprising that languages with consistent grapheme-phoneme correspondences allow for more fluent reading than languages with less consistent ones. Based on this, one might speculate that early readers of transparent orthographic languages may show a stronger relationship between reading fluency and reading comprehension than readers of less transparent languages. For example, Florit and Cain (2011) examined 4- to 5-year-old children and 10- to 11-year-old children, who were learning to read in different languages (including English, Dutch, Finnish, French, German, Greek, Italian, Norwegian and Spanish). In transparent orthographic languages, reading fluency was more strongly predictive of reading comprehension in 4- and 5-year-old children as compared to 10- and 11-year-old children. However, in the English language, which has an opaque orthography, reading fluency significantly predicted reading comprehension only in 10- to 11-year-old children. This was in contrast to younger children, for whom reading comprehension was significantly predicted only by decoding accuracy. This shows that for children of languages with transparent orthographies, reading fluency becomes an important factor in reading comprehension early in their first year of acquiring reading skills, which could be attributed to their early acquisition of decoding accuracy skills. However, for children of languages with opaque orthographies, because of a late development of decoding accuracy skills, their reading fluency skill becomes an important factor in reading comprehension later in their childhood.

Somewhat different findings have been observed in other studies examining this relationship in languages with more transparent orthographies. Reading fluency did not significantly predict reading comprehension in 6- to 10- year-old children from an Italian sample (a language with a transparent orthography) (Tobia & Bonifacci, 2015). A similar lack of relationship was also observed in 8- to 10-year-old Greek-speaking children (a language with a transparent orthography) (Chrysochoou, Bablekou & Tsigilis, 2011). Therefore, future studies examining the relationship between reading fluency and reading comprehension in other languages with transparent orthographies could clarify this question.

As these studies show, reading fluency is an important lower-level contributor to reading comprehension in children. The ability to read words quickly is essential in helping children to convert words from their written form to their phonological form, and thus plays a vital role in the first stage of reading. Unsurprisingly, therefore, reading fluency predicts reading comprehension in children (Joshi & Aaron, 2000; Fuchs, Fuchs, & Maxwell, 1988; Shinn, Good, Knutson, Tilly, & Collins, 1992). Moreover, reading fluency is affected by the orthographic depth of languages. Because of the inconsistent findings in the relationship between reading fluency and reading comprehension in children of different ages, it is important to test this relationship further in other more transparent languages, to ensure greater clarity on the precise contribution that reading fluency makes.

1.3.3. Vocabulary knowledge. Vocabulary knowledge is the ability to access the semantic meaning of a word when read. Unsurprisingly, it plays an important fundamental role in reading comprehension, since understanding the meaning of words read is integral to understanding the overall meaning of a text – and if a reader doesn't understand the meaning of the words they're reading, then their overall comprehension of a text will fail. To assess vocabulary knowledge children are usually presented with sets of pictures and are required to listen to the words read aloud to them and point to the picture that matches the word. Vocabulary knowledge has been shown to predict overall reading comprehension in early readers. For example, Muter, Hulme, Snowling and Stevenson (2004) conducted a longitudinal study of children in first two years of schooling (4- to 6- year - old children) and found that vocabulary knowledge was the most significant predictor of reading comprehension.

Vocabulary knowledge plays an important role in determining how fast readers are able to retrieve the meaning of a word read. Knowledge about the meaning of the words is stored in the reader's mental lexicon and must be accessed quickly and accurately to allow readers use the meaning of the words to understand the text. The mental lexicon is the storage facility in long-term memory where the meaning of known words is stored. It is continuously updated throughout life as new words are learned. Being able to access word meanings quickly and efficiently is crucial for effective reading comprehension, as it allows a reader to save cognitive resources for other more demanding comprehension skills. This view is perhaps best expressed by Perfetti's (2007) *lexical quality hypothesis*, which states that quick and efficient access to word meanings will free up space in working memory, which can then be used for higher-level comprehension skills. This is a further example of how lower-level reading skills are important not merely in their own right, but as an integrated part of reading comprehension as a whole. For good reading comprehension to be achieved, it is important that readers do not merely understand the meaning of the words they read, but that they are also able to grasp that meaning quickly and efficiently, so that limited cognitive resources are spared for more demanding higher-level aspects of reading comprehension. Indeed, the speed of access to word meaning is found to have a mediating role in the relationship between vocabulary knowledge and reading comprehension (Cain, Oakhill & McCarthy, 2017).

The relation between vocabulary knowledge and reading comprehension is reciprocal. While vocabulary knowledge contributes to comprehension by allowing the reader to easily access the meaning of the words encountered, reading can contribute to vocabulary growth (Chall, 1987; Nation, 2001). Obviously, the more texts a reader is exposed to, the greater the likelihood that they will encounter new words, and thus increase their vocabulary (Cain & Oakhill, 2011). But more broadly, a reader with rich vocabulary knowledge may also find reading easier and more enjoyable than a comparable reader with poorer vocabulary, and may thus create a more regular reading habit. This reading habit allows the reader to read more frequently and also read a variety of texts which provide a good opportunity to learn new vocabulary. This reciprocal relation between vocabulary knowledge and reading comprehension has been referred to as the "Matthew Effect" (Stanovich, 1986), from the Biblical story that describes the rich getting richer, and the poor getting poorer. According to this view, the more children read, the more their vocabulary will grow. Empirical evidence also supports the hypothesis that reading experience contributes to vocabulary knowledge (Cain & Oakhill, 2011).

Vocabulary's role in reading comprehension becomes increasingly important after children become proficient at word reading skills (Foorman, Koon, Petscher, Mitchell, & Truckenmiller, 2015). For younger children (5- to 7-year-old children), who are still trying to figure out the mapping between graphemes and phonemes, their word reading skill could play a more important role in reading comprehension than vocabulary knowledge (Vellutino, Tunmer, Jaccard, & Chen, 2007). Once they have become relatively fluent in word reading, then vocabulary knowledge becomes a more important predictor of reading comprehension. For example, Ouellette and Beer (2010) examined the role of vocabulary knowledge in 6- to 7- year- old children, and 11- to 12- year-old children, and found that while vocabulary knowledge did not predict reading comprehension in the younger children, it significantly predicted reading comprehension in the older children.

However, findings from languages with transparent orthographies show that vocabulary knowledge predicts reading comprehension even in young children (6 to 7 years old). Vocabulary knowledge significantly predicted reading comprehension in 6, 7 and 8 year-old Dutch speaking children (de Jong & van den Leij, 2002). A possible explanation for these findings could be that in languages with transparent orthography, children attain high levels of word recognition accuracy by the end of the first grade (i.e. between the age of 5 and 6) (see de Jong & van den Leij, 2002), whereas children learning to read in an opaque orthography, such as English, do not (Goswami, Gombert & de Barrera, 1998). Thus for children who are good at word recognition by around 7 years old, vocabulary knowledge would have an additional influence on the development of reading comprehension in the years to come. This hypothesis could be further tested by studying languages with even more transparent orthographies such as the Albanian language.

1.3.4. Lower-level reading comprehension processes: A Summary. In sum, reading comprehension depends heavily on lower-level comprehension skills such as word decoding, reading fluency and vocabulary knowledge – since these are foundation-level skills, without which higher levels of comprehension would not be possible. To be able to comprehend a text, a child must first decode words presented in the text. This happens by one of two routes: either through a non-lexical route, where words are decoded by following the grapheme-phoneme correspondences of a language; or through a lexical route, where words are retrieved from the reader's mental lexicon and as a result an automatic recognition of the whole written word happens. The lexical route is more applied in languages with an opaque orthography, such as the English language, as the mapping between the graphemes and phonemes is inconsistent, making it difficult for readers to rely mainly on phonological decoding. As a child's word recognition skills improve, he/she is better able to read not just accurately but also more quickly. This improved efficiency, known as reading fluency, importantly allows readers to save cognitive resources which can then be used for higher-level comprehension skills. Vocabulary knowledge has an important role in reading comprehension, as it enables a child to understand the meaning of the words read. Furthermore, readers with a rich vocabulary knowledge tend to read more, and in this way learn new word meanings contributing to further vocabulary growth.

But while all these single components are important, in most cases they will not be sufficient for a full comprehension of a text. In order to fully understand a written text, the reader must build on, and go beyond, these lower-level comprehension skills. The ability to progress beyond the initial stages of reading involves usage of higher-level comprehension skills, to take the basic information provided by lower-level comprehension skills, to construct a full, rich representation of what the text is about. How this is achieved will be covered in the following section.

1.4. Higher-level comprehension skills

Higher-level comprehension skills are those skills that enable the understanding of the concepts and ideas conveyed by the text (McMaster, & Espin, 2007; Rapp, van den Broek, McMaster, Kendeou, & Espin, 2007). They are vital to the construction of the mental model of a text, as they enable the reader to organize ideas and concepts contained in the sentences and integrate them with the reader's own prior knowledge.

While there are some differences in how researchers conceive of these higher-level reading skills, for the purpose of this thesis, I focused on five core higher-level comprehension skills: Literal comprehension (the ability to understand the explicitly stated information in the text); Necessary Inferences (the ability to integrate information stated in the text with the reader's previous knowledge, in order to draw inferences that are necessary to understand the meaning of the text); Elaborative Inferences (the ability to integrate information stated in the text with information from the reader's previous knowledge that is not implied by the content of the text; Simile comprehension (the ability to understand figurative language in the text); and Comprehension control (the ability to monitor, evaluate and maintain one's own understanding of the text). These five higher-level comprehension skills are vital to the construction of the mental model of the text (Cain & Oakhill, 2007).

These five higher-level comprehension skills work together using the basic information generated by lower-level processes, in order to construct an accurate and precise mental model of the text. Literal comprehension is essential to this construction, since understanding the basic information explicitly stated in the text would be almost always expected from any reader. Both necessary inferences and elaborative inferences are important, since every reader should be able to combine the explicitly stated information in the text with their prior knowledge to understand the implicit meaning of the text. These three higher-level comprehension skills are crucial to the success of the reader's construction of the mental model and are tapped in almost all instances of reading.

Written texts often contain information that cannot simply be processed literally – for example, figurative statements, such as similes. Figurative language, in order to be accurately understood, must be integrated with the reader's prior knowledge of the world, so that the reader can work out the intended non-literal meaning. The ability to comprehend similes is typically called upon less frequently compared to other higher-level comprehension skills, because figurative statements do not necessarily occur in all written texts – they may be relatively common in narrative fiction, for example, but would be almost entirely absent from technical writing. When texts contain similes or other non-literal language, then the ability to interpret them correctly, and to avoid mistakes that might arise from an inappropriate literal interpretation, will greatly aid the process of mental-model construction. Relatedly, an important aspect of the construction of the mental model is the reader's ability to continually check that his/her own understanding of the text is correct, and that as the model is updated with each new sentence read, it remains an accurate reflection of the meaning intended by the author of the text. The ability to check the integrity and accuracy of the mental model as it is developed is known as comprehension control, the fifth of the higher-level skills focused on in this thesis. Taking actions to remedy inconsistencies found during reading and applying different strategies to facilitate the comprehension construction process is crucial to mental model construction.

These higher-level comprehension skills work simultaneously and in concert, with the aim of producing a coherent representation – or mental model – for the text. They are crucial to understanding successes and failures of reading comprehension in childhood. However, research to date has not looked at all higher-level skills equally, and some are much better understood than others. Inference generation and literal comprehension have been studied relatively widely, whereas simile comprehension and comprehension control have been less studied, despite their obvious importance. The following section presents a summary of the research base of each higher-level skill featured in this thesis.

1.4.1 Literal comprehension. Literal comprehension is the ability to understand ideas described in the text that can be interpreted in a semantically straightforward manner. It is a central feature of reading comprehension which occurs in the textbase level (see Kintsch, 1989). Textbase level refers to the comprehension of the information extracted from the reading of successive sentences in the text. To construct a textbase level, the reader does not need to use his/her background knowledge, instead he/she uses only explicitly stated information in the text and builds a literal comprehension for the text. For example, when considering how one might go about reading a fictional story, the understanding of the text will be based on interpreting information about the main characters, their motives, and the events that happen in the text. As an example, we can consider the sentence "Ana invited her school friends to her birthday party". To understand the literal meaning of this sentence, the reader needs to understand who the main characters are (Ana and her friends), and what is their main motive (celebration of her birthday party). To measure literal comprehension, children are typically asked questions that tap only the information that was explicitly stated in the text (for example, identifying the main character's name). Clearly, having a literal comprehension of a text is a key basic requirement for following the author's intent. Also, comprehension of these main ideas stated in the text is important for any reader who aims to go beyond what was explicitly stated in the text, in order to generate new ideas (in other words, to make inferences). Hence, literal comprehension has been found to predict both inference generation (Barnes, Dennis, & Kalvaitis, 1996), and also general measures of reading comprehension (Silva & Cain, 2015).

The ability to comprehend the literal meaning of the text emerges by around 4 to 6 years of age (Florit, Roch, & Levorato, 2011), and is first seen when children follow the meaning of stories or texts that are read to them (rather than in texts they read for themselves). This means that even before children start using their word reading skills, they are capable of understanding the main ideas from the text read to them, or when asked to retell stories from picture books. The ability to comprehend the literal meaning of the text was found to increase between 6 and 10 years of age (Yussen, Matthews, Buss, & Kane, 1980). This is consistent with the idea that the more children read, the better they become at understanding the main ideas presented in the text – in other words, the better their literal comprehension.

Literal comprehension has been shown to rely on lower-level comprehension skills (Florit et al., 2011; Silva & Cain, 2015), at least in part because the fewer resources the child has to devote to lower-level processes, the more resources they can devote to understanding the meaning of the text (see Oakhill & Garnham, 1988). Vocabulary knowledge is known to predict literal comprehension. For example, Silva and Cain (2015) assessed how far vocabulary knowledge, grammar, and verbal working memory predicted literal comprehension in 4- to 6-year-old children. They found that only vocabulary knowledge predicted literal comprehension. These results are consistent with the idea that vocabulary knowledge is fundamental to understanding even the explicitly stated information in the text. Comparable results were obtained in a study by Florit et al., (2011), in which vocabulary knowledge played an important role in explicit listening text comprehension in 4- and 6-year-olds. Furthermore, vocabulary knowledge has also been found to mediate the relationship between working memory and literal comprehension (Chrysochoou et al., 2011). Therefore, it is plausible that the more word meanings children know, the better they can save their general cognitive resources for understanding the main ideas explicitly stated in the text.

There has been less research exploring the relationship between reading fluency and literal comprehension. It has been suggested that reading fluency might help comprehension by allowing more cognitive resources for higher-level comprehension skills (Shankweiler, 1999). To test this assumption, Chrysochoou and colleagues (2011) assessed the mediating role of reading fluency in the relation between working memory and literal comprehension. They found no mediating effect of reading fluency in this relationship. This finding indicates that reading fluency, while important to reading comprehension more generally, does not directly affect the way that working memory underpins the processing of explicitly stated information.

Since there is relatively little research that looks directly at the relationship between lower-level comprehension skills and literal comprehension, future studies looking at the direct relation between all three core lower-level comprehension skills (word decoding, reading fluency and vocabulary knowledge) and literal comprehension would be valuable, as they would provide a more comprehensive account of these skills' possible relationships and contributions to reading comprehension.

1.4.1. Inference generation. "Inference" refers to information that is not explicitly stated in the text, but which is implied, and must be worked out by the reader (Kintsch, 1998; McNamara & Magliano, 2009). When it comes to understanding fully the meaning of a written text, it's often possible that a child will not be able to do this unless he/she is able to follow the implied information as well as the literally stated information. The process of making inferences is called inference generation, and researchers have tended to consider it as involving two stages: the activation stage, and the integration stage (Kendou, 2015). The activation stage involves the retrieval of background knowledge from the reader's long-term memory. Then, in the integration phase this information gets integrated with new information presented during reading. Although these two stages can be independent from one another (for example, information can be activated from long term memory but not integrated with the present information), in reading comprehension these two stages of inference generation occur in parallel (Kinstch, 1998).

Inference generation is a skill that emerges at around 4 years of age (Florit et al., 2011; Hanon & Frias, 2012; Lepola, Lynch, Lakkonnen, Silven & Niemi, 2012), though this ability continues to improve with age (Currie & Cain, 2015). Inference generation is heavily dependent upon a reader's general knowledge. Consequently, the development of inference generation follows the developmental trajectory of knowledge acquisition (van den Broek et al., 2005). To measure inference generation children are asked questions that require an inference to be made after they have read the text.

Inference generation has been classified by researchers into different types of inferences. In this thesis I focused on two main types of inferences: those that are *necessary* and those that are *elaborative* (Garnham, 1982). Necessary inferences are those that are essential to understand the essence of a text, and which cannot be skipped without important information being lost. Elaborative inferences are those that are not strictly necessary for the construction of the mental model, but which can help to embellish or enrich the meaning of the text (Oakhill et al., 2014).

1.4.2. Necessary inferences. Necessary inference is the ability of a reader to identify key information not stated in the text, in order to understand the essence of a text (Oakhill, Cain, & Elbro, 2014). Generating necessary inferences while reading requires the reader to fill in a semantic gap – doing so is vital for creating a consistent and intelligible mental model of a text. Such inferences can involve the integration of multiple pieces of information presented separately within the text, or the association of information presented in the text with information retrieved from the reader's own long-term memory (Johnston, Barnes, & Desrochers, 2008). Oakhill, Cain and Elbro (2014) offer a helpful illustrative example: "Yasmine adored her new pet. Her little puppy was very cute and loveable". In order to understand the connection between these two sentences, the reader needs to infer that they refer to the same thing, even though they use different labels: the little puppy was Yasmine's new pet. This is achieved by the reader first activating his/her general knowledge about pets to note that puppies can be kept as pets, and then to integrate that information with the first sentence (that Yasmine adored her little puppy).

Necessary inferences are required both when the reader needs to bring together information from different sentences in a paragraph or section, and when the reader attempts to bring together information from different parts of a longer text (see Oakhill et al., 2014). In the example of a new pet, in order for the reader to understand what sort of a pet is mentioned in one sentence, it is necessary for him/her to link referents across sentences (see Oakhill, et al., 2014). Without this ability, it would be difficult for a child to be able to build an understanding of the text. Necessary inference also plays an important role on a larger scale, for example in the setting of the story and character's goals in a longer story. Thus in the example with the puppy, if it were presented as part of a much longer story, the reader may need to link this information with other information previously presented earlier in the story – perhaps that it was Yasmine's birthday, and that the puppy pet was a birthday present. In this case, by drawing necessary inferences, a reader will be able to understand motives and specific goals of the characters, and combine them to produce an overall coherent representation for the text.

1.4.4 Elaborative inferences. Elaborative inferences allow the reader to work out information that may not be necessary for comprehension of the essence of the text, but which nevertheless enriches the mental model of the text. The generation of such inferences can contribute to the development of a personal, emotionally driven relationship with the text, and can also facilitate its storage and recall (see Block, Rodgers, & Johnson, 2004; Oakhill & Garnham, 1988). Elaborative inferences extend a reader's understanding of the text, by engaging with his/her wider knowledge of the world. These inferences can embellish a story, by allowing a fuller description to be drawn from a text. However, elaborative inferences are encoded less often than necessary inference (McKoon & Ratcliff, 1990; Perfetti, Landi, & Oakhill, 2005;). In the example "Yasmine adored her new pet. Her little puppy was very cute and loveable.", it would be possible to draw elaborative inferences, such as that Yasmine has had other pets before, because this was her new pet; or that the new pet may have had large brown eyes, because it was described as a cute puppy (see Oakhill et al., 2014). Thus, elaborative inferences typically draw more heavily on information external to the text than do necessary inferences (Cain & Oakhill, 1999, Currie & Cain, 2015). The construction of the mental model would not typically rely on these types of inferences, as their absence does not hinder the reader's ability to understand the meaning of the two sentences. However, the presence of these types of inference to the mental model will enrich its representation.

To better understand these types of inferences, it is helpful to look at the factors that underlie them in the process of constructing the mental model of the text. Perhaps the most important factor underpinning inference generation is the reader's background knowledge. Recall that the initial stage of inference generation involves activation of information from the reader's prior knowledge, which is then integrated with information presented during the reading process. Clearly, then, background knowledge is a crucial element for the ability to generate inferences: if a reader possesses only limited general knowledge for a particular story, then he or she may struggle to understand the context of that story – for example, failing to understand the motive and goals of the characters involved. As a consequence, a reader may fail to draw an appropriate inference, and their understanding of the text will be impaired.

Inference generation is also dependent on lower-level comprehension skills. In general, all lower-level comprehension skills contribute to inference generation, either directly or indirectly (Currie & Cain, 2015; Lynch et al., 2008; Oakhill & Cain, 2012). Their contribution is to help a reader to accurately and quickly read words presented in the text, as well as to access the meaning of the words in the reader's mental lexicon. However, to understand the exact role of each of these skills in inference generation, it is helpful to draw a distinction between these two specific types of inferences, i.e. necessary vs elaborative inferences.

Necessary inferences are dependent on a reader's vocabulary knowledge (see Oakhill et al., 2014). For example, Currie and Cain (2015) assessed 6- to 10-year-old children on measures of vocabulary knowledge, working memory, and story comprehension. In terms of the ability to draw inferences from neighbouring sentences, vocabulary knowledge was a significant predictor, and for younger children (6- and 8-year-olds) was a stronger predictor than working memory. Moreover, vocabulary knowledge fully mediated the relationship between working memory and reading comprehension in 6-year-old- children. For inferences that required the reader to link ideas across different parts of the text, vocabulary knowledge was again the strongest predictor of performance in all three groups of children (6-, 8- and 10-year-old children). Moreover, vocabulary knowledge fully mediated the relationship between working memory and reading comprehension. This shows that the knowledge of word meanings is vital to drawing inferences. This contribution is evident not only in helping readers understand the words they encounter, but also in optimising working memory by helping to process information accurately and efficiently.

When it comes to elaborative inferences, in contrast, vocabulary knowledge is less important. For example, in an attempt to understand the mediating role of vocabulary knowledge in the relationship between working memory and elaborative inferences, Chrysochoou and colleagues (2011) tested 8- and 9-year-old children. The study showed that vocabulary knowledge only partially mediated the relationship between working memory and elaborative inferences. This suggests that drawing elaborative inferences requires sufficient memory resources to allow for integration of ideas from the text with background knowledge, and that the availability of the capacity will depend on the efficiency of word meanings retrieved from the reader's mental lexicon. However, the ability to draw elaborative inferences, which require integration of additional information to embellish comprehension, is not fully dependent on the efficiency of word meanings retrieval.

Less is known about the contribution of reading fluency to these two types of inferences. Moreover, the two studies that have looked at the role of reading fluency to inference generation have provided different findings. Klauda and Guthrie (2008) examined 8-year-old children aiming to understand whether the relationship between reading fluency and reading comprehension is mediated by inference generation and prior knowledge. A regression analysis revealed that the relationship between reading fluency and reading comprehension was partially mediated by inference generation and background knowledge, suggesting that the better reading fluency is, the more cognitive resources are left for inference generation, which in turn aids reading comprehension. In another study, Chrysochoou and colleagues (2011) tested the mediating role of reading fluency in the relationship between the two types of inferences (necessary and elaborative) and working memory in 8-year-old children. The authors did not report any mediating effect of reading fluency in the relationship between working memory and necessary and elaborative inference in these children. This finding is somewhat surprising, considering that extracting meaning from the text is thought to be hampered by poor reading fluency, because a bottleneck effect occurs in which there is competition between higher-level and lower-level processes (Shankweiler, 1999). The limited and incongruent findings in this area call for further investigation of the role that reading fluency plays in higher-level comprehension skills.

1.4.3. Simile comprehension. A simile is a figurative statement involving an explicit comparison between two things, often using a hedge word such as "like" or "as" (e.g. "You are as brave as a lion") (Shibata, Toyomura, Motoyama, Itoh, Kawabata, & Abe, 2012). Simile comprehension is a skill that enables a reader to understand and interpret the meaning of a simile, and stands as a general index of how well a reader can process and understand figurative language. Although simile comprehension shares similarities with the ability to draw inferences, it is considered by most reading researchers to be a distinct skill. Similes are similar to metaphors, as they both draw on the similarity between objects or concepts to convey meaning (Godbee & Porter, 2013). The main difference between similes and metaphor is that similes make an explicit (rather than an implied) comparison, often using a marker word such as "like".

Similes are often used to help readers understand new concepts. For example, consider the simile "The mind is like a computer." To understand the intended meaning of this phrase, the reader makes an interpretation about how these two initially disparate concepts share a commonality – for example, the reader might infer that our minds can save lots of information like computers do. So to understand what the mind does, the meaning of the word "computer" provides a helpful comparison that aids understanding. Thus, through illuminating an unfamiliar topic by using existing background knowledge, a text becomes easier to understand (Xu, 2010). Therefore, similes enrich a text by relating new ideas to concepts already understood by the reader. Simile comprehension develops in early childhood with children as young as 4, and continues to develop throughout childhood and adolescence (Bernicot, Laval, & Chaminaut, 2007; Happe, 1995).

Simile comprehension is an effortful process. Because the words stated explicitly in a simile are not meant to convey a literal meaning, the reader has to put more effort into understanding them, compared to a simple non-figurative sentence. For example, the simile "The mind is like a computer", when introduced to 5- and 6-year-old children, would take more effort to understand than a literal statement such as "The mind can store lots of information". To understand the simile, information from the sentence would have to be combined with knowledge from children's long-term memory in order for the child to be able to identify the relevant feature of the comparator term (in this case, that computers are devices that can store lots of information). To measure simile comprehension children are typically asked question that require them to interpret the simile they have read in the text.

Simile comprehension is a skill that relies on working memory. To comprehend a simile, the reader needs to hold in mind the information presented within the simile, and at the same time search for and retrieve information drawn from his/her background knowledge. This is not always straightforward. For example, with the simile "My work is like a prison", the reader's first response will be to process this phrase literally. Then, once the reader notices that the literal meaning is not sufficient, or does not match with what their mental model of the wider text would lead them to expect, he /she goes *beyond* the literal meaning, by searching for information from their own experience or background knowledge that would help to make sense of the simile (Miller, 2012). Without the ability to temporarily store and integrate different sources of information in working memory, the reader may fail to draw the correct inference about the simile, and may proceed with an incomplete or incorrect model of the text.

Simile comprehension is generally within the abilities of even poor readers (Cain et al., 2001). Empirical findings suggest that children who are less skilled in reading comprehension are not significantly impaired in their ability to interpret similes (Mashal & Kasirer, 2012). Furthermore, typically developing 8- and 10-year-old readers performed better in simile comprehension and literal comprehension than they did in inference generation and comprehension control (Chrysochoou et al., 2011). However, it is clear that research into simile comprehension is limited, and that further investigation of the cognitive processes involved in simile comprehension would strengthen current knowledge.

1.4.4. Comprehension control. Comprehension control refers to the ability to monitor, check and correct one's own understanding of the text as it is being read. Comprehension control helps the reader to build a successful mental model for the text, as it allows him/her to identify any areas where the mental model is not coherent, or where it doesn't match up to new information presented in the text, and to then take actions to resolve any such problems (e.g. Dunlosky & Metcalfe, 2008). A common way to measure the ability of the reader to control his/her understanding of the text is by asking him/her questions which are inconsistent with the essence of the story. To answer these questions, a reader must first be able to monitor the content of the questions and compare it with his/her mental model for the text read. Then, while checking for the inconsistencies between the question and the mental model already constructed for the text, the reader will then try to fix the inconsistency by reacting to the question with an answer that is consistent with his/her mental model for the text.

Comprehension control (sometimes also referred to as comprehension monitoring) involves continually evaluating and revising information relating to the mental model of the text, so that it is up-to-date and error-free. This constant evaluation allows readers to detect any inconsistencies in their understanding of the text that may arise. When such an inconsistency is detected, readers are able to take appropriate measures to resolve it. These measures can include speeding up or slowing down their reading, re-reading previous sections to check understanding or to retrieve a specific piece of information, or even seeking information from somewhere outside the current text, in order to provide some background information (Pressley & Gaskins, 2006). Empirical evidence has shown that comprehension monitoring predicts reading comprehension, by showing that children with high performance in reading comprehension tasks are also good at monitoring their comprehension when they have to deal with inconsistencies in a text (e.g. Ehrlich, Remond, & Tardieu, 1999; Oakhill, Hartt, & Samols, 2005; Yuill & Oakhill, 1991).

The most common way to measure comprehension control is by asking children questions after they have the read the text, which are incompatible with the gist of the story. For example: if the story was about two children who spent a day on the beach and came back home by bus, the children could be asked a question: *Why did the children walk all the way back home?.* To answer this question correctly children must first realize that the content of the question is inconsistent with the information provided in the text (*that the children returned home by bus)* and remedy this inconsistency by explaining that – *the children did not walk back home but instead they returned home by bus.*

Comprehension control can be seen in children prior to them learning to read (4- to 5-year-olds), as it is a skill used to help them monitor whether or not stories they *hear* make sense to them (Oakhill et al., 2014). This skill improves with age (Baker, 1984; Hacker, 1997). This view has been also supported with the findings of a study examining 12- to 16-year-old children in a set of comprehension monitoring and control tasks, where the author observed that the ability to control comprehension increased with age and reading ability (Hacker, 1997).

Comprehension control has been repeatedly found to improve comprehension (Baker & Brown, 1984; Brown 1980; Hacker, 1997). For example, Cornoldi, DeBeni, & Pazzaglia, (1996) longitudinally examined groups of poor readers and good readers of 11 years of age, assessing their performance on language-related tasks (e.g. Reading comprehension, listening comprehension, and word decoding), on working memory measures, and on metacognitive tasks involving both monitoring and control. Poor readers were less able to control their comprehension for the text read as compared to good readers, had poor comprehension control, suggesting that poor comprehension control negatively impacted reading comprehension. The authors also found that a reading comprehension failure generally implied a lower metacognitive control on reading comprehension leading the authors to claim that metacognitive skills and working memory are necessary prerequisites contributing in reading comprehension. Therefore, there is a general consensus in reading comprehension research that comprehension control is a metacognitive task considering that poor comprehenders have difficulties realizing that they do not understand the text and fail to monitor the text. Similar findings were reported in a study examining 9- to 13-year-old children on two different kinds of reading-related tasks: one kind relating to basic text comprehension (e.g. identifying story characters, events and facts) and one relating to more complex comprehension monitoring abilities (e.g. recognizing words that were incongruent with the text meaning) (Meneghetti, Carretti, & DeBeni, 2006). The "complex" comprehension tasks were better predictors of overall reading comprehension performance than the basic comprehension tasks, suggesting that metacognitive skills such as comprehension control are vital contributors to reading comprehension.

There is, therefore, evidence to suggest that comprehension control is an important part of children's developing reading skills. However, due to the relative sparseness of empirical work looking at comprehension control directly, there are still unanswered questions about how comprehension control is achieved, and about the possible contributory factors that influence this higher level comprehension skill in children. As with inference generation, comprehension control also relies on the reader's ability to draw on his/her background knowledge. This suggests that working memory may well play a supporting role in comprehension control. Indeed, there is some evidence to support this view: a study measuring comprehension control in 8- to 10-year-old children through a regression analysis found that the comprehension control measure was very strongly related to working memory (Chrysochoou et al., 2011). Furthermore, Chrysochoou and Bablekou (2010) examined comprehension control in oral comprehension and its relationship with working memory in 5-, 7-, and 9-year-old- children. The findings from this study showed that comprehension control was significantly predicted by working memory in 5- and 7-year-old children's oral comprehension.

In the studies discussed above, after testing the mediating role of vocabulary knowledge and reading fluency in the relationship between working memory and comprehension control, results showed that neither vocabulary knowledge nor reading fluency mediated this relationship. There are no other studies to my knowledge that have looked at the relationship between working memory and other domain-general cognitive skills and comprehension control. Neither are there any studies examining the potential contributory role of lower-level comprehension skills to comprehension control in children. Thus to have a better understanding of comprehension control and the supporting role that other cognitive processes may play, it would be valuable to further examine this relationship in children.

1.4.5. The role of domain-general cognitive skills in reading comprehension. Reading comprehension is a multi-stage process, whereby the reader builds a mental model of a text through the concurrent deployment of a number of different cognitive processes. To successfully construct a mental model for a text, the reader needs to coordinate a number of complex cognitive activities, notably including higher-level comprehension skills. These higher-level comprehension skills are themselves underpinned by a variety of domain-general cognitive skills – that is, skills which are not specific to reading, but are used in virtually all tasks requiring cognitive control. The most notable of these domain-general skills are working memory as defined by Baddeley's multicomponent model (2000) and executive functions as defined by Miyake's three-factor model (2000).

The role of working memory in reading comprehension has been studied very extensively, and has been shown to be one of the most important determinants in terms of domain-general cognitive skills in explaining individual differences in reading comprehension (Cain, 2006; Cain et al., 2004; Currie & Cain, 2014; Silva, & Cain, 2015). Its essential role in reading comprehension is not surprising, since as we have already seen, working memory enables the reader to store and manipulate information they encounter while reading a text (e.g. DeBeni & Palladino, 2000; Sesma, Mahone Levine, Eason & Cutting, 2009). It also provides crucial support for higher-level comprehension skills, by providing the means by which the reader retrieves the information from their background knowledge, necessary, for example, in drawing inferences about the meaning of the text.

Higher-level comprehension skills also rely on executive functions, which are important cognitive skills that underpin planning and goal-directed activities (Kendeou et al., 2014). The most influential model of executive function, Miyake's three factor model, posits that there are three core executive functions: updating, inhibition and cognitive flexibility (Miyake et al., 2000). These three core executive functions have received less attention in reading research than Baddeley's working memory model, but nevertheless have emerged as important contributors to reading comprehension (Cartwright, 2015). The potential roles played by executive functions in reading comprehension are diverse, but include enabling the reader to focus on relevant information by inhibiting less important or irrelevant information; supporting the reader in updating information with newly read information; and shifting attention between multiple aspects of a text while reading, for example shifting between their own background knowledge and the information provided in text, or shifting between processing of phonological and semantic information in the text (e.g. Georgiou & Das, 2018) .

To recap: considering that executive functions are used in situations where we have to carry out novel or difficult tasks, then their contribution to children's reading comprehension, which for many children is an effortful thing to do, is likely to be vital. In the following sections, accounts of the development of working memory and each separate executive function is provided, followed by a discussion on their contribution to reading comprehension in childhood.

1.4.6. Working memory. Working memory is the ability to hold and manipulate information in mind (Baddeley & Hitch, 1974). More specifically as it relates to reading, it is the ability to store information while at the same time processing incoming information for use in different cognitive tasks. Individual differences in working memory are known to predict reading comprehension (Oakhill, Cain, & Bryant 2004a).

When it comes to reading comprehension, working memory plays two crucial roles in the construction of the mental model. First, it provides the capacity to maintain and manipulate information presented during reading (for example, the meaning of a sentence that has just been read, which is then integrated with existing information about the text – see Cain, Oakhill, & Elbro, 2014). Second, working memory plays a crucial role in the retrieval of information from the reader's background knowledge, stored in his/her long-term memory. This is mainly achieved by allowing readers to access information already stored in long-term memory and integrate it with the currently stored information. These two roles are fundamental to higher-level comprehension skills such as inference generation, simile comprehension and comprehension control. To understand how exactly working memory works to support reading comprehension, it is informative to consider the most influential working memory model, that of Baddeley and Hitch (1974), as this model has provided the theoretical framework for the overwhelming majority of research into reading comprehension.

According to Baddeley and Hitch's model (1974), working memory is a limited capacity system that comprises three distinct but interrelated components: the phonological loop (PL), the visuospatial store (VS) and the central executive (CE). The phonological loop (PL) is the component of working memory that enables the retention of auditory information (which for most research in reading comprehension tends to refer to *verbal* information). Stored information in the phonological loop can last only for a few seconds before it decays. This decay can be countered through strategies such as rehearsal, which allows a person to refresh the stored information, by retrieving and re-articulating the stored information (see Baddeley, 2003). The capacity of the phonological loop develops in a linear way from around the age of 4 years to adolescence (Gathercole, Pickering, Ambridge, & Wearing, 2004). It is known to play an important role as children learn to read (Gathercole & Baddeley, 1993) – mainly by enabling children to learn new words (through rehearsing and storing new words that they encounter), as well as by providing the cognitive means by which words presented visually can be converted to phonological forms.

The visuospatial sketchpad is responsible for the processing and storage of visual or spatial information. It is thought to be limited in capacity, typically to about three or four objects (Baddeley, 2003). The visuospatial sketchpad enables us to store and retrieve information relating to the visual features of an object (such as form and colour), as well as to its location (i.e. where in a space the object was located: Baddeley, 2007). The visuospatial sketchpad develops in a linear way from around 6 years to adolescence (Gathercole et al., 2004).

The central executive is the component of the working memory system that controls and regulates the flow of information between the separate parts of the system (Baddeley & Logie, 1999). Its main role is to supervise the phonological loop and the visuospatial store by allocating and coordinating necessary resources (Alloway et al., 2004). It also enables the retrieval of information from long-term memory. In the following sections the role of working memory in reading comprehension will be discussed.

Working memory, and in particular the central executive component, has been shown to be strongly correlated with reading comprehension in children (Cain, 2006; Cain, Oakhill, Cain & Elbro, 2014; Carreti, Borella, Cornoldi & DeBeni, 2009). The contribution of the central executive to reading comprehension is twofold. It enables the reader to focus and switch attention between the text details in memory while processing new text details as reading goes on (Cain 2006; Christopher, et al., 2012). It also plays a significant role in activating information retrieved from long-term memory. Indeed, many studies report that measures of the central executive significantly predict reading comprehension in children (Oakhill, Hartt, & Samols, 2005).

The central executive accounts for some of the individual differences in reading between poor readers and better readers (Cain, 2006). In this study it was found that strong readers and weak readers did not differ in their abilities to recall lists of digits, or of concrete words, or of abstract words. However, they did differ in their performance on complex working memory tasks (tasks which required them to supply final words in sentences, and to then recall those words later). This suggests reading comprehension may be supported more by the ability to *manipulate* information, rather than the ability to *store* information – consistent with the idea that the central executive plays a more significant role in reading comprehension that either the phonological loop or visuospatial store.

The most commonly used tasks to measure the central executive are backward span tasks. These tasks assess children's ability to hold in mind information and manipulate that information to produce some results. For example, the Backward Digit Span task requires participants to recall a series of digits, in reverse order. This task requires storage and processing of verbatim information that contains a minimal amount of syntactic and semantic relations between items (Nouwens, Groen, & Verhoeven 2016). A task that taps into semantic processing is the Listening Recall task. In this task the reader is presented verbally with unrelated sentences, and is asked to first judge if sentences are semantically correct or not. Once the reader has judged the veracity of the sentence, he /she is required to recall the final word of the sentence/sentences presented (Daneman & Carpenter, 1980). Thus, when examining the role of central executive to reading comprehension tasks, measures of Backward Digits and Listening Recall are mainly used (Nouwens, et al., 2016).

Working memory is also vital to higher-level comprehension skills in children. Working memory significantly predicts inference generation in preschool children (Silva & Cain, 2015), primary school children (Cain & Oakhill, 1999) and middle school children (Cain et al., 2004). With regard to different types of inference, most studies have looked at the necessary inference only. For example, Currie and Cain (2015) reported a positive correlation between working memory measures (including a Listening Recall task) and the ability to draw necessary inferences in 6- 8- and 10-year-old children. Working memory also predicts elaborative inferences (Chrysochoou et al., 2011). Therefore, working memory appears to support reading comprehension not only by allowing readers to draw inferences that are necessary for the construction of the mental model, but also by allowing them to draw inferences that enrich and strengthen the mental model itself.

Working memory has also been shown to support comprehension control. Children who performed well on a Listening Recall task were better able to answer comprehension control questions, compared to children who did poorly on the Listening Recall task (Chrysochoou et al., 2011). The comprehension control items in this study asked questions that were inconsistent with the basic meaning of stories. To succeed, children needed to be able to detect the inconsistencies. The study suggests that the ability to detect and remedy inconsistencies between the mental model and new information from the text relies on working memory capacity.

However, not all aspects of higher-level reading comprehension are supported by working memory. Working memory does not appear to predict literal comprehension in children (Chrysochoou et al., 2011; Potocki, Sanchez, Ecalle, & Magnan, 2017). Examining the contribution of working memory to literal comprehension in 10-year-old children, Potocki and colleagues (2017) found that unlike inference generation, literal comprehension was not predicted by working memory. Nor does working memory support simile comprehension (Chrysochoou et al., 2011). These findings may not be all that surprising. With literal comprehension, the key demand of processing of information presented explicitly in the text may be relatively straightforward for most readers, not least as it does not particularly rely on retrieving information from background knowledge. With simile comprehension, because this requires resolving meaning within a single sentence – rather than throughout the entire text – it could plausibly be that it does not specifically depend on working memory capacity.

It must be noted that most of the studies looking at the relationship between working memory and reading comprehension were mostly correlational in design, leaving unanswered questions about causes of this relationship. However, a recent study by Karbach, Strobach and Schubert (2014) explored the benefits of working memory training in reading comprehension to see whether adaptive WM training yielded larger training benefits than non-adaptive low-level WM training in reading. The authors examined two groups of 8-year-old children, the so called the control group and the training group, both of which were typically developing children. The tasks in the training group were adaptive, that is task difficulty was adapted to the individual level of performance. The control group went through an identical testing procedure to the training group but training in their sessions was non-adaptive. The authors found that there was a short-term transfer to reading abilities in the training group but not in the control group, also participants showing the largest working memory training gains also showed the largest transfer effects. Therefore, these findings provide strong evidence for the effectiveness of working memory training in reading comprehension improvement in young children.

However, to date there are no other studies looking at the relationship between working memory and all five higher-level comprehension skills at once (literal comprehension, necessary inferences, elaborative inferences, simile comprehension and comprehension control). Differentiating between different types of higher-level comprehension skills, and examining the role of different predictors to each of these skills simultaneously, would give us a clearer picture of how and to what extent specific predictors contribute to each of these skills. This simultaneous examination of higher-level comprehension skills would help us avoid any overlapping between the contribution of specific predictors to these skills. Furthermore, such findings would help practitioners to identify specific difficulties in reading comprehension and provide support to poor readers.

1.4.7. Executive functions: Updating. Updating, or the ability to monitor and update information held in memory, is one of the three core executive functions proposed in Miyake's three-factor model (Miyake et al., 2000). Updating is important for many aspects of reading comprehension. For example, when building a mental model for the text, readers need to continuously integrate new incoming information from the existing text into the model (Gueraud, Harmon, & Perachi, 2005). Thus, during reading the reader holds the text ideas in mind to build the mental model for the text, and as the story unfolds he/she continues to add new details and update the previously stored information in working memory. The ability to hold and update information in mind develops very early, with infants of only 9 to 12 months being able to update the content in their working memory (Diamond, 2007).

In this thesis, I focused on updating as one of the three distinct executive functions proposed by the model of Miyake et al., (2000). According to this model, updating involves efficiently revising the components of working memory – for example, as new and relevant information becomes available on a task (Carretti, Cornoldi, De Beni, & Romano, 2005). Thus, based on this framework, the main reason for looking at updating in addition to working memory in this thesis was that updating is known to be an important ability for reading comprehension.

Updating in children is commonly assessed using the N-back task (Schneider et al., 2002). In this task, the child is presented with a long sequence of stimuli – typically presented one at a time, at a rate of around one stimulus per second – and has to indicate when the current stimulus matches the one that appeared N steps earlier in the sequence. In this way, the participant is required to continuously update old information with new relevant information – specifically, they need to keep track of what stimulus appeared N steps back in the sequence. The N-back task has been used as a reliable measure of updating with children as young as 5 years of age (see Im-Bolter, Johnson, & Pascual-Leone, 2006; Whitely & Colozzo, 2013). Updating has also been assessed in children using the Keep Track task (Yntema, 1963). In this task, children are presented with a set of categories (e.g. animals, colours, countries, etc.). 15 words from all categories are presented sequentially in the screen. These words are exemplars from the six possible categories, with 2-3 words from each category. The reader is required to read the words and remember the most recent word presented for each of the target categories and write them down at the end of the trial. Thus, they need to continuously update the most recent word associated with each of the categories. The dependent variable is the proportion of words that participant identified correctly.

Updating is a predictor of several reading skills. First and foremost, it plays a fundamental role in children's reading comprehension (Cain, Oakhill, & Bryant, 2004; Engle, Carullo, & Collins, 1991; Seigneuric, et al., 2000). For example, Carretti and colleagues (2005) examined a group of poor and good readers between 8 and 11 years of age using a Verbal Updating task. Poor readers were also found to be poor at updating information in working memory. As the authors postulated, during a Reading Comprehension task readers must continuously monitor the incoming information, and then update the contents of their memory with newly encoded information. In a more recent study, Potocki and colleagues (2017) tested the contribution of updating (as measured by an N-back task) to reading comprehension in 10-year-old-children. They found that updating significantly predicted reading comprehension (specifically inference making). These findings suggest that updating plays a vital role in helping readers to update memory content to extract the implicit meaning from the text read.

Updating was also found to predict reading fluency (van den Sluis, de Joeng, & van den Leij, 2007). Using three updating tasks (the Keep Track task, Letter memory task and Digit Memory task) and a standardized task of Reading Fluency it was observed that updating was positively related to reading fluency.. In a recent meta-analytic sample comprising 65 studies with 8-year-old children, Ober, Brooks, Homer and Rindskopf (2020) found that updating was significantly associated with decoding. These findings illustrate the important role of updating in both lower-level reading processes (i.e. reading fluency) and in reading comprehension.

To date, the predictive role of updating has been only tested in literal comprehension and inference generation. When updating was tested in 10- and 11-year-old children in a reading comprehension task including both literal comprehension and inference generation questions, it was found to be a significant predictor (Iglesias-Sarmiento, & Rodriguez, 2015). However, the reading comprehension task did not have differentiated questions which tapped literal comprehension and inference generation and therefore one could hesitate to argue that updating predicts both higher-level comprehension skills. A more recent study examined updating in a reading comprehension task which differentiated questions tapping literal and those tapping inferential skills in 11-year-old children (Potocki et al., 2017). The authors observed that updating uniquely predicted inferential skills, suggesting that updating skill could very well play a very important role in readers aiming to integrate information to draw inference generation.

Taken together, empirical evidence shows that updating plays an important role in children's reading comprehension. However, it is still unclear whether updating is only required in inference generation, or also in other higher-level comprehension skills such as simile comprehension and comprehension control. Moreover, examining the contribution of updating in two different types of inference (necessary and elaborative) would be important for better understanding reading comprehension failures.

1.4.8. Executive functions: Inhibition. Inhibition is the ability to suppress information or responses that are in conflict with current task goals (Miyake et al., 2000). It is thought to play an important role in reading comprehension by suppressing irrelevant information, thus freeing up working memory capacity. Specifically, the construction of the mental model relies on the two core stages, construction and integration, and inhibition plays an important role in both. During the construction process – which involves mainly recall of information explicitly stated in the text – a general understanding for the main ideas is established, but this understanding lacks the full coherence necessary for the creation of the mental model. However, in the integration stage, a rather more complex processing is involved, that of activation of information from long-term memory, and the subsequent integration of this information with information presented in the text. During this process, the reader will attempt to suppress any inaccurate information, and allow the processing of relevant information which enable a successful and coherent mental model. Thus inhibition supports the reader to suppress these inaccurate constructions so that a coherent mental model can be built (e.g. Gernsbacher & Faust, 1991).

Inhibition emerges by around 3 years of age (Hughes, 1998), when children begin to be able to suppress task-inappropriate responses. Inhibition continues to develop up until around the age of 10 years, with little or no further development in young adults (Levin et al., 1991). A commonly used task to examine inhibition in children is the Eriksen Flanker task (Eriksen & Eriksen, 1974). In this task participants have to select a central target stimulus that is flanked by irrelevant stimuli (e.g. “LLALL”, where the central letter A is the target stimuli). The participant will have to respond with a button press that matches the central, target stimuli, as quickly as possible without sacrificing accuracy – and, crucially, while ignoring information presented as flanker stimuli.

There is a general consensus in the literature that inhibition should be treated as set of attentional control processes rather than as a unitary mechanism (Borella et al., 2010). Friedman and Miyake (2004) have proposed a taxonomy of inhibitory-related functions comprising the following: “prepotent response inhibition,” which allows for the blocking of prepotent responses that are automatically activated by a particular stimulus; “response to distracter inhibition,” which enables the focusing of attention on relevant items by ignoring simultaneously presented irrelevant items; “resistance to proactive interference (PI),” which refers to the ability to inhibit the activation of no longer relevant items, and thus to decrease memory-based intrusion errors. According to the authors, prepotent response inhibition and response to distractor inhibition are responsible for suppressing irrelevant information coming from the *environment*. Conversely, resistance to proactive interference is responsible for suppressing irrelevant information coming from the *contents of memory*. Therefore, when seeking to understand the contribution of inhibition to reading comprehension, it is important to look at different inhibition-related functions rather than at a single indicator of inhibition.

Inhibition is important to successful comprehension, as it allows readers to suppress information that is not relevant to the construction of the mental model. Inhibition is required when irrelevant ideas previously read in the text need to be suppressed – for example, when new information makes previous ideas or assumptions in the model outdated (DeBeni & Palladino, 2000; Kieffer, Vukovic, & Berry, 2013; Nation & Pimperton, 2010). For example, inhibition predicted performance in reading comprehension in 9-year-old children (Kieffer et al., 2013). In this study, inhibition was measured with an adapted version of the Stroop task known as the Number/Quantity Stroop (see Bull & Scerif, 2001). The authors reported that inhibition made a significant, small-to-moderate unique contribution to reading comprehension. Moreover, this contribution was significant above and beyond word reading, language comprehension and working memory. This is consistent with the idea that readers who are able to inhibit irrelevant or no-longer relevant information, are also better at constructing an accurate mental model of the text.

Inhibition is also used when activation of wrongly recalled words occurs (that is, words that were previously read) and which have to be suppressed, known as intrusive words (Cain, 2006; DeBeni & Palladino, 2000). For example, if children are asked to read several lists of words in succession, and to recall items of each list after a rehearsal-prevention task, they must use their inhibition to suppress words that were presented in previous lists that were relevant at an earlier moment of the task, but which have become irrelevant for the current task. DeBeni and Palladino (2000) ran a longitudinal study comparing good readers and poor readers on a test battery. The battery included standardized Reading Comprehension tests that involved inferential questions. The authors found that children who made more intrusion errors, that is recall of non-relevant words, also did worse in answering inferential questions in the reading comprehension task.

To test whether inhibition predicted inference generation, the same authors used a "Memory of a Passage" task. This task required children to read a passage including both information related to the main story, and information unrelated to the title of the passage. On the first reading of the passage, readers were required to focus on information related to the title of the passage, and on the second reading readers were asked to underline this information. At the end of this phase, readers were asked to recall all the units of information presented in the passage (regardless of their relatedness to the title of the passage). Poor readers recalled more passage-irrelevant information than good readers. These findings are consistent with the idea that inhibition plays an important role in preserving cognitive resources to help with reading, most likely used when irrelevant words or irrelevant information need to be suppressed.

Inhibition has also been shown to support reading comprehension by playing a specific role in inference generation. Potocki and colleagues (2017) tested 11-year-old children with a reading comprehension task including questions tapping literal comprehension and inference generation. They also assessed inhibition using the Stroop task. The findings revealed that inhibition predicted unique variance in inference generation, after controlling for word reading and vocabulary skills. This means that children who performed well in the Stroop task were also good at generating inferences about the text. However, inhibition did not predict any unique variance in literal comprehension. This indicates, perhaps unsurprisingly, that recalling of information explicitly stated in the text does not require significant contributions from inhibition, and that inhibition plays a specific but not universal general role in supporting reading comprehension.

Taken together, these findings suggest that inhibition provides support for reading comprehension in a variety of ways. Inhibition allows readers to block irrelevant information from being reactivated as readers attempt to retrieve relevant information necessary for drawing inferences (e.g. Borella, Carretti, Pelegrina, 2010; Nation & Pimperton, 2010).

While much is known about how inhibition contributes to reading comprehension, a number of issues still remain unaddressed. For example, while inhibition is known to play a role in inference generation, it remains unclear whether inhibition predicts children's performance in drawing different types of inferences (i.e. necessary inferences vs elaborative inferences). While we do know that inhibition predicts inference generation, independent of the contribution played by lower-level skills such as word reading, we don't know if this relationship is independent of reading fluency and vocabulary knowledge.

1.4.9. Executive functions: Cognitive flexibility. Cognitive flexibility describes the ability to adapt our thoughts and behaviour in response to changes in our goals or our environment (Blakey, Visser, & Carroll, 2016). It is plausible to think that cognitive flexibility may be important to reading comprehension, as it enables the reader to consider a number of different ideas or perspectives at one time, and to actively switch between them. This may be important when the reader attempts to construct a coherent meaning of the text – for example, if the reader knows information that a character in the story does not, the reader would need to be able to maintain both their own perspective on a situation and the character's perspective. To be able to switch from one perspective to another, cognitive flexibility may well play a crucial supporting role (see also Cartwright, 2015).

Cognitive flexibility is thought to be underpinned by the other two executive functions, working memory and inhibition, and emerges later in development (Davidson, Amso, Anderson, & Diamond, 2006). One of the tasks used to measure cognitive flexibility is the Switching, Inhibition, and Flexibility Task (SwIFT: FitzGibbon, Cragg, & Carroll, 2014). In this task children are required to match colourful stimuli, first according to one dimension (e.g. shape) and then according to another dimension (e.g. colour). The key requirement of the task is to switch from one rule to another.

The idea that cognitive flexibility plays an important role in reading comprehension is consistent with existing studies – though research into this role is relatively limited. For example, cognitive flexibility uniquely predicted 2.7% of reading ability in 10- and 11-year-old children (Latzman, Elkovitch, Young, & Clark, 2010; van der Sluis et al., 2007;). In a longitudinal study with children (3- to 5-year-olds, tested until they were 6- to 9-year-olds), Guajardo and Cartwright (2016) found that cognitive flexibility was a unique predictor of reading comprehension, accounting for 14% of the variance in reading comprehension beyond the predictors of age, vocabulary, decoding, and proxies for socioeconomic status. The authors suggested that cognitive flexibility allows readers to consider multiple aspects of a story concurrently, and also to construct coherent mental models of stories read.

Cognitive flexibility may also support reading comprehension via a less direct route, by supporting lower-level comprehension skills. Kieffer and colleagues (2013) examined the contribution of cognitive flexibility to reading comprehension among a sample of 9-year-old children aiming to find if cognitive flexibility makes a direct contribution to reading comprehension, or if it has an indirect contribution through language comprehension. Cognitive flexibility demonstrated a unique direct prediction to reading comprehension, but also an indirect association with reading comprehension through language comprehension. Kieffer and colleagues (2013) suggested that this mediating effect of language comprehension in association between cognitive flexibility and reading comprehension is important, as it shows that cognitive flexibility could play a role in real-time processing of oral language and in the development of the sophisticated oral language skills necessary for reading fourth-grade texts.

While cognitive flexibility appears to be important for reading comprehension in a relatively general way, it remains an understudied aspect of domain-general processing. It is not yet known to what extent cognitive flexibility contributes to different types of higher-level comprehension skills. To my knowledge, cognitive flexibility has only been examined in relation to two out of five higher-level comprehension skills: literal comprehension and inference generation. Cognitive flexibility (as measured by the Trail Making Task) did not explain literal comprehension nor inferential skills in 10- and 11-year-old- children (Potocki et al., 2017). Moreover, cognitive flexibility explained no significant part of the variance in word decoding skills. It should be noted that in this study, the Trail Making Task was used; this task assesses the ability to combine and coordinate all executive functions together; as such, the role of cognitive flexibility might have been masked by other skills such as working memory or inhibition. However, the authors ran a second study testing less skilled readers from 8 to 15 years of age, examining cognitive flexibility with the Animal Sorting subtest from the NEPSY II (Korkman , Kirk & Kemp, 2007). The findings showed that less skilled readers had poorer cognitive flexibility than more skilled readers.

Based on the limited available evidence, there is a good reason to believe that cognitive flexibility plays a role in reading comprehension in children. Existing empirical evidence indicates that children who have poor cognitive flexibility perform worse at reading comprehension (e.g. Cartwright, 2002; 2015, Latzman, et al., 2010; Potocki, et al., 2017). However, future studies looking at specific role of cognitive flexibility to each higher-level comprehension skill would strengthen the current understanding of this relationship.

1.5. Aims of the research

This thesis had two principal aims. Firstly, it sought to investigate reading comprehension in developing readers, specifically focusing on the roles played by domain-general cognitive skills to children's higher-level comprehension skills. While these skills have a protracted developmental trajectory, this thesis focuses on a particularly crucial time of development, when children are becoming *independent* readers (8- and 10-year-old children). For the purpose of this study, independent readers are considered children who can read and comprehend text on their own, without the support of adults. Secondly, it sought to understand whether the relationships between domain-general cognitive skills and higher-level reading comprehension skills were moderated by lower-level comprehension skills. These aims will be addressed by focusing on a language with highly transparent orthography (the Albanian language).

The following chapters report empirical work conducted to address these dual aims. Chapter Two reports a preliminary battery study that was conducted with the main objective being to establish suitable reading comprehension tasks for use in Albanian. In this attempt it involved two main steps. The first step was to adapt relevant tasks used in other languages, and to translate them in the Albanian language. These tasks included a vocabulary knowledge task; a reading fluency task; a working memory task; a resistance to proactive interference task; and a reading comprehension task. The second step was to pilot test and adapt the novel tasks to ensure that they were all suitable for use with Albanian children.

Chapter Three reports the main empirical study of the thesis. This study sought to better explain how reading comprehension happens in 8- and 10-year-old children. More specifically it sought to answer the two research questions of this thesis: a) what is the relationship between domain-general cognitive skills and the five higher-level comprehension skills at a crucial time of development, when children are becoming independent readers; and b) is the relationship between domain-general cognitive skills and higher-level comprehension skills moderated by lower-level comprehension skills? To do this, an extensive test battery was designed, to assess (a) reading comprehension, including the five different higher-level comprehension skills of interest to this thesis; (b) domain-general cognitive skills (i.e. working memory and executive functions); and (c) lower-level comprehension skills (specifically reading fluency and vocabulary knowledge).

To better understand how reading comprehension happens, this thesis looks at the moderating role of the lower-level comprehension skills in the relationship between domain-general cognitive skills and higher-level comprehension skills. This is important because it can shed light on any potential interactions between lower-level comprehension skills and executive functions in predicting specific aspects of reading comprehension.

To look at the developmental aspect of the relationship between domain-general cognitive skills and higher-level comprehension skills, the studies reported in this thesis were conducted with two age groups, 8-year-old and 10-year-old children. These two age groups were selected because they span a particularly important time for the area of reading comprehension. At this age, children become independent readers and can read texts without the help of adults.

Albanian-speaking children were chosen for this study because Albanian is a transparent orthographic language, that is it has a highly regular mapping between graphemes and phonemes. Albanian as a language of the Indo-European family of languages, has a Latin alphabet comprising 36 letters (7 vowels and 29 consonants). Each letter in the Albanian language highly corresponds with its sound regardless of the combination of letters in syllables. However, despite its highly transparent orthography, Albanian has a complex syntax. It has a three-gender system and five cases (nominative, accusative, dative, genitive and ablative). Albanian is also characterized with several compound past tenses, the future tense, the present progressive, and the past passive. Another noticeable feature of the Albanian language is its division into two dialects; the Tosk and the Gheg. Gheg is a dialect mostly spoken in Kosovo while Tosk is a dialect mostly spoken in Albania. The most notable difference between the two dialects is their phonological variation, with the Gheg dialects having nasal vowels while Tosk does not. In Kosovo the standard Albanian language is based on Tosk dialect but it also preserves some Gheg features. Therefore, although it is one language spoken and used in both countries when examining participants in this language the issue of dialect must be taken into consideration.

Testing children in this language would bring important insights in understanding reading comprehension, because interrelations between domain-general skills and reading specific skills may differ in orthographically transparent languages, compared to most existing research which has been done in orthographically opaque languages. More importantly, the construct of reading comprehension, and its relationship with other cognitive skills, hasn't been sufficiently examined in the Albanian language. Especially considering the fact that Albanian-speaking children's score average in reading (353) as tested by the Programme for International Student Assessment (PISA) in 2018 and 2019 was way below the OECD average (487). This under-achievement calls for closer investigation of the factors impacting reading comprehension. Therefore, the Albanian language was chosen for this study due to its highly-transparent orthography but also to the research gap in reading construct in this language.

Chapter 2: Adapting cognitive measures to test reading comprehension in Albanian-speaking children.

2.1 Introduction

This chapter reports an experimental study that had the principle aim of coming up with suitable measures for testing reading comprehension and broader cognitive skills in Albanian-speaking children. It achieves this principally by adapting and translating into Albanian reading comprehension measures previously used in other languages.

The majority of research into reading comprehension has focused mainly on the English language. English is a language that has an opaque orthography – in which new readers, therefore, have to cope with particularly challenging rules around grapheme-phoneme correspondence. Learning to read in a language with irregular spelling rules is challenging, but this challenge is not universal – readers in languages with *transparent* orthographies are generally able to avoid it, and can focus all their cognitive resources on meeting the other challenges around reading. How this affects the other cognitive processes involved in reading is not entirely clear, since so much of what we know about reading comprehension is based on research with children whose language has an opaque orthography. To address this gap in our knowledge, this thesis sought to examine reading comprehension in a language with a transparent orthography. Albanian was chosen for this purpose as it has highly regular grapheme-phoneme mapping. However, because there has been very little research into reading comprehension in Albanian – or indeed, into cognition more broadly – there were very few available measures in Albanian. Thus, it was an imperative first step to develop suitable measures for use with Albanian children. The experiment reported in this chapter aimed to adapt a range of existing cognitive measures from other languages into Albanian. This is a necessary preliminary step prior to conducting the major experiment of this thesis reported in Chapter 3. In the next section I discuss i) the background idea of examining the two research questions of this thesis in the Albanian language and ii) the need to first adapt the experimental measures (study one) which then were used in the main study (study 2).

2.1.1. Reading comprehension and orthographic transparency

To ensure a successful construction of a coherent mental model for the text, readers have to rely on the execution and integration of many cognitive skills (Cain, Oakhill & Bryant, 2004; Kendeou, et al., 2014; van den Broek & Espin, 2012;). In particular, readers must rely on their domain-general cognitive skills to successfully process the information that is needed to construct the mental model. However, recent research has identified that the orthographic depth of a language can potentially affect the way in which domain-general cognitive processes support reading comprehension (e.g. Ehri, 2014). In particular, there is a significant difference in the rate of word recognition between languages with transparent orthographies compared to those with opaque orthographies, with word recognition much more rapid in languages with transparent orthographies (Ziegler & Goswami, 2005). This research demonstrates that the rate at which written words are read can affect other cognitive skills, since because readers spend less effort in reading words, they have more cognitive resources available to devote to the later stages of reading comprehension, and may therefore be better able to construct a robust mental model for the text. Nevertheless, the majority of the studies examining the role of domain-general cognitive processes in reading comprehension has been conducted in English, which has an opaque orthography. To determine whether or not findings based on reading comprehension in English can be generalised across other languages, there is a need to address that question looking at reading comprehension in children in a language with a transparent orthography.

Albanian is an excellent example of a language with a transparent orthography, and as such is ideal for this purpose. However, there are very few established measures of reading comprehension or of general cognitive processes suitable for use with Albanian-speaking children. Therefore, in order to test the two main research questions of this thesis - "What is the relationship between domain-general cognitive skills and higher-level reading comprehension skills at the time when children are becoming independent readers?" and "Is the relationship between domain-general cognitive skills and higher-level reading comprehension skills moderated by lower-level comprehension skills?" – it was necessary to develop or adapt suitable tasks. Thus, the main aim of the study reported in this chapter was to establish suitable tasks for use in Albanian. To achieve this, there were two main steps: first, to identify, adapt and translate into Albanian relevant existing tasks in other languages; and second, to run a pilot study to check the appropriateness of the adapted tasks.

Due to its multifaceted nature, reading comprehension requires complex methodological assessment. In particular, to test the research questions of this thesis, it was necessary to use tasks measuring cognitive skills across the following three categories: Lower-level comprehension skills, higher-level comprehension skills, and domain-general cognitive skills. However, only a few tasks measuring these skills were available in Albanian and therefore I adapted tasks used in other languages.

There were two lower-level comprehension skills to be assessed: vocabulary knowledge and reading fluency. For the vocabulary knowledge task, I adapted the British Picture Vocabulary Scale III task (BPVS: Dunn, Dunn, Styles, & Sewell, 2009). The adaptation of the task was made by translating all items from English into Albanian. For the reading fluency task, a Reading Fluency task previously adapted for use with Albanian-speaking children was used (Ellis et al., 2004). Although this task was already adapted for use in Albanian, potential dialect differences meant that it was considered necessary to pilot test the adapted version with Albanian-speaking children in Kosovo. (The reason for this was that although Albanian is spoken in both Albania and Kosovo, there are some language differences between the two countries. These differences are mainly related to the dialects: the Tosk dialect is used by the majority of the population in Albania, while the Gheg dialect is used by the population in Kosovo. Thus, to ensure that this task was suitable for use with Albanian-speaking children in Kosovo, it was necessary to test the task first and identify if further adaptation was necessary.)

To examine higher-level comprehension skills, a Reading Comprehension task consisting of written texts was required. For this purpose, a task initially developed by Oakhill (1984), and further refined by Cain and Oakhill (1999), was used. This task involved 5 short stories to be read by children, each followed by questions tapping the five higher-level comprehension skills of interest to this thesis (literal comprehension, necessary inference, elaborative inference, simile comprehension and comprehension control). This task had already been adapted for use with Greek-speaking populations by Chrysochoou (2006) (see also Chrysochoou & Bablekou, 2011; Chrysochoou, Bablekou, Kazi, & Tsigilis, 2017). This Greek-adapted version of the task was most readily available, and served as the basis for the task adapted into Albanian.

To test domain-general cognitive skills, an extensive test battery was designed (to be described fully in the next chapter). Of the tasks included in this test battery, only two tasks were particularly language-dependent, and therefore had to be adapted and translated in Albanian. The first task was the Listening Recall task, which is used to test verbal working memory. This task was adapted from the original English-language version of the task (Pickering & Gathercole, 2001). The second task was the Resistance to Proactive Interference

Task (PI). This task measures children's ability to inhibit no-longer relevant information. The task was adapted from the original English-language version of the task (Borella et al., 2010).

Working memory is the ability to hold and manipulate information in mind (Baddeley & Hitch, 1974). More specifically as it relates to reading, it is the ability to store information while at the same time processing incoming information for use in different cognitive tasks. Individual differences in working memory are known to predict reading comprehension (Oakhill, Cain, & Bryant 2004a).

2.1.1. Adaptation and translation of tasks. The goal in the adaptation and translation process was to maintain equivalence, as far as possible, between the measures in the original version and the adapted version. Equivalence between the two versions was judged based on four main steps: a) finding equivalent words and phrases; b) making sure the essential meaning was not lost; c) ensuring that the difficulty level of individual items was comparable across both versions of the task; and d) ensuring that all task items were culturally appropriate and familiar to the children. To complete these steps, the adaptation process involved three stages: i) translation of the tasks from their original language into Albanian; ii) equating the level of difficulty across both versions of the task; and iii) ensuring that all task items were culturally appropriate and familiar to the children.

The first stage of the adaptation process, translation into Albanian, involved forward translation (by which the original task was translated into an Albanian version) followed by further backward translation (by which the new adaptation was separately translated back into its original language; this was to identify any errors or mistranslations that might have occurred). For the forward translation, two qualified translators were used, to produce two independent forward-translations. The translators were instructed to provide a translation that was as close as possible in structure and format to the original language. When both versions of the forward translations were ready, both translators and the experimenter worked together to check the results of the translations, and to identify a best single forward-translation. In this way, a single version of the forward translation was produced. Then, this version was translated back into its original language. The backward translation was done by a qualified bilingual translator. The translator was instructed to check whether the translated items had similar conceptual meanings to the items in the original version of the task. When the backward translation was complete, the translator and the experimenter worked together to compare the original and the backward translated versions of the task, and to identify any problematic items, or areas where the process of translation had changed the meaning of the language used. Based on discussion between translator and experimenter, a final version of each translated task was drafted.

For the second stage of the adaptation process, equating difficulty across both versions of the tasks, the syntactical and morphological structures of all the translated tasks was conducted. For the Reading Comprehension task, it was important to retain comparability between sentence structure in the original and adapted versions of the task. To do this, a thorough analysis of the number of nouns, adjectives, adverbs, verbs, prepositions, numerical, articles and pronouns in the adapted version of the task was carried out. In addition, for each reading comprehension story. the language specialists analysed the sentence structure by identifying the types of sentences in all stories of the task was made (e.g. simple sentences, composite sentences, complex sentences), including main and subordinate clauses. After that, the structures all of the types of the sentences were compared to sentences in the original version of the task to ensure the grading criteria was similar between the two versions of the task.

For both the Listening Recall task and the Resistance to Proactive Interference task, it was important to keep the incidental working memory demands as low as possible. To achieve this, the language component was kept very simple: all words included in these tasks were short: for the Listening Recall task, only 2-syllable words were included; for the Resistance to Proactive Interference task, only 2-syllable and 3-syllable words were used.

The third stage of the adaptation process involved ensuring that the words used in the final version of the tasks would be familiar to Albanian-speaking children. This was necessary for *all* the adapted tasks (i.e. British Picture Vocabulary Scale, Reading Fluency, Listening Recall, Resistance to Proactive Interference and Reading Comprehension task). To achieve this goal, two school teachers were asked to read and check all the language used in the adapted tasks. They confirmed that in their opinion all items were appropriate for, and would be familiar to, children.

2.1.4 Testing of the adapted tasks. Following the adaptation process, the tasks were then pilot-tested in a sample of Albanian-speaking children, to assess their suitability. It is difficult to come up with a clear and unambiguously appropriate set of criteria to judge the suitability (or otherwise) of tasks adapted from one language to another. However, as a broad and relatively objective indicator of suitability, a standard criterion was set for all the tasks. Specifically, if the mean score of the data from the adapted version of the task was within one standard deviation of the mean score of the data in the comparison version of the task, then this was taken as an indication that the adapted task was broadly comparable to the comparison version, and the task was considered as adequate. In addition, descriptive data for all tasks would be assessed individually, as a means of identifying further potential adaptations.

2.2. Method

2.2.1. Participants. Sixty children participated. All participants were recruited by word of mouth from two public primary schools and one private school in Prishtina, capital city of Kosovo. All participants spoke Albanian as their first language. Children were excluded from participating if they were identified as having special educational needs, if they had been identified with a learning disability, if they spoke Albanian as a second language, or if they were bilingual.

To allow for analysis of performance by age, children were divided into two age groups (hereafter referred to as the Younger group and the Older group). The Younger group comprised 31 children (17 males, 14 females; M = 8.4 years, range = 8 years 1 month to 8 years 6 months). The Older group comprised 29 children (20 males, 9 females; M = 10.3 years, range = 10 years 1 month to 10 years 6 months). Data from two participants were removed, due to extremely poor performance in individual tasks. Thus the final data set comprised 58 participants.

The study was approved by the University of Sheffield's Department of Psychology Ethics Committee, and also by the Ministry of Education, Science and Technology of Kosovo. Parents of participating children were informed about the study, and were asked to give consent for their child to take part. In addition, all participating children were told prior to testing that they could withdraw from the study any time if they wished.

2.2.2 Design.

Tasks were administered across three sessions. The first two sessions included the testing of all the adapted tasks, and the third session included the retesting of three tasks. Retesting of tasks was considered important as it would show if the tasks have internal validity, that is the assumption that the measurements obtained in one sitting were stable over time. The first two sessions lasted around 35 minutes. In the first session, participants were tested individually. The first session comprised the British Picture Vocabulary Scale, the Reading Fluency task, the Listening Recall task, and the Resistance to Proactive Interference task, presented in a pseudorandom order. The second session comprised the Reading

Comprehension task. In this session, children were tested in groups of 15. The third session comprised the retesting of the British Picture Vocabulary Scale task, Reading Fluency, and the Listening Recall task. Due to time constraints only three tasks were managed to be retested. The interval time between the first two sessions and the session three was 15 days.

2.2.3 Material and procedure.

British Picture Vocabulary Scale task. This was a computerized task used to test children's receptive vocabulary. In this task, on each trial children were shown a series of four pictures, and heard a single word. They had to respond by pointing to the picture among the four that matched the word they heard on that trial. The task comprised 168 trials.

Adaptation of the task

The task is based on a list of 168 words, that varied systematically in their familiarity to children. All words in the list were translated from English to Albanian. The focus was to preserve the compatibility, as much as possible, between the words in the adapted version and original version of the task. More specifically, in the original version of the task, the 168 words in the list increase in difficulty. Thus the focus in adapting the task was to maintain this increase of difficulty across words.

2.2.4 Procedure. On each trial, children were shown four pictures, and heard a word read by the experimenter. The children had to point to the picture that best matched the given word. All children had a short practice to familiarize them with the task. For administration purposes, the 168 words on the task were grouped into 14 sets, containing 12 words each. The task ceased when the children failed to identify 8 words within a set. The total score was the sum of all correct responses and the maximum score was 168.

Reading Fluency task

This was a computerized task used to test children's ability to read words accurately and quickly. It lasted about 10 minutes. The task required children to spend 60 seconds reading a list of 100 words, as quickly and accurately as they can.

Adaptation of the task

Although this task was previously used with Albanian-speaking children, it was deemed necessary to test the task with Albanian-speaking children in Kosovo, to verify if the words were familiar to them.

Procedure

In this task, children sat next to the examiner facing the computer screen. Each word of the task appeared one at a time on a PowerPoint document in a computer screen. For the practice phase of the task, children were presented with a practice list of words which contained 20 items in the same font size as items presented in the main task. During the practice phase children were instructed to read as quickly and accurately as possible. For the testing phase of the task, children were presented with a sequence of words to be read. Words in the list increased in difficulty; the list comprised 51 short words (defined as words containing fewer than four letters) and 49 long words (defined as words containing five letters or more) (see Hoxhallari, 2006). The words on the list of the reading fluency task were ordered in terms of decreasing frequency of occurrence.

In the original version of the task, scoring was based on the accuracy, and reading time measured for each word. Thus the dependent variables were a) the total number of words accurately read in the first minute (see Riedel, 2007; Tilstra et al., 2009), and b) reading time per word, computed by dividing the total number of words read by the number of seconds it to the child to complete it.

Listening Recall task

This was a paper-based task which assessed children's working memory, and lasted approximately 15 minutes. In this task children were required to listen to sets of spoken sentences presented one by one, and were asked to verify if sentences were "true" or "false". In addition, for every sentence, children were required to remember the last word of each sentence. The adapted task was based on the English-language version of the task (see Pickering & Gathercole, 2001).

Adaptation of the task

All sentences in the task were translated into Albanian. To keep incidental working memory demands low, it is desirable to use short words. However, because Albanian has so few 1-syllable words, 2-syllable words were used instead (see also Chrysochoou, 2006; Chrysochoou et al., 2011; for similar adaptation in Greek). On this basis, during the adaptation of the task, 15 sentences had to be modified.

Procedure

In this task, children listened to a series of short sentences. After each one, they had to say whether each sentence was true or false. After the series of sentences had been presented, children had to recall the final word in each sentence. For example, the children might hear the sentences "Rabbits have ears" (true) and "Bananas can fly" (false). They would then have to recall the last word of each sentence in order ("ears, fly").

This task administered trials grouped into separate series, and these series increased with length across the task. The task began with a series of a single sentence. Series subsequently increased in length by one sentence at a time (up to a maximum length of 6 sentences). There was a practice trial prior to commencing the main trial. Testing was discontinued when children made three errors in a single series. The children's score was the total number of trials correctly recalled until testing was discontinued or completed.

Resistance to Proactive Interference task

The Resistance to Proactive Interference task was a computerized task which assessed children's ability to recall items presented in a list, while inhibiting items presented earlier in other lists. This task lasted approximately 20 minutes. In this task children had to silently read separate lists of words, and were then asked to recall the lists of words afterwards. Between the presentation of each list and its recall, children completed a distractor task (counting backwards by two). To accurately recall the items from the last list, children had to suppress items from earlier lists. This task was adapted based on the English version of the task used by Borella and colleagues (2010).

Adaptation of the task

All words in the original task were translated into Albanian. To keep incidental task demands low, short words were used. Because the Albanian language has few 1-syllable words, the adapted task used 2- and 3-syllable words.

Procedure

This task was presented to children on a PowerPoint document on a computer screen. This task contained 12 lists of nouns belonging to four categories: fruits, animals, body parts and occupations (so there were 3 lists per category). Each list contained four nouns from a single category (e.g. fruits). The lists were presented at a rate of one word every 2.5 seconds. Children were asked to read these words silently. Once the list of words was finished, a number appeared on the screen (e.g. 68) and children then had to count backward from that number in twos, for 30 seconds. When the counting ended, children had to recall as many words as possible (in any order).

The task had two dependent variables. The first was the total number of intrusion errors (that is, the total number of words incorrectly recalled from other list in the same category), which is considered as an index of resistance to proactive interference (Borella et al, 2010;

Hasher, Chung, May, & Foong, 2002). The second dependent variable was the total number of recalled words in each category, which captured children's ability to maintain and process relevant information in the task.

Reading Comprehension task

This was a paper-based task which assessed children's ability to comprehend written text, and which lasted 35 minutes. The reading comprehension task comprised five short stories. Each story included questions that required all five higher-level comprehension skills (i.e., literal comprehension, necessary inference, elaborative inference, simile comprehension and comprehension control). Thus, each story was followed by ten questions – two questions for each type of higher-level comprehension skill.

Literal comprehension questions tapped the ability to recall explicitly stated information in the text. Necessary inference questions tapped the ability to integrate information presented in the text with information from the reader's background knowledge, which was necessary to infer the implicit meaning of the text. Elaborative inference questions involved the ability to infer implicit information which would enhance the overall understanding of the meaning of the text. Simile comprehension questions tapped the reader's ability to interpret figurative language in the text. Comprehension control questions assessed participants' understanding of the essence of the stories' meanings.

Adaptation of the task

For the present study, the stories and questions were translated from Greek to Albanian. In the original task, the five stories increased in syntactic complexity. Thus, the adaptation process aimed to retain this (i.e. the first story had to be the simplest and the fifth story the most complex). To achieve this, the translated stories were graded according to length, syntactic structure and grammatical structure (based on Chrysochoou, 2006; Chrysochoou et al., 2017; Clark & Clark, 1977). This was achieved by counting number of words, subordinate clauses, and verb tenses, and by then comparing them to the Greek version of the task. Based on these criteria the tasks were considered to be suitably similar to the original version of the task.

Procedure

For this task, children were tested in groups of 15, and were given printed copies of the relevant stories. Each story was presented on a separate page, followed by 10 questions related to that story. The first story was used as a practice, to familiarize children with the task. Children were asked to read each story once, silently, and then to answer the 10 questions related to that story. Children were told to answer from memory, and not to look back to the story when answering questions. This procedure was repeated for all four stories. Children were allowed approximately 6 minutes to complete the task.

2.3 Results

This section reports two types of analyses: a) descriptive statistics and b) reliability analyses. Descriptive statistics were used to compare the mean scores and standard deviations between the data from the current experiment with the data from other studies using the original version of the tasks. For the reliability analyses, two types of analyses were carried out. Cronbach's alpha was run to test the internal consistency between the five types of reading comprehension questions (i.e. literal comprehension, necessary inferences, elaborative inferences, simile comprehension and comprehension control). For the other tasks, test-retest reliability analyses were carried out, to see if there was consistency between task scores taken at two different times.

2.3.1. Comparing results between the original and adapted versions of the tasks..

The following section presents comparisons of mean scores from the adapted tasks with mean scores from the original versions. If the mean scores of the adapted versions were within one standard deviation of the mean score of the original version of the task, then the task would be considered as adequately adapted. Conversely, if the mean score from the adapted version was more than one standard deviation away from the mean score in the original version of the task, then the tasks would be considered for further adaptations.

British Picture Vocabulary Scale task

The data for the adapted version of the task were compared to data using the English version of the task in a study by Mahon and Crutchley (2006). This study was chosen as the demographics of their sample closely matched those of the sample reported in this chapter (see Table 1).

Table 1. *Means and standard deviations from the adapted version and from the comparison version of the British Picture Vocabulary Scale task.*

British Picture Vocabulary Scale	**Adapted measure**		**Comparison measure**	
	Younger group (M=8.4 years) (N=29) M (SD)	**Older group (M=10.3 years) (N=29)** M (SD)	**Younger group (M=8.11 years) (N=38)** M (SD)	**Older** group **(M=9.11 years) (N=19)** M (SD)
Total number of words identified (0-168)	87.5 (19.30)	92.24 (12.23)	86.12 (2.22)	98.60 (2.80)

The minimum score was 0 and the maximum possible score was 168. The mean age (in years) is provided for each age group of the current study and of the comparison study.

The mean score of the younger group of children in the adapted version of the task (M=87.5) was within one standard deviation of the mean score of the younger children in the comparison version of the task (M= 86.12). However, data for the older group of children were less well matched. The older group of children in the Mahone and Crutchley's (2006) study were a year younger than the older group of children in the adapted version of the task; however, their mean BPVS score was higher than the mean score of the sample of the current study. Thus, based on this comparison, the task was judged not to be adequately adapted and further adaptations were deemed necessary. (These will be described further in the Discussion section.)

Reliability analysis

In terms of the test-retest analyses all three adapted tasks had high reliabilities. In the British Picture Vocabulary Scale task the test-rest reliability coefficient was .93; for the Reading Fluency task the test-retest reliability coefficient was r=.90; and for the Listening Recall task the test-retest reliability coefficient was r= .81. This shows that the adapted versions of the tasks had a strong consistency between the results in Time 1 and results in Time 2.

Reading Fluency task

To judge whether the Reading Fluency task was adequately adapted, a comparison was made looking at the total number of words children read correctly (out of 100 words). The performance of the children in the current study was compared to the performance of children in Albania in a study reported by Hoxhallari, (2006) – see Table 2.

Table 2. *Means and standard deviations from the adapted version and from the comparison version of the reading fluency task.*

Reading fluency task	**Adapted measure**		**Comparison measure**	
	Younger group (M=8.4 years) (N=29)	**Older group (M=10.3 years) (N=29)**	**Younger group (M=9.3 years) (N=60)**	**Older group (M=11.3 years) (M=60)**
	M (SD)	M (SD)	M (SD)	M (SD)

Words correctly read (0-100)	91.03 (5.49)	93.59 (10.90)	87.10 (10.16)	91.18 (10.90)

The minimum score in this task was 0 and the maximum possible score was 100. Mean age (in years) is provided for each age group of the current study and the comparison study.

The mean score of the younger group of children in the current sample (M=91.03) was within one standard deviation of the mean score of the younger group of children in Hoxhallari's (2006) study. The mean score of older group of children (M=93.59) in the current sample was within one standard deviation of the mean scores of the older group of children in Hoxhallari's (2006) study. Based on these comparisons, this task was considered to be adequately adapted, and no further changes were made.

Listening Recall task

The data from the adapted version of the Listening Recall task were compared to data from a version of the task reported by Currie and Cain (2015) (see Table 3).

Table 3. *Means and standard deviations from the adapted measure and from the comparison version of the Listening Recall task.*

Listening Recall task	**Adapted measure**		**Comparison measure**	
	Younger (M=8.4) (N=29)	**Older (M=10.3) (N=29)**	**Younger (M=8. 3) (N=43)**	**Older (M=10.2) (N=43)**
	M (SD)	M (SD)	M (SD)	M (SD)
Total number of correctly recalled words (0-36)	10.15 (2.03)	11.70(2.10)	9.72 (2.45)	11.79 (3.38)

The minimum score in this task was 0 and the maximum possible score was 36. Mean age (in years) is provided for each age group of the current study and the comparison study.

The mean score of the younger group of children (M=10.15) in the adapted version of the task was within one standard deviation of the mean score of the younger group of children (M=9.72) in Currie and Cain's (2015) study. The mean score of the older group of children (M=11.70) in the adapted version of the task was within one standard deviation of the mean score of the data from the older group of children (M=11.79) in the comparison version of the task. Therefore, the adapted Listening Recall task was considered as adequately adapted, and no further changes were made.

Resistance to Proactive Interference task

The data from the adapted version of the Resistance to Proactive Interference task were compared to data from a version of the task reported in a study by Borella et al. (2010) (see Table 4). Two dependent variables were considered. The first was the total number of intrusion errors in the task, which was an index of children's ability to inhibit no-longer relevant information. The second was the total number of recalled words in each of the three lists; this measured children's ability to maintain and process relevant information in the task. In the comparison version of the task (Borella et al., 2010), only children 10 years of age were tested. Therefore, in the next table we compare only data from participants of the same age (i.e. 10-year-old children).

Table 4. *Means and standard deviations of the adapted version and the comparison version of the resistance to proactive interference task.*

Resistance to proactive interference task	Adapted measure		Comparison measure
	Younger (M=8.4) (N=29)	**Older (M=10.3) (N=29)**	**Older (M=10.3) (N=13)**
	M (SD)	M (SD)	M (SD)
Total number of intrusion errors	1.57 (1.55)	1.48 (0.50)	1.15 (1.34)

Words recalled List 1 (0-16)	2.41 (1.82)	10.76(3.01)	11.27 (2.38)
Words recalled List 2 (0-16)	2.81 (2.81)	9.07(2.66)	9.31 (2.21)
Words recalled List 3 (0-16)	2.00 (2.03)	8.30(2.22)	6.92 (2.89)

For the dependent variable: total number of words recalled for each list, the minimum score was 0 and the maximum possible score was 16. Mean age (in years) is provided for each age group of the current data and of the comparison study.

For the total number of intrusion errors, the mean score of children in the adapted version of task (M=1.48) was within one standard deviation of the mean score in the comparison version of task (M=1.15). For the total number of recalled words, the mean scores in the adapted version were within one standard deviation of the mean scores in the comparison version of the task (List 1: adapted mean score M=10.76, comparison mean score M=11.27; List 2: adapted mean score M=9.07, comparison mean score M=9.31; List 3: adapted mean score M=8.30, comparison mean score M=6.92). Therefore, the resistance to proactive interference task was considered as adequately adapted, and no further changes were made.

Reading Comprehension task

The data from the adapted Reading Comprehension task were compared to the data from the Greek version of the task reported by Chrysochoou et al. (2011) (see Table 5).

Table 5. *Means and standard deviations from the adapted version of the task and the comparison version of the reading comprehension task.*

Reading Comprehension Questions	**Adapted measure**		**Comparison measure**	
	Younger (M=8.4)	**Older (M=10.3)**	**Younger (M=8.7) N=43)**	**Older (M=9.6) (N=49)**

	(N=29)	**(N=29)**		
	M (SD)	M (SD)	M (SD)	M (SD)
Literal comprehension (0-8)	5.6 (1.3)	6.69 (1.1)	5.23 (1.72)	5.94 (1.35)
Necessary Inference (0-8)	2.64 (1.7)	4.34 (1.95)	4.14 (2.03)	5.14 (1.81)
Elaborative Inference (0-8)	2.41 (1.82)	2.48 (.76)	4.21 (1.47)	4.86 (1.23)
Simile Comprehension (0-8)	2.81 (2.81)	3.48 (2.00)	6.26 (1.24)	6.63 (1.19)
Comprehension Control (0-8)	2.00 (2.03)	3.22 (2.53)	2.47 (2.23)	3.72 (2.37)

The minimum score in each of the reading comprehension questions was 0 and the maximum possible score was 8. Mean age (in years) is provided for each of the age group of current study and of the comparison study.

The mean scores of both the younger group and the older group of children in the adapted version of the task was within one standard deviation of the mean scores of the younger and older groups of children in the comparison version of the task across all subscales of the task (i.e. reading comprehension questions). Based on these results, the Reading Comprehension task was considered as adequately adapted, and no further changes were made.

Reliability analysis for the Reading Comprehension task

In terms of the internal consistency in the reading comprehension task, all five types of reading comprehension questions had high reliabilities with Cronbach's $\alpha = .86$. The literal comprehension questions had a reliability of Cronbach's $\alpha = .65$; Necessary Inference questions had a reliability of Cronbach's α = .73; Elaborative Inference questions had a reliability of Cronbach's α = .68; Simile Comprehension had a reliability of Cronbach's α = .75 and the reliability of the Comprehension Control questions was Cronbach's α = .70.

2.4 Discussion

The aim of this study was to establish suitable measures for examining reading comprehension in the Albanian language. To achieve this, existing tasks in other languages were adapted and translated into Albanian, and were then tested for suitability with a sample of Albanian-speaking children. Results from the adapted tasks were compared with results from comparison versions of the tasks, according to an approximate comparison criterion. This study was generally successful, as performance in most of the tasks met the suitability criterion. Overall, four of the five adapted tasks were found to be suitable for use in Albanian. However, one task, the British Picture Vocabulary Scale task, required further revision (described below).

British Picture Vocabulary Scale task – further revisions

The British Picture Vocabulary Scale task was not considered to be adequately adapted, principally because mean scores for the older group of children in the current sample were substantially lower than data from children a year younger, reported in the comparison version of the task (M=92.24 vs M= 98.60). While this difference could be attributable to sample differences, it was also potentially indicative of the adapted task inadvertently introducing more difficult items than in the original version of the task, thus leading to lower scores. Thus the adapted version was adapted further to adjust for this. Measures of vocabulary knowledge typically present items in order of increasing difficulty. In the adapted version of the task, an item-by-item analysis of performance indicated that the adapted task did not have items that consistently increased in difficulty. Therefore, to improve the suitability of the task, items were reordered so that order of presentation matched individual item difficulty. This way older children would eventually reach the ceiling level after passing sets containing words of less difficulty. (For transparency, the original order of items in the adapted task is presented in Appendix A, and the revised order of items is presented in Appendix B.)

Reading Fluency task

Results showed that the adapted version of the task met the suitability criterion compared to previous version of the tasks. (A full list of items in the adapted version of the task is shown in Appendix C.)

Listening Recall task

Results indicated that the adapted Listening Recall task met the suitability criterion compared to previous versions of the task. Based on these results no further changes were made to the task. (A full list of all items in the adapted version of the task is shown in Appendix D).

Resistance to Proactive Interference task

The Resistance to Proactive Interference task had two dependent variables: total number of intrusion errors made, and total number of recalled words in each of the three word lists. The results indicated that the performance in both measurements the suitability criterion compared to previous versions of the task (see Borella, et al., 2010). Based on these results no further changes were made to the task. (A full list of the items in the adapted version of the task is shown in Appendix E.)

Reading Comprehension task

Results showed that performance in all five types of questions in the adapted Reading Comprehension task – literal comprehension, necessary inference, elaborative inference, simile comprehension and comprehension control – met the suitability criterion for comparability with the same types of questions in the comparison version of the task. Therefore, the Reading Comprehension task was considered suitable for testing reading comprehension in Albanian-speaking children and no further changes were made to this task. (An extract of a full story and questions to the story from the adapted version of the task is presented in Appendix F. Also a detailed grading procedure is presented in Appendix G.)

In conclusion, the results of this study suggest that four of the adapted tasks (Reading Fluency, Listening Recall, Resistance to Proactive Interference and the Reading Comprehension task) were adequately adapted for use in the Albanian language. The British Picture Vocabulary Scale task was further adapted since it did not meet the suitability criterion. Following the further adaptation, all five adapted tasks were considered suitable for testing reading comprehension in Albanian-speaking children. These tasks all form part of the experimental task battery reported in the study in the next chapter.

The contribution of the work in this chapter is twofold. Firstly, with a successful adaptation of the tasks in Albanian, it is now possible to assess reading comprehension in Albanian using a variety of measures that were unavailable before. This will hopefully prove to be a valuable contribution for future researchers conducting research with Albanian-speaking populations. Secondly, the successful adaptation of these tasks means that that it is now possible to address the two questions of this thesis: a) what is the relationship between domain-general cognitive skills and the five higher-level comprehension skills at a crucial time of development, when children are becoming independent readers; and b) is the relationship between domain-general cognitive skills and higher-level comprehension skills is mediated by lower-level comprehension skills? It is these two questions to which we now turn.

Chapter 3: The relationship between domain-general cognitive skills and reading comprehension

3.1 Introduction

This chapter reports a study aiming to better understand how reading comprehension happens in children. In particular, this study had two research questions: a) what is the relationship between domain-general cognitive skills and higher-level reading comprehension skills at the time when children are becoming independent readers? and b) is the relationship between domain-general cognitive skills and higher-level reading comprehension skills moderated by lower-level comprehension skills?

To address these questions, the current study uses an extensive test battery. This approach, although necessarily complex, would allow for the fullest account of how reading comprehension develops. Importantly, the context for this study was to look at reading comprehension in a language with a transparent orthography (specifically, the Albanian language), and at a crucial time in development – the point at which children are becoming fully independent readers. Therefore, this study examined two age groups: 8- and 10-year-old readers of the Albanian language.

Reading comprehension is the process by which readers process a written text, understand its meaning, and integrate it with what they already know. To achieve this, the reader builds a coherent representation of the meaning of a text, also known as the mental model for the text (Kintsch, 1988). This is a complex process, and one that mainly relies on the reader's ability to integrate (i) information that is presented within the written text with (ii) information that is external to what is presented, but that is relevant and necessary for making sense of the text read (van Dijk & Kintsch, 1993). Therefore, in order to fully understand a written text, the reader must interact with that text in such a way that he/she not only extracts information directly from it, but also brings their own previous experience to bear, to successfully interpret, contextualize, and ultimately comprehend the text.

Given its complexity and multi-dimensionality, researchers have tended to operationalize reading comprehension by considering it to be made up of two distinct sets of reading skills: lower-level comprehension skills, and higher-level comprehension skills (e.g. Fender, 2001; Grabe, 2009; Koda, 1992; Nassaji, 2003). Lower-level comprehension skills focus on the basic, fundamental process of transforming written information into phonological information, allowing a reader to read printed words accurately and efficiently, as well as to identify the meaning of those words. Thus, broadly speaking these skills include word recognition, reading fluency and vocabulary knowledge. (e.g. Nagy, Herman, & Anderson, 1985; Perfetti, 1985; Fuchs, Fuchs, Hosp, & Jenkins, 2001;). Conversely, higher-level comprehension skills focus on building up a coherent overall sense of the text's meaning, enabling the reader to integrate information explicitly stated in the text with information from the reader's prior knowledge, so as to build a successful mental model for the text (Kendeou, et al., 2014; van den Broek, 1997). These higher-level skills include literal comprehension, drawing necessary inferences, drawing elaborative inferences, simile comprehension and comprehension control.

Although lower-level comprehension skills and higher-level comprehension skills interact with each other in the process of reading comprehension, they are considered to be dissociable skills. This chapter will consider both types of skill, but will focus chiefly on seeking to better understand higher-level comprehension skills. Higher-level comprehension skills are essential for building a successful representation of the text (e.g. Silva & Cain, 2015). They provide coherence to the mental model for the text, by allowing a reader to establish relationships between information explicitly stated in the text, information that remains implicit in the text, and information that the reader themselves already possesses (Cain & Oakhill, 1999;

Kintsch, 1998; van den Broek, 2014). Higher-level comprehension skills are complex, and occur at the later stages of reading comprehension (e.g. Luna, Garver, Urban, Lazar, & Sweeney, 2004). Moreover, the extent to which each of these skills is required in reading comprehension can vary greatly, according to the specific demands of a given text. Necessarily, therefore, this means they are less well understood than simpler, earlier-occurring aspects of reading comprehension. This experiment focuses on the five higher-level comprehension skills known to be essential to the process of reading comprehension: literal comprehension, necessary inferences, elaborative inferences, simile comprehension and comprehension control (Oakhill & Cain, 2007).

All five higher-level comprehension skills are crucial processes in reading comprehension, and each plays a distinct role in the process of constructing a mental model for the text. To briefly outline the roles of each of these higher-level comprehension skills: Literal comprehension helps the reader to understand the main ideas of the text – for example, understanding the main characters and their motives – based on the information that is explicitly stated in the text (e.g. Silva & Cain, 2015). However, to construct a coherent representation of the text, the reader will have to rely on his/her ability to draw inferences by interacting between the text and their background knowledge. Thus, drawing an inference, referred to also as inference generation, describes when the reader uses his/her background knowledge to identify relevant information that is not explicitly stated in the text (e.g. Kendeou, 2008). To illustrate, we look at an example given by Kintsch and Rawson (2005): 'Fred parked the car. He locked the door'. Readers must infer that the 'door' is the car's door, based on their general knowledge that cars have doors.

There are two distinct kinds of inference that may need to be drawn during the reading comprehension. Necessary inferences are inferences that the reader has to make in order to understand the essential meaning of a text. Conversely, elaborative inferences are inferences that are not necessary to understand the basic informational content of the text, but which enrich the mental model by providing additional contextual information (Oakhill, Cain & Elbro, 2014). If a text contains figurative or non-literal language, then the reader will rely on simile comprehension to help them to understand the author's intended meaning (e.g. Godbee & Porter, 2013). Finally, to ensure that the overall comprehension of the text is accurate and coherent, the reader relies on their comprehension control (e.g. Dunlosky & Metcalfe, 2009). This ability essentially plays a monitoring and checking role, and helps the reader to identify and to remedy any inconsistencies of meaning or understanding that may have arisen in the process of trying to read and understand a written text.

3.2 Higher-level comprehension skills and domain-general cognitive skills

Given their central importance in reading, researchers have made extensive attempts to understand these higher-level comprehension skills. In particular, these research efforts have focused on the crucial enabling roles played by other domain-general cognitive skills not specific to reading. The majority of these studies have found that higher-level comprehension skills are underpinned by specific domain-general skills, notably working memory and executive functions (e.g. Cain, 2006; Currie & Cain, 2015; Iglesias-Sarmiento, Carriedo-Lopez, & Rodriguez, 2015, Nation & Pimperton, 2010; Potocki et al., 2017). Working memory is the ability to represent, maintain and process information in mind (e.g. Baddeley & Hitch 1974). Executive functions are a set of cognitive control processes that modulate the dynamics of human cognition (e.g. Miyake et al., 2000). According to arguably the most influential model of executive functions, there are three distinct functions: a) updating, or the ability to briefly store and revise information with newly coming information; b) inhibition, or the ability to suppress the no-longer relevant for the ongoing task; and c) cognitive flexibility, or the ability to flexibly switch attention between different demands of the task. The contribution of both working memory and executive functions to the five higher-level comprehension skills can perhaps best be understood through the way in which they allow the reader to control the information needed to construct the mental model.

3.2.1. Working memory and higher-level comprehension skills

Working memory is fundamental to many aspects of cognition, and is thought to play a variety of key roles in reading comprehension – including helping the reader to store the information presented in sentences, to process new information that arises during the reading process, and to retrieve relevant information from their background knowledge. Empirical evidence has shown that working memory predicts reading comprehension performance in children between 9 and 15 years of age (Cutting, Materek, Cole, Levine, & Mahone, 2009; Nouwens, Groen, & Varhoeven, 2016; Seigneurich & Ehrlich, 2005; Sesma, et al., 2009). For example, in a three-year longitudinal study of reading comprehension in French-speaking children, Seigneuric and Ehrlich (2005) found that the contribution of working memory capacity to reading comprehension increased between 7 and 10 years of age. In particular, the findings of this study showed that working memory capacity at the age of 8 significantly predicted reading comprehension at the age of 9. These findings are consistent with the idea that children who perform well on working memory tasks are better at building a coherent mental model for the text than children with poorer working memory.

Working memory has also been shown to play a direct role in enabling some – though not all – higher-level comprehension skills. Notably, it appears to play a role in both inference generation and comprehension control. For example, working memory significantly predicted inference generation in 10-year-old children – even after word recognition skill, vocabulary knowledge and syntactical skills were controlled for (Potocki et al., 2017). In this study, working memory scores accounted for an additional 4% of the variance in an inference generation measure. When differentiating between necessary and elaborative inferences, Currie and Cain (2015) found that working memory measures significantly predicted necessary inferences in 6-year-old children, and elaborative inferences in 6-, 8- and 10-year-old children. Together, these studies indicate that working memory is important when drawing inferences of both types, by allowing the reader to process information presented in the text and integrate it with necessary information from their background knowledge (in the case of necessary inferences) as well as with background knowledge information that is not necessary, but which helps the reader enrich their mental model for the text (in the case of elaborative inferences).

In a similar line of research, working memory was also found to significantly predict comprehension control in 8- and 9-year-old children (Chrysochoou et al., 2011). In this study, comprehension control was assessed by asking children questions that deliberately included some information that was incompatible with the gist of the story. To respond correctly, children had to detect the inconsistencies presented in the question, and correct them based on their comprehension of the text. The findings of this study demonstrated that working memory supports reading comprehension also by enabling the reader to monitor and adapt his/her own comprehension of the text, and to take steps to remedy any inconsistencies that, if left uncorrected, could lead to an inaccurate mental model for the text.

In contrast, however, the same study found that working memory did *not* play a role in either simile comprehension or literal comprehension (Chrysochoou et al., 2011). In the study, the reading comprehension test battery included questions tapping literal comprehension and simile comprehension, but working memory did not predict performance on either measure. This lack of an association between working memory and literal comprehension may not be all that surprising; it could be because literal comprehension requires the processing of information presented explicitly in the text, with little or no reliance on the reader’s background knowledge. If that were the case, then there would be less need to use working memory to integrate distinct sources of information. However, the finding that working memory does not predict simile comprehension in children is rather more surprising, considering that simile comprehension requires the reader to hold in mind information presented by the simile, and at the same time integrate it with information activated from the reader's background knowledge. For example, in the following simile "the girl is like a butterfly" one might expect working memory to help the processing of information presented in the sentence containing the simile, but also to play a crucial role in retrieving necessary information from long-term memory (that butterflies represent lightness and transience). However, such an account would seem at odds with these results. Future studies looking at the relationship between working memory and simile comprehension would give a clearer picture of whether this is a reliable finding, or whether in fact working memory does have a role to play in understanding similes.

3.2.2. Executive functions and higher-level comprehension skills

Executive functions are important domain-general control processes, and there is a range of evidence to suggest that the three chief executive functions play distinct roles in reading comprehension (e.g. Cain et al., 2004; Cutting et al., 2009; Kieffer et al., 2013; Locascio, Mahone, Eason, & Cutting, 2010). It should be noted that there is some conceptual overlap between aspects of Baddeley and Hitch's working memory model, and aspects of Miyake's executive function model – notably, there is some similarity between the coordinating function of the central executive in Baddeley and Hitch's model, and the updating function in Miyake's model. It should also be noted that the Baddeley and Hitch model has been very influential in understanding reading comprehension (e.g. Kieffer et al., 2013; Nouwens et al., 2016). However, considering the three executive functions separately has the potential to shed important light on the specific way in which reading comprehension is achieved, since updating, inhibition and cognitive flexibility allow quite distinct cognitive processes to be achieved – all of which have the potential to play an important part in reading comprehension. This is also important because previous studies examining reading comprehension have mainly tested executive functions in isolation, rather than simultaneously. Thus, following the executive function model of Miyake et al., (2000) – that is, updating, inhibition and cognitive flexibility – would allow us to explore the unique contribution of each of the three core executive functions to reading comprehension.

3.2.2.1. Updating and higher-level comprehension skills

Updating has been found to play a role in reading comprehension, specifically by helping to support inference generation. In a study of reading comprehension that involved questions tapping literal comprehension and inference generation in 10- and 11-year-old children, updating significantly predicted overall reading comprehension performance (Iglesias-Sarmiento et al., 2015). However, in this study, the two types of questions (literal comprehension and inference generation) were not separated. Rather, both were combined into a single total score of reading comprehension. This somewhat limits our scope to identify the specific role of updating to each type of question. However, in a more recent study also looking at reading comprehension in 10-year-old children, literal comprehension and inference generation were considered separately (Potocki et al., 2017). In this study it was found that updating (as measured by the N-back task) was closely related to inference generation – but was not related to literal comprehension. This suggests that when children attempt to generate inferences from the text, they rely heavily on their ability to maintain previously presented information, and to revise it with newly read information in the text. This is because extracting implicit information from the text requires not just maintaining and processing the information presented, but also carefully monitoring and selecting newly presented relevant information which must be integrated with previous knowledge in order to successfully comprehend the text (e.g. Kendeou, 2008). Conversely, in literal comprehension, in an attempt to extract explicitly stated information, readers don't rely on their updating skills but may only need to maintain and process the information presented in the text (e.g. Potocki et al., 2017).

Thus, based on a somewhat limited number of studies, there are grounds to think that updating plays an important role in inference generation. However, given the fundamental and highly versatile role played by updating in cognition more generally, it would not be surprising if updating also made further contributions to other aspects of reading comprehension. Thus, it would be important to further test the potential contribution of updating to other higher-level comprehension skills.

3.2.2.2. Inhibition and higher-level comprehension skills

Inhibition has been found to play an important role in reading comprehension, in particular because the ability to inhibit no-longer relevant information helps the reader to draw inferences about a text. To examine the association between reading comprehension and inhibition, Pimperton and Nation (2010) examined 7- and 8-year-old children using a reading comprehension task tapping both literal comprehension and inference generation. They assessed inhibition using a verbal Proactive Interference task. Children with better inhibition did better at reading comprehension than children with poorer inhibition.

This finding is consistent with the view that inhibition supports both literal comprehension and inference generation skills. However, it should be noted that in this study, children's reading comprehension scores were based on combined scores, rather than on individual scores of literal comprehension and inference generation. A more fine-grained approach was adopted by Potocki and colleagues (2017). When looking separately at scores for literal comprehension and inference generation, Potocki and colleagues (2017) found that inhibition significantly predicted performance on inference generation questions, but not on literal comprehension questions. These findings are consistent with the view that the ability to inhibit no-longer relevant information presented by the text or retrieved from the reader's previous knowledge plays a key role in reading comprehension. Thus, the role of inhibition is particularly important in inference generation tasks, where the reader attempts to integrate relevant information from the text as well as from reader's previous knowledge by suppressing information that was previously relevant but has since become irrelevant for the current task.

3.2.2.3. Cognitive flexibility and higher-level comprehension skills

Cognitive flexibility's prospective role in reading comprehension has been studied far less extensively than the other two executive functions. Nevertheless, there is some evidence to suggest that it can help reading comprehension (e.g. Cartwright, 2000; Keiffer et al., 2013), and in particular the process of inference generation (e.g. Potocki et al., 2017). To my knowledge, the role of cognitive flexibility in higher-level reading comprehension has only been examined in a single study – that of Potocki and colleagues (2017). The authors reported two experiments. In the first, cognitive flexibility was assessed in typically developing 10-year-old children using the Trail Making task. It was found that cognitive flexibility did not predict performance on either literal comprehension or inference generation measures. However, in their second experiment, they assessed cognitive flexibility in less skilled readers (aged between 8 and 15 years), using the Animal Sorting subtest from the NEPSY II. Here, cognitive flexibility performance significantly predicted reading comprehension, including questions tapping literal comprehension and inference generation. This finding indicates that cognitive flexibility may indeed play a role in supporting reading comprehension. Conceivably, when attempting to construct a mental model, the ability to shift attention between different task demands may support successful reading comprehension. However, different findings drawn from the two experiments including different populations, suggest that this speculation would benefit from further direct study.

3.3. Lower-level comprehension skills and higher-level comprehension skills

When seeking to understand reading comprehension, higher-level comprehension skills clearly play a major role. However, if we wish to understand reading comprehension as a whole, their contribution must be considered alongside the contributions from lower-level comprehension skills. Lower-level comprehension skills play a crucial role in the process of reading comprehension, both independently and through an interplay with higher-level comprehension skills (e.g. Perfetti & Adlof, 2012; Perfetti, Landi, & Oakhill, 2005). In the present experiment, I will focus on two key lower-level comprehension skills: reading fluency and vocabulary knowledge. Reading fluency and vocabulary knowledge equip the reader with the basic tools necessary to extract the meaning from the text, enabling a reader to accurately and automatically read printed words, as well as to identify their meaning during the process of reading comprehension (e.g. Hirsch, 2003). So while reading comprehension requires higher-level skills, those skills are built on the foundational ability to convert written text into a phonological form that can be understood – and the better children can deploy those lower-level skills, the easier the more complex parts of reading comprehension become. Indeed, the correlation between lower-level comprehension skills and reading comprehension in children has been clearly established (e.g. Cutting & Scarborough, 2000; de Jong & van den Leij, 2002; Klauda & Guthrie, 2008; Kneopke, 2016; Muter, Hulme, Snowling & Stevenson, 2000). For example, in an attempt to determine the predictive roles of lower-level comprehension skills to reading comprehension, a two-year longitudinal study was conducted with 4- and 5-year-old English-speaking children (Muter et al., 2000). It was found that vocabulary knowledge, word recognition and grammatical skills at age 4 predicted reading comprehension skills at age 6, which together accounted for 86% of the variance in reading comprehension performance.

More specifically, there is some evidence to suggest that lower-level comprehension skills may play a *moderating and/or mediating* role between domain-general cognitive skills and higher-level comprehension skills. For example, it has been suggested that vocabulary knowledge may aid the contribution of working memory to inference generation, because children who have good vocabulary knowledge have available more representations of words in their long-term memory; this in turn may better support accurate maintenance of information in working memory (Walker & Hulme, 1999). This theoretical view is also supported by empirical evidence. Currie and Cain (2015) found that vocabulary knowledge fully mediated the relationship between working memory and necessary inference questions in 6-year-old children (though this mediation was not found in 8-year-old or 10-year-old children). In the same study, vocabulary knowledge fully mediated the relationship between working memory and elaborative inferences in 6-, 8- and 10-year-old children. However, a slightly different pattern of results was reported in another study examining the mediating role of vocabulary knowledge. When studying the relationship between working memory and both necessary and elaborative inference generation in 8- and 9-year-old children, vocabulary knowledge was found to fully mediate the relationship between working memory and necessary inferences; however, vocabulary knowledge only partially mediated the relationship between working memory and elaborative inferences (Chrysochoou et al., 2011). This suggests that while vocabulary knowledge *can* play a mediating role between working memory and some higher-level comprehension skills, it may not do so consistently across all skills, nor across different age groups of children.

Further evidence to suggest a possible mediating role for other lower-level skills is somewhat sparse, and tends to be theoretical, rather than empirical, in nature. Theoretical accounts have proposed that reading fluency plays a crucial role in reading comprehension. For example, the verbal efficiency theory (Perfetti, 1985) posited that readers who have efficient word recognition skills are thus able to reserve greater attentional resources to focus on higher-level comprehension skills. This suggestion seems plausible. However, despite theoretical accounts suggesting a possible mediating role for reading fluency, there is relatively little empirical evidence to support this. This is largely because most of the studies examining links between reading comprehension and domain-general cognitive skills have *controlled* for the effect of reading fluency, rather than directly examining its influence. One study that did examine the possible mediating role of reading fluency found no evidence of mediation (Chrysochoou et al., 2011). This study looked at the relationship between working memory and all five higher-level comprehensions skills. Results showed that reading fluency did not exert any mediating role between working memory and any of the higher-level skills. As the authors noted, the apparent lack of mediating role could be due to the orthography of the Greek language. Greek is a transparent orthographic language with a highly regular mapping between graphemes and phonemes (e.g. Protopapas & Vlahou, 2009). It is plausible that Greek children become fully fluent in reading between the age of 6 and 7; if so, reading fluency might not play a significant role in this relationship any longer. This is an important possibility to consider, particularly given the scarcity of direct evidence on this question. Therefore, future research on the effect of reading fluency in the relationship between domain-general cognitive skills and reading comprehension is much needed.

Another rarely explored pathway in the existing research is whether reading fluency interacts with domain-general cognitive skills in predicting reading comprehension. Interactions between reading fluency and domain-general cognitive skills can be hypothesized based on LaBerge and Samuel's (1974; Samuels, 1994) theory of automatic information processing in reading. This theory posits that because attention is a limited resource that may constraint the processing of information during reading comprehension then readers' experience in basic reading skills may determine the deployment of attention in extracting the meaning from the text read. Therefore, it is plausible that the faster readers are able to decode words the less memory resources they use to achieve this task. As a result, this spare memory resources could be used to build a mental model for the text read. In support of this hypothesis, Kieffer and Christodolou (2020) in a longitudinal study examining 12 and 13-year-old children found that reading fluency significantly interacted with executive functions in predicting reading comprehension in both age groups of children. These findings indicated that the relation between executive functions and reading comprehension were higher for readers with higher reading fluency as compared to the relation between executive functions and reading comprehension in lower reading fluency readers. Therefore, it would be valuable to further examine the interactions (moderations) between executive functions, working memory and reading fluency in different higher-level comprehension skills in children.

In summary, reading comprehension in children is supported by a range of domain-general cognitive skills, which have been shown to enable a number of processes essential to higher-level comprehension skills. Of these higher-level skills, the skill that has been the subject of most research is inference generation; this has the most clearly established links with domain-general processes, most notably with working memory. Nevertheless, other higher-level skills also rely on domain-general cognitive skills, though the precise way in which they do so remains to be fully explained. Any attempt to provide such an explanation should also take account of lower-level comprehension skills, since theoretical and empirical accounts suggest that these skills may play an important mediating and/or moderating role between domain-general cognitive processes and higher-level comprehension skills.

3.4. Orthographic transparency and higher-level comprehension skills

When seeking to understand how reading comprehension may come about through the deployment of domain-general skills, a potentially crucial factor that has frequently been overlooked is orthographic transparency. Orthography refers to the conventional spelling system of a language, and in particular how combinations of letters are converted into combinations of sounds. Languages are generally grouped into one of two categories: those with transparent orthographies, and those with opaque orthographies. Transparent orthographies are those with consistent grapheme-to-phoneme mappings, and highly regular spelling rules (for example, the Finnish language). Opaque orthographies are those with much less consistent grapheme-to-phoneme mappings, and where spelling rules are much less consistent (for example, the English language).

Broadly speaking, reading comprehension happens in similar ways across opaque and transparent orthographies: written words are converted to their phonological equivalent by a dual processing route of word recognition – either through a non-lexical route, or through a lexical route (Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001; Toonman & Hoover, 1993). The non-lexical route involves converting printed words, letter by letter, into a phonological code, by applying the role of mapping graphemes onto phonemes. This route is especially important for beginning readers, since they recognize very few words, and therefore rely on sounding out words, letter by letter. The non-lexical route enables them to decode – that is, to read – new and unknown words based on single grapheme-phoneme mapping (Kneopke, et al., 2014). On the other hand, the lexical route becomes increasingly useful as readers get more experience. It enables readers to recognize words as whole units, without needing to use grapheme-phoneme mappings. The lexical route is a fast and efficient route to reading, and starts to be used by younger readers when they encounter words with high frequency (Kneopke, et al., 2014).

However, the extent to which each of these two routes are used during development varies, depending on whether a language has a transparent or an opaque orthography. In languages with a transparent orthography, written words are converted to their phonological equivalent mainly via the non-lexical route, due to a highly consistent mapping between graphemes and phonemes. Conversely, in languages with an opaque orthography, written words are converted to sounds mainly via the lexical route (Goswami, Wombert, & de Barrera, 1998; Frith, Wimmer & Landerl, 1998). That is because in opaque orthographies, graphemes do not always correspond to a single phoneme, and so using the non-lexical route may result in incorrect phonological representations of a written word. As such, in languages with opaque orthographies, readers must rely more on the lexical route, by memorizing spelling patterns in order to build up a lexicon of words that they can access easily.

As a result of this fundamental difference between transparent and opaque orthographies, there are also likely to be important differences in how reading comprehension happens in those two kinds of language (e.g. Seymour, 2005; Seymour, Aro, & Erskine, 2003). Most notably, we would expect to see differences in the speed of recognizing written words in young children. Indeed, in a study comparing a highly orthographically transparent language (Albanian) with two highly orthographically opaque languages (Welsh and English), it was observed that 7-year-old Albanian-speaking children became more skilled in reading fluency and accuracy earlier than Welsh- and English-speaking children (Hoxhallari, van Daal & Ellis, 2004). Similarly, a study examining word recognition speed between German (which has a transparent orthography) and English reported a clear advantage for German children, meaning that German-speaking children made fewer errors in reading nonsense words than did the English-speaking children (Wimmer & Goswami, 1994). This suggests that the role of reading fluency may well differ according to the orthography of the language. As a result, there may also be orthography-related differences in the specific higher-level mechanisms that underpin reading comprehension.

For example, in languages with transparent orthographies such as Finnish, Italian and German, children become accurate and fluent in word recognition skills by the end of the first school year (around 5 or 6 years of age) (Seymour et al., 2003). As a result of the relatively early development of this lower-level comprehension skill, these children may not need to expend much effort on the word recognition stage of reading comprehension. Consequently, this may mean that they have surplus available cognitive resources with which to engage with other (potentially more complex) aspects of reading comprehension. In contrast, young readers of languages with opaque orthographies may need to expend considerably more effort on word decoding – or perhaps on dealing with the consequences of decoding a word incorrectly. This may have important consequences when they then subsequently try to deploy higher-level comprehension skills. Thus, there may be important interactions between orthography and lower-level reading skills. Considering the sparseness of literature on this possible moderating role of reading fluency, further research to shed light on this role would be extremely valuable.

In sum, while we know that some key aspects of reading comprehension rely on the basic, fundamental process of transforming written information into phonological information, and also on domain-general cognitive skills, there are still a number of important questions unanswered. First, we still don't know the extent to which all the higher-level comprehension skills rely on domain-general cognitive skills. Second, we don't know whether previously reported roles played by domain-general skills – based on studies where these skills are tested in isolation – are robust, and whether these findings will replicate when multiple domain-general skills are tested together. Third, we do not know if the contributions of domain-general cognitive skills to higher-level comprehension skills are direct, or whether they are moderated by lower-level comprehension skills (specifically reading fluency and vocabulary knowledge). Fourth, we still lack a clear picture of how in a language with a highly transparent orthography, domain-general cognitive skills and lower-level reading skills contribute to higher-level comprehension.

Addressing all of these questions across the full span of development, from early childhood to adulthood, would likely be beyond the practical scope of a single study. However, arguably the most important stage in the development of children's reading comprehension is the period when children start to develop the ability to read written texts independently. Although the ability to comprehend written text first emerges in early childhood, at around 4 years of age, at this stage reading is an extremely slow and laborious process. Reading for pleasure is still some years off, or else it relies on an adult or older child to read stories for these children. In contrast, once lower-level comprehension skills have been sufficiently practiced, children are able to read independently, and must, therefore, rely entirely on their own skills to follow a written story, or to work out the meaning of a text. This skill starts to emerge at around the age of 8 years; children around this age are undergoing a transition from being dependent readers to becoming independent readers. They likely possess all the higher-level comprehension skills that they require for reading comprehension, though these are not likely to be so well practiced that they become automatic. Therefore, the role of domain-general skills is likely to be particularly important. Consequently, the following experiment was conducted with two age groups: children aged 8 and 10 years of age.

3.5. Aim of the study

This experiment sought to better explain how reading comprehension happens in 8- and 10-year-old children, and to address the four specific gaps in our understanding. To do this, an extensive test battery was designed, to assess (a) reading comprehension, including the five different higher-level comprehension skills of interest to this thesis; (b) domain-general cognitive skills (i.e. working memory and executive functions); and (c) lower-level comprehension skills (specifically reading fluency and vocabulary knowledge). From a methodological standpoint, there are three notable aspects of this study. First, unlike most previous studies in this area, it examined all domain-general cognitive skills simultaneously, in order to better identify what variance in reading comprehension should be attributed to each specific domain-general cognitive skill. To achieve this, individual tasks designed to test each of the domain-general cognitive skills were used. To measure working memory capacity, the current study uses a measure of Listening Recall from the Working Memory Test Battery of Children (Pickering and Gathercole, 2001). This task was chosen because different studies have found that processing capacities tapped by working memory tasks, especially in the semantic domain, are important in explaining variance in reading comprehension in children (Daneman & Merike, 1996; Nouwens, et al., 2016).

To measure updating, this study uses the N-back task which is known to measure the ability to efficiently revise the contents of working memory and has been widely used with children (see Im-Bolter, Johnson, & Pascual-Leone, 2006; Whitely & Colozzo, 2013). In this study inhibition is measured with two different tasks, each measuring a distinct inhibition-related function (Friedman & Miyake, 2004). The Eriksen Flanker task is used to measure the ability to suppress simultaneously presented irrelevant information, also known as Resistance to Distractor Interference. The Resistance to Proactive interference task is used to measure the suppression of no-longer relevant information (see Borella, et al., 2010). Cognitive flexibility is measured by the Switching Inhibition and Flexibility Task (Blakey, Visser, & Carroll, 2016), because this task gives us two indices of the measure of cognitive flexibility: in one hand it shows us how are children able to switch from one rule to another – or the switch cost, and on the other hand it allows us to see how children are able to monitor the need to switch from one rule to another – or the mixing cost.

In addition, this study also uses the Raven's Colour Progressive Matrices test, which is a task used to measure children's non-verbal intelligence. This task was used, because in examining reading comprehension it is potentially informative to measure children's general intelligence.

The second notable aspect of this study is that it focused on reading comprehension in a language with highly transparent orthography (specifically, Albanian). In the Albanian language there is a highly regular mapping between graphemes and phonemes, allowing Albanian-speaking children to develop their reading fluency skill in the first years of education (6 to 7 years of age). Thus, by testing reading comprehension in this population, we would be able better understand how reading comprehension is achieved in a language with highly transparent orthography. The third notable aspect of this study is that in order to provide as full an account of reading comprehension as possible, this experiment also examined the possible moderating role of key lower-level comprehension skills in the relationship between higher-level comprehension skills and domain-general cognitive skills.

While the task battery approach would allow for a broad exploratory study of reading comprehension in newly independent readers, there are a number of *specific* predictions that follow on from previous research. First, because higher-level comprehension skills depend upon the control of information on which the construction of the mental model relies (e.g. Kendou, et al., 2014), it was predicted that most of these higher-level skills will be underpinned by domain-general cognitive skills (i.e. working memory, updating, inhibition and cognitive flexibility). More specifically, it was predicted that domain-general cognitive skills will make a greater contribution to the four higher-level comprehension skills that require integration of information from the text with reader's previous knowledge (i.e. necessary inferences, elaborative inferences, simile comprehension and comprehension control), as compared to literal comprehension, which relies on the extraction of information explicitly stated in the text. Finally, since the Albanian language has a transparent orthography, it was predicted that reading fluency would be an important contributor in the relationship between domain-general cognitive skills and higher-level comprehension skills – but only in young readers. Furthermore, it was expected that this relationship will be significantly moderated by the contribution of vocabulary knowledge in both age groups of children.

3.3 Method

3.3.1. Participants. One hundred and seventy-six children participated in this study (M = 9 years, 10 months; range = 8 years, 2 months to 10 years, 5 months). For subsequent analysis, participants were divided into two groups, based on age (referred to as the Younger group and the Older group). The Younger group comprised 96 children (41 males, 45 females; M = 8 years, 4 months; range = 8 years, 2 months to 8 years, 6 months). The Older group comprised 90 children (37 males, 53 females; M = 10 years, 3 months; range = 10 years, 1 month to 10 years, 5 months).

Participants were recruited by word of mouth from three public primary schools and one private school in Prishtina, Kosovo. All participants spoke Albanian as their first language. Children were excluded from participating in the study if they had been enrolled in a special education class, if they had been identified with a learning disability, or if Albanian was not their first language. Bilingual children were also excluded from the study since some findings have suggested that bilingual children have better executive functions than monolingual children (e.g. Bialystok, 1999).

The study was approved by the University of Sheffield's Department of Psychology Ethics Committee, and also by the Ministry of Education, Science and Technology of Kosovo. Parents of participating children were informed about the study, and were asked to give consent for their child to take part. In addition, all participating children were told prior to testing that they could withdraw from the study at any time if they wished.

3.3.2. Design. Tasks were administered across three sessions, each lasting around 45 minutes. The first session comprised the British Picture Vocabulary Scale task, the Reading Fluency task, the Listening Recall task, the Resistance to Proactive Interference task and the Raven's Coloured Progressive Matrices test. The second session comprised the N-back task, the Eriksen Flanker task, and the SwIFT task.. In the first two sessions, children were tested individually in their schools. The third session comprised the reading comprehension task, involving stories and questions tapping the five higher-level comprehension skills (literal comprehension, necessary inferences, elaborative inferences, simile comprehension and comprehension control). For this session, children were tested in groups of approximately 15 participants, administered in the participants' schools. In the first two sessions, the tasks were presented in a pseudo-random order..

3.4 Material and Procedure.

3.4.1. British Picture Vocabulary Scale. This task assessed children's vocabulary knowledge, and lasted around 15 minutes. The procedure was similar to that described in Chapter Two, with the single difference that based on the results of Chapter Two, the order of individual items was rearranged, in order to ensure that items increased in difficulty as the task progressed (see Appendix H for a full list of word items; rearranged words are shown in bold).

3.4.2. Reading fluency task. This task assessed the ability to read words efficiently, and lasted around 10 minutes. The procedure was identical to that described in Chapter Two.

3.4.3. Listening Recall task. This task assessed children's verbal working memory, and lasted around 15 minutes. The procedure was identical to that described in Chapter Two.

3.4.4. Resistance to Proactive Interference task. This task assessed children's ability to suppress the activation of no-longer relevant information, and thus to resist memory intrusions. This task lasted around 20 minutes. The procedure was identical to that described in Chapter Two.

3.4.5. Raven's Colour Progressive Matrices test. The Raven's Colour Progressive Matrices test was a computerized task used to assess children's non-verbal intelligence, and lasted 10 minutes. In this task children were presented with 36 trials. Each trial presented a series of images of abstract shapes, which together formed a logical pattern. One image was missing. (See Figure 1 for an example.) Children needed to identify which picture (from six possible response options) completed the pattern

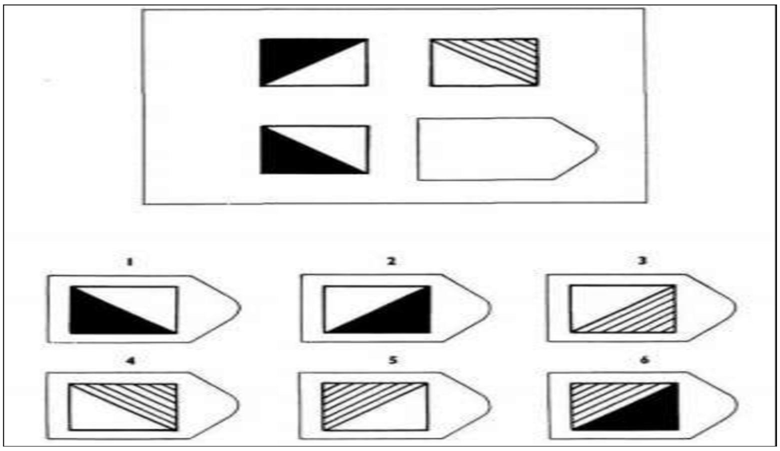


Figure 1. *Example image of a trial from the Raven's Coloured Progressive Matrices test.*

The child sat next to the experimenter facing a computer screen, and was told that they were going to play a game where they needed to find the missing picture that matched the other pictures on the screen. A picture appeared on screen showing both the group of abstract shapes, and the series of possible responses that could be used to complete the sequence. The child was told to choose the single image from six alternatives that best completed the sequence. Each response option was numbered from 1 to 6, and children were asked to say the number that corresponded to the figure he/she selected. The task began with a single example trial, followed by 36 test trials in total. The dependent variable was the total number of correct answers given out of 36.

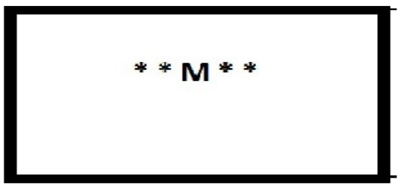
3.4.6. N-back task. This was a computerized task which assessed children's updating skill. The task lasted around 15 minutes. In this task, children were shown a series of numbers, presented one at a time. Each time a new number appeared, children had to decide whether that number was identical to the number presented two steps previously. Children were required to press a key whenever the number on screen was identical to the number presented two steps previously – but to make no response if the number on screen was different to that presented two steps previously.

3.5 Procedure.

The child sat next to the experimenter facing the computer screen. A series of numbers appeared on a computer screen, presented one at a time, and the child was asked to respond when the current stimulus matched the one that had appeared two steps earlier in the sequence. This was done by pressing a key on the keyboard. The number sequence comprised the digits 4, 6, 8, and 9. Each stimulus was presented for 500ms, and the next stimulus was presented 2500ms later. The task began with a practice block of 20 digits (including 7 targets), followed by a test block of 60 digits (including 20 targets). The dependent variable was the total number of correct responses (correctly recognized and correctly ignored), which was calculated by subtracting the number of false alarms with the number of hits (e.g. Snodgrass & Corwin, 1988).

3.5.1. Eriksen Flanker Task. This was a computerized task which assessed children's ability to suppress irrelevant information, and which lasted 15 minutes. In this task, children were shown a row of five stimuli, and had to make a response (pressing a mouse button) based only on the central stimulus – in other words, they needed to ignore the flanker stimuli. The target stimulus was a letter (either A or M). The stimuli remained on screen until the children made a response. This task included three different types of trial, which differed according to the type of flanker. These were: neutral trials, compatible trials, and incompatible trials. In all three conditions, the target letter was flanked by two distractors on each side. The flanker stimuli were either: (a) asterisks (neutral trial) (b) matching letters (compatible trial), or (c) different letters (incompatible trial) (see Figure 2 for examples).

a) Neutral trial



b) Compatible trial

c) Incompatible trial

Figure 2. *Example stimuli for the three trials of the Eriksen Flanker task (neutral, compatible and incompatible trials*)

3.5.1.1. Procedure. Children were told that on each trial, they would see 5 letters, but that they should only respond to the central letter (A or M). If the central letter was "A", they should press the left mouse button. If the central letter was "M", they should press the right mouse button. Children were told to respond as quickly and accurately as possible. Each trial began with the presentation of a blank screen (1000ms) followed by a fixation point (500ms), then the stimulus for that trial appeared. The stimulus remained on the screen until a response was made. All stimuli were black and presented on a white background.

The task began with a practice block of 24 trials, with feedback, followed by the test phase. This was split into three blocks, each containing 24 trials, without feedback. For each trial, accuracy and reaction time measures were recorded. The dependent variable was computed as the reaction-time (milliseconds) difference between compatible trials and incompatible correct trials. The smaller this difference, the better the child's ability to suppress distracting information.

3.5.2. Switching, Inhibition and Flexibility Task (SwIFT). This was a computerized task which assessed cognitive flexibility, and which lasted 15 minutes. In this task, children were shown two colorful shapes, and were told to pick the one that matched a third colourful shape, according to either its colour or its shape. The task began with two "pure" blocks, in which stimuli were sorted by one rule only (Shape, then Colour – or vice versa). In the third, "mixed" block, stimuli were sorted by both rules – Shape and Colour – with the to-be-sorted rule varying pseudorandomly. An example of a trial is shown in Figure 3.

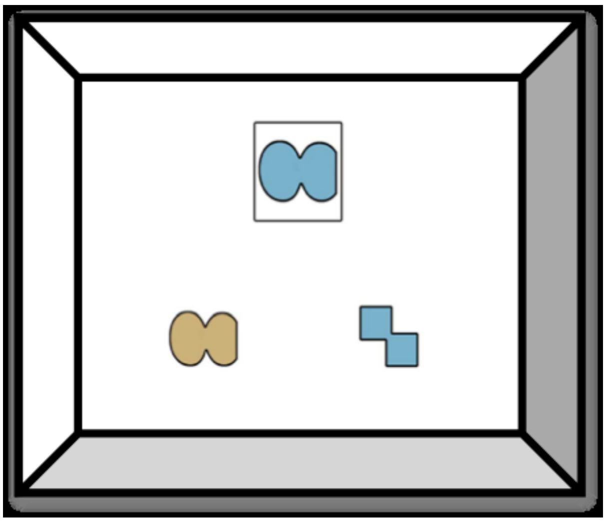


Figure 3. *The stimulus array in the SwIFT. The prompt stimulus (top) appears first, followed by the response stimuli (bottom).*

3.5.2.1. Procedure. The child sat next to the experimenter facing the computer screen. Instructions were presented on the screen. If needed, the experimenter also explained the instructions verbally. The child was told that some colourful pictures would appear on the screen, and that he/she should find a match for the top picture, either according to its shape or to its colour. To select the picture on the left, the child should press the letter “Z” on the keyboard. To select the picture on the right, the child should press the letter “M” on the keyboard. The child was told to respond as quickly and accurately as possible.

Each trial began with an empty box at the top of the screen, within which the prompt stimulus would appear. After 500ms, the prompt stimulus appeared at the top of the screen. After a randomly determined interval of between 1500 and 2250ms, the two response stimuli appeared at the bottom of the screen (see Figure 3). When the child pressed a key to respond, the relevant response stimulus flashed to indicate that a response had been registered.

When analyzing performance on switching tasks, there are two distinct indices of performance of general interest, *switch costs* and *mixing costs.* Switch costs reflect the processing cost needed in order to switch from sorting by one rule to sorting by another rule, at a trial-by-trial level. Mixing costs, on the other hand, reflect the processing cost needed to maintain the *possibility* of switching rules, even if no actual rule switch takes place. Switch costs were calculated by subtracting the mean reaction time on switch trials (in seconds) (that is, trials on which the sorting rule was different to that of the previous trial) from the mean reaction time on non-switch trials (in seconds) (that is, trials on which the sorting rule was the same as on the previous trial). Mixing costs were calculated by subtracting the mean reaction time on non-switch trials from the mean reaction time (in milliseconds) on pure block trials (that is, comparing non-switch trials where a switch *could* have occurred, with non-switch trials where a switch *could not* have occurred).

3.5.3. Reading Comprehension test battery. This task assessed children's ability to comprehend written texts, and lasted around 30 minutes. The test battery included five short stories (one practice and four assessment stories) and every story was followed by 10 questions. These questions assessed each of the five higher-level comprehension skills of interest to this experiment, with two questions per skill. The procedure was identical to that described in Chapter Two. (See an extract of a full story with all types of questions in Appendix F).

3.6 Results.

The results of this experiment are organized into three sections: a) descriptive statistics, b) correlational analyses, and c) multiple regression analyses. This section starts with reporting descriptive statistics for all tasks, and for both age groups. Then it presents correlation analyses including all variables for both age groups. Finally, this section reports the regression analyses, which are presented separately for each of the five higher-level comprehension skills for both age groups.

Before the analyses, the Q-Q plots for all measures were examined separately for each age group. Q-Q plots provide means of assessing deviation from a normal distribution (see Cohen, Cohen, West, & Aiken, 2003). The plots indicated that the data were normally distributed and no outliers were detected. The analyses of the data of Flanker Accuracy were conducted by transforming the raw scores from all three conditions of the task (i.e. neutral, compatible and incompatible) to z scores. This was done to better understand how good or bad a score was relative to the entire group

3.7 Descriptive statistics.

Table 6. *Lower-level comprehension skills and higher-level comprehension skills measures: means (and standard deviations) for both age groups.*

Task	Younger group			Older group		
	M (SD)	**Highest**	**Lowest**	**M (SD)**	**Highest**	**Lowest**
BPVS (0-168)	79.59 (14.76)	111	46	85.51 (12.73)	114	52
Reading fluency (0-100)	60.82 (9.74)	80	0	69.32 (8.38)	95	45
Literal Comprehension (0-8)	6.58 (1.56)	8	1	7.15(1.22)	8	2
Necessary Inference (0-8)	4.01 (1.60)	8	1	4.73 (1.79)	8	1
Elaborative Inference (0-8)	3.49 (1.53)	8	1	4.28(1.45)	8	1
Simile Comprehension (0-8)	4.73 (1.52)	8	1	4.20 (1.73)	8	1
Comprehension Control (0-8)	3.78 (2.73)	8	1	4.76(2.14)	8	0

Minimum and maximum scores for each measure are shown in brackets after each task name

Table 7. *Domain-general cognitive measures: means (and standard deviations) for both age groups.*

Task	Younger group			Older group		
	M (SD)	**Highest**	**Lowest**	**M (SD)**	**Highest**	**Lowest**
Ravens (0-36)	30.11 (2.68)	35	19	31.51 (2.70)	36	25

Listening Recall	10.53 (1.63)	17	7	11.79 (2.85)	23	6
N-back (0-20)	11.80 (2.93)	17	5	13.77(3.08)	20	5
Proactive Interference (0-46)	32.91 (5.70)	42	17	34.26 (5.77)	42	17
PI/Intrusions	1.80 (1.63)	7	0	1.54(1.45)	8	0
Eriksen Flanker Accuracy score	212.65 (15.82)	229	126	214.89 (10.86)	229	183
Eriksen Flanker Reaction Time (milliseconds)	.921(2.06)	13.21	-3.49	-.844(1.28)	2.55	-3.06
SwIFT SwitchCost Accuracy (%) (seconds)	-2.73 (2.17)	4	-8	-2.37 (2.15)	3	- 7
Switch Cost Reaction Time (Milliseconds)	152.8 (961.4)	2821	-2745	-12.72 (501.2)	1558	-1262
Mixing Cost (milliseconds)	202.2 (1054)	3698	-2238	296.3 (796.3)	2951	-2491

Note: Scores from all three conditions of the Flanker Accuracy indices (neutral, incompatible and compatible) were converted to z scores.

3.8 Correlations.

To examine the interrelations between variables, correlations were conducted separately for each age group. Before running correlations, composite scores were produced for the following tasks: The Eriksen Flanker task (added up scores from neutral, compatible and incompatible trials) and the N-back task (number of correct recognized targets plus number of correctly missed targets)., This procedure was similar to that of Currie and Cain (2015), who used similar tasks. The correlation coefficients are reported based on Cohen's criteria (Tabachnick, Fidell, & Ullman, 2007), according to which correlations above .50 are considered large, correlations above .30 are considered moderate and correlations below .30 are considered small.

Table 8. *Pearson correlation coefficients among the dependent, independent and mediating variables for the Younger group of children.*

		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Ravens	-	.14	.13	.10	.12	.07	**.25***	16	-.07	-.02	-.11	-.05	.08	.18*	.20*	.10	. 24*
2. BPVS		-	-.01	.05	.10	.01	.16	.08	-.01	-14	.02	-.04	.12	.20**	**.26***	.17	- .03
3. Reading Fluency			-	.20	-.02	-.01	.15	-.05	.08	.04	-.04	-.03	**.21***	**.23***	**.24***	.16	.08
4. Listening Recall				-	**.25***	.00	.09	**-.26***	-.09	.06	-.07	-.01	.18	.05	.16	**.21***	.11
5. Flanker Accuracy zscore					-	.10	.02	-.07	-.08	.10	-.11	.11	.10	-.12	.08	**.20***	.07
6. Flanker RT zscore						-	.08	-.00	.08	-.07	.01	.07	.02	.18	.08	.06	-.04
7. N-back total correct							-	-.08	.01	.03	.02	-.11	-.03	.14	**.22****	.16	-.03
8. PI total recall								-	-.19	.00	.07	-.20	.03	.08	.01	.14	.05
9. PI total intrusions									-	-.00	.00	.10	-.05	-.13	-.07	-.01	-.07
10. Switch cost accuracy										-	-.05	-.04	.14	-.06	-.00	.07	-.07
11. Switch cost RT											-	**.50****	.02	-.02	-.17	-.00	**-.21***
12. Mixcost												-	-.13	.01	.04	.03	.18
13. Literal Comprehension													-	.44**	.27*	.49**.	.17
14.Nessary Inference														-	**.48****	**.36****	. .24**
15. Elaborative Inferences															-	**.40****	**.22****
16.Simile comprehension																-	.09
17. Comprehension Control																	-

Note: Ns = *p < .05, ** p < .01, *** p < .001

Table 9. *Pearson correlation coefficients among the dependent, independent and mediating variables for the Older group of children.*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
1. Ravens	-	**.47****	**.23***	**.43****	-.08	**-.25***	**.27***	**.25***	-.11	-.04	.00	-.04	.18	.32**	**.24****	**.43****	-.09	
2. BPVS		-	.00	**.30****	-.02	-.10	-.00	.01	-.02	-.11	.03	.07	.04	**.35****	**.16**	**.32****	- .04	
3. Reading Fluency			-	**.24***	.02	-.14	.16	.01	-.06	**.24***	-.10	.02	.13	-.04	.15	-.11	.16	
4. Listening Recall				-	**-.04**	-.26	.24	.06	-.02	.01	-.10	-.17	.32**	.21*	**.36****	**.28****	.18	
5. Flanker Accuracy zscore					-	**.21***	.03	-.03	.04	.09	.09	-.07	.05	.06	.06	-.04	.13	
6. Flanker RT zscore						-	**-.28***	**-.34***	.26	-.12	**.30****	-.11	-.15	-.21	**-.24***	**-.22***	-.09	
7. N-back total correct							-	.09	.03	.16	.04	.14	**.19**	.13	.13	**.24***	**.23***	
8. PI total recall								-	**-.26***	.16	-.07	.03	**.21***	**.28****	.14	**.35****	-.05	
9. PI total intrusions									-	.11	**.30****	.02	.01	-.11	-.08	-.05	- .05	
10. Switch cost accuracy										-	.00	.10	.15	.14	.03	.06	.05	
11. Switch cost RT											-	**-.25***	**-.29***	-.02	**-.16***	**-.18***	**- .28****	
12. Mixcost												-	.12	**.06**	.12	.05	.02	**-.**
13. Literal Comprehension													-	**.30****.	**.40****	. 34**.	**.29****	
14. Necessary inferences														**-**	**.42*****	**.47****	.14	
15. Elaborative Inferences															-	**36****	.24*	
16. Simile Comprehension																-	.09	
17. Comprehension Control																	-	

Note: BPVS= British Picture Vocabulary Scale; Flanker RT= Flanker Reaction time; PI= Resistance to Proactive Interference; Switch cost RT= Switch cost Reaction Time.

Pearson correlations for the younger group of children as seen in table 8 show that all three moderating variables moderately correlate with the five higher-level comprehension skills. Ravens moderately correlates with inference generation and comprehension control, BPVS moderately correlates with inference generation and Reading Fluency moderately correlates with literal comprehension, inference generation and simile comprehension. Among the executive function measures, Listening Recall and Eriksen Flanker moderately correlate with simile comprehension while Switch cost only correlates with comprehension control.

Pearson correlations for the older group show that Ravens and BPVS significantly correlate with inference generation and simile comprehension. In the older group of children, both inhibition measures, PI and Eriksen Flanker correlate with inference and simile comprehension, but the correlation between PI and elaborative inference and simile comprehension is stronger than that of Eriksen Flanker and the two. Switch cost strongly correlates with <comprehension control but only moderately with inference generation and simile comprehension. As seen in table 9, Listening Recall strongly correlates not just with inference generation and simile comprehension but also with literal comprehension.

In general, in the younger group significant correlations are found between the measures of lower - level skills and higher-level comprehension skills, while in the older group significant correlations exist also between executive functions measures and higher-level comprehension skills measures.

3.9 Multiple regression analyses.

Fixed-order hierarchical multiple regression analyses were conducted to test the two research questions of this experiment: a) what is the relationship between domain-general cognitive skills and higher-level reading comprehension skills at the time when children are becoming independent readers; and b) is the relationship between domain-general cognitive skills and higher-level reading comprehension skills moderated by lower-level comprehension skills? To answer these questions, a series of five regressions were conducted for each age group, with each regression testing the prediction of all the independent variables (domain-general cognitive skills) to each of the five dependent variables (i.e. the five higher-level comprehension skills) separately. In total, 10 regression analyses were conducted. Each regression comprises two models: Model 1, which shows the prediction of the independent variables to each of the dependent variables; and Model 2, which shows the *interaction* between moderating variables and independent variables in predicting the dependant variable. To see which moderators interacted with independent variable in predicting dependent variables, only moderators that significantly correlated with dependent variables were entered in model of regression analyses.

3.9.1. Literal Comprehension. To test whether literal comprehension was predicted by domain-general cognitive skills, a multiple regression analysis was conducted. Literal comprehension was entered as a dependent variable, and all independent variables were entered as predictors to the first model of the regression. Regressions were run separately for each age group. For the Younger group a significant regression equation was found (F (1.28) = 6.48; $p<.01$) with an R^2 of .19. Working memory (β = .26, $p<.001$) was a significant predictor explaining 19% of the variance in literal comprehension performance.

For the Older group a significant regression equation was found ((F (2.84) = 23.47; p<.01) with an R^2 of .23. Working memory (β = .36, p<.001) and cognitive flexibility (β = -.21, p<.001) significantly predicted literal comprehension performance. (see Table 10).

Table 10. *Multiple regressions with literal comprehension performance as dependent variable and all independent and moderating variables.*

Age	Model	Variable	R²	Final ß	Sig.
Younger group	1	Working memory	.07	.64*	.03
		Reading fluency		.02	.10
	2	Working memory X RF	.07	.01	.10
Older group	1	Working memory	.23	.36*	.04
		Cognitive flexibility		-.21	.03
		Inhibition (PI)			.09
	2	Working memory X RF	.15*	-.2.75	.00
		Cognitive flexibility X RF	.15*	.2.44	.00

Note. Standardized beta values are given for the final model with significant predictors. ** p < .01. Note: RF = Reading fluency; RT= Reaction Time; Inhibition PI= Resistance to Proactive Interference.

In the second model of the regression only moderators which significantly correlated with dependent variables were included. For literal comprehension only reading fluency was entered as a moderator in the second model, as it significantly correlated with literal comprehension. (See model 2 for Younger and for Older children in Table 10).

For the younger group, no significant interaction was found (F (2,89) = 6.75, $p>.01$) with R^2 of .07. The results indicated that for this age group the influence of working memory to literal comprehension was not significantly moderated by reading fluency. (see Table 10).

For the older group two significant interactions were found. The first significant interaction was found between working memory and reading fluency (1,58) = 6,39, $p<.01$) with $R^2$of .15. The results indicated that for this age group reading fluency significantly interacted with working memory in predicting literal comprehension explaining 15% of the variance in literal comprehension. The second significant interaction was found between reading fluency and cognitive flexibility (F (1,29) = 6,20, $p<.01$) with $R^2$of .15. The results indicated that reading fluency significantly interacted with cognitive flexibility to predict literal comprehension for this age group of children.

3.9.2. Necessary inference. To test whether necessary inference was predicted by domain-general cognitive skills, a multiple regression analysis was conducted. Necessary inference was entered as a dependent variable and all independent variables were entered as predictors to the first model of the regression. Regressions were run separately for each age group.

For the Younger group, a significant regression equation was found (F (2,16) = 5.17, $p<.01$) with an R^2 of .12. It was found that working memory (β = .09, $p<.001$) significantly predicted necessary inference, explaining 15% of the variance in necessary inference performance. Reading fluency was also found to be a significant predictor (β = .03, $p<.001$). to necessary inferences explaining 3% of the variance in this task.

For the Older group, a significant equation was found (F (1,55) = 6.28, $p<.01$) with an R^2 of .25. Three significant predictors – Working memory (β =.12, $p<.001$), Inhibition PI (β = .03 $p<.00$) and Vocabulary knowledge (β = .02, $p<.001$). – explained 25% of the variance in necessary inference performance (see Table 11).

Table 11. *Multiple regressions with necessary inference performance as dependent variable and all independent and moderating variables.*

Age	Model	Variable	R²	Final ß.	Sig.
Younger group	1	Working memory	.12 *	.12.*	. 04
		Reading fluency		.21*	.04
	2	Working memory X RF			
Older group	1	Working memory	.25*	.40*	.03
		Inhibition PI		.22*	.03
		Vocabulary knowledge		.28*.	.01
		Reading fluency		-.11	.23
		Cognitive flexibility.		.06	.50
		Non-verbal intelligence		.10	.39
		Working memory X Voc.	.19*	.55*.	.00

Note. Standardized beta values are given for the final model with significant predictors. ** p < .01. RF= Reading fluency; Inhibition PI= Resistance to Proactive Interference, Voc = Vocabulary knowledge

To test if vocabulary knowledge and reading fluency moderated the influence of domain-general cognitive skills to necessary inference, the two moderating variables were entered into the model.

For the Younger group, a significant interaction was found (F (1,64) = 6..48, p<.01) with an R^2 of .09. The results of the regression indicated that reading fluency (β = -.18, p<.001) significantly interacted with working memory in predicting necessary inferences, explaining 9% of the variance in necessary inferences.

For the Older group, a significant interaction was found F (1,83) = 2.96, p<.01) with an R^2 of .19. The results of the regression indicated that vocabulary knowledge (β = .55, p<.001) significantly moderated the effect of working memory to necessary inference, explaining 19% of the variance in this task (see Table 11).

3.9.3. Elaborative inference. To test whether elaborative inference was predicted by domain-general cognitive skills, a multiple regression analysis was conducted. Elaborative inference was entered as a dependent variable, and all independent variables were entered as predictors to the first model of the regression. Regressions were run separately for each age group.

For the Younger group, a significant regression equation was found ($F(2,88) = 2.06$, $p<.01$) with an R^2 of .12. Updating was a significant predictor explaining 5% of the variance in elaborative inference performance ($\beta = .05$, $p<.001$), Reading fluency ($\beta = .21$, $p<.001$) was also a significant predictor and so was the vocabulary knowledge ($\beta = .22$, $p<.001$), explaining 22% of the variance in this task.

For the Older group, a significant regression equation was found ($F(2,79) = 1.35$, $p<.01$) with an R^2 of .15. Working memory was found to be a significant predictor ($\beta = .16$, $p<.001$),– explaining 5% of the variance in elaborative inference performance and also cognitive flexibility was found to significantly predict elaborative inference explaining 22 % of the variance in this task. (see Table 12).

Table 12. *Multiple regressions with elaborative inferences performance as dependent variable and all independent and moderating variables.*

Age	Model	Variable	R²	Final ß.	Sig.
Younger group	1	Updating	.12 *	.05*.	.04
		Reading fluency		.21*.	.04
		Vocabulary knowledge		.22*	.03
		Non-verbal intelligence		.11	.29
	2	Updating X RF.	.06	.05	.17

Older group	1	Working memory	.05*	.16*.	.04
		Cognitive flexibility	.09 *	.22*.	.03
		Non-verbal intelligence		.05	.66
		Inhibition (RDI)		-.17	.11
	2	Working memory X RF.	.08.	.10.	.09

Note. Standardized beta values are given for the final model with significant predictors. ** p < .01. Inhibition (RDI)= Resistance to Distractors Interference.

To test if vocabulary knowledge and reading fluency moderated the effect of domain-general cognitive skill on elaborative inference, both moderating variables were added to the regression model. The results indicated that there was no significant interactions between reading fluency and updating in the younger group of children. The results also indicated that there was no significant interaction between working memory and reading fluency in the older group of children.

3.9.4. Simile comprehension. To test whether simile comprehension was predicted by domain-general cognitive skills, a multiple regression was conducted. Simile comprehension was entered as a dependent variable, and all independent variables were entered as predictors to the first model of the regression. Regressions were run separately for each age group.

For the Younger group, a significant regression equation was found (F (1,63 =3.68, $p<.01$) with an R^2 of .07. Two significant predictors – working memory ($\beta = -.44$, $p<.001$) and inhibition (RDI) ($\beta = .22$, $p<.001$) – explained 24% of the variance in simile comprehension performance.

For the Older group, a significant equation model was found (F (1,85) = 10.27, $p<.01$) with an R^2 of .15. Three significant predictors – inhibition (PI) ($\beta = .28$, $p<.001$), working memory (β = .26, p<.001) and non-verbal intelligence (β = .24, p<.001). – explained 27% of the variance in simile comprehension performance (see Table 13).

Table 13. *Multiple regressions with simile comprehension performance as dependent variable and all independent and moderating variables.*

Age	Model	Variable	R^2	Final ß.	Sig.
Younger group	1	Working memory	.24 *	.14*.	.04
		Inhibition (RDI)		.22*	.03
	2	Working memory X Intell.	.05.	.10	.12
		Inhibition (RDI) X Intell.	.11	.09.	.07
Older Group	1	Inhibition PI	.27*	28*.	.01
		Working memory		.26*.	.04
		Non-verbal intelligence		.24*	.03
		Cognitive flexibility.		-.00	.99
		Inhibition (RDI		-.15	.18
		Inhibition (PI).		.03	.73
	2	Inhibition (PI) X RF.	.25*	.27*.	.02

Note. Standardized beta values are given for the final model with significant predictors. ** p < .01. Note RF= Reading fluency, Proactive interference X RT= Proactive interference interaction with reading fluency; Inhibition (RDI) X RF = Interaction between Resistance to Distractors Interference and reading fluency; Working memory X Intell. = Interaction between working memory and non-verbal intelligence; Inhibition (RDI) X Intell. = Interaction between resistance to distractors interference and non-verbal intelligence.

To test if and non-verbal intelligence moderated the effect of the domain-general cognitive skills on simile comprehension, it was added to the regression model.

For the Younger group, the results of model 2 showed no significant interaction between non-verbal intelligence and the domain-general cognitive skills in explaining simile comprehension.

For the Older group, a significant interaction was found (F (9,75) = 11.97; $p<.01$) with an R^2 of .25. The results of model 2 indicated that non-verbal intelligence ($\beta = .27$, $p<.001$) significantly interacted with inhibition in predicting simile comprehension (see Table 13).

3.9.5. Comprehension control. To test whether comprehension control was predicted by domain-general cognitive skills, a multiple regression was conducted. Comprehension control was entered as a dependent variable, and all independent variables were entered as predictors to the first model of the regression. Two multiple regressions were run for each of the age groups.

For the Younger group, a significant regression equation was found (F (4.42) = 1.45; $p<.01$) with an R^2 of .09. Only one independent variable, the cognitive flexibility was found to significantly predict comprehension control ($\beta = -.22$, $p<.001$)– explained 22% of the variance in simile comprehension performance.

For the Older group, a significant regression equation was found (F (3,83) = 6.04; $p<.001$, with an R^2 of .15 Three significant predictors – Working memory ($\beta = .43$, $p<.001$), cognitive flexibility ($\beta = -.24$, $p<.001$), and updating ($\beta = .25$, $p<.001$) – explained 15% of the variance in comprehension control performance (see Table 14).

Table 14. *Multiple regressions with comprehension control performance as dependent variable and all independent and moderating variables.*

Age	Model	Variable	R²	Final ß.	Sig.
Younger group	1	Cognitive flexibility	.09	-.22*	.02
	2	Cognitive flexibility X RF.	.06.	-.07	.14

Older group	1	Working memory	.19*	.43*	.03
		Cognitive flexibility		-.24*	.01
		Updating		.25*	.01
	2	Working memory X Intell.	.09*	.16*	.01
		Working memory X RF	.05*	.18 *	.02

Note. Standardized beta values are given for the final model with significant predictors. ** p < .01. Note Working memory X Intell.= Interaction between Working memory and non-verbal intelligence; Working memory X RF= interaction between working memory and reading fluency; Cognitive flexibility X RF= interaction between cognitive flexibility and reading fluency.

For the younger group of children, to test if reading fluency interacted with cognitive flexibility to predict comprehension control, reading fluency was entered as a moderator in the second model. The results indicated that there was no significant interaction between cognitive flexibility and reading fluency in predicting comprehension control.

For the older group, a significant interaction was found (F (2,93) = 7.16; p<.01) with an R^2 of .09. The results of model 2 indicated that non-verbal intelligence (β = .16, p<.001) significantly interacted with working memory in predicting comprehension control. The results also indicated that reading fluency (β = .18, p<.001) significantly interacted with working memory to predict comprehension control explaining 5% of the variance (see Table 14).

3.10 Discussion.

This study asked two main questions. The first question asked what is the relationship between domain-general cognitive skills and the five higher-level reading comprehension skills at a crucial time of development, when children are becoming independent readers. The second question was to examine whether the relationship between domain-general cognitive skills and higher-level comprehension skills is moderated by lower-level comprehension skills in Albanian, a language with highly transparent orthography.

There are three main findings that can be drawn from this study. First, working memory and executive functions significantly predict *all* higher-level comprehension skills of interest to this thesis – but they predict some higher-level comprehension skills more than others. Second, the contribution of working memory and executive functions to the five higher-level comprehension skills changes markedly as a function of age. And third, reading fluency plays a significant moderating role in helping readers use their working memory and executive functions to achieve the five higher-level comprehension skills – in contrast to what one would expect of a language with a highly transparent orthography.

The first major finding of this study is that all higher-level comprehension skills are underpinned by working memory and executive functions, but both working memory and executive functions play a more important role in some higher-level comprehension skills than others. In terms of their contribution to each of the higher-level comprehension skills, this experiment identifies three separate developmental patterns: a) literal comprehension relies on working memory and cognitive flexibility); b) both necessary inference and simile comprehension rely on working memory and inhibition; and c) both elaborative inference and comprehension control rely on cognitive flexibility, updating and working memory.

These findings are broadly, but not entirely, in line with previous research (e.g. Chrysochoou et al., 2011; Currie & Cain, 2015; Potocki et al., 2017). More specifically, the data from this thesis is consistent with previous findings showing a significant relationship between working memory and the two types of inference generation: necessary and elaborative inferences (Currie & Cain, 2015) – as well as with findings suggesting a significant relationship between working memory and comprehension control (Chrysochoou et al., 2011). The current thesis also lends support to the findings of the study of Potocki and colleagues (2017), reporting that inhibition predicted inference generation. However, different from what was found in the study of Potocki and colleagues (2017), and Chrysochoou and colleagues (2011), the current data shows that working memory plays a crucial role in helping children achieve literal comprehension and simile comprehension. Finally, this thesis reports that reading comprehension is underpinned by cognitive flexibility; specifically, this switching ability plays a role in helping children's literal comprehension, elaborative inference and comprehension control.

The second major finding of this study is that the contribution of working memory and executive functions to higher-level comprehension skills changes as a function of age for some skills – but not all. More specifically, the contribution of working memory and executive functions to literal comprehension, necessary inference, elaborative inference and comprehension control changes between 8 and 10 years of age, with older children deploying different executive functions to achieve these tasks. On the other hand, the contribution of working memory and executive functions to simile comprehension remains stable across this age range.

The third major finding of this study is that in a language with highly transparent orthography, such as Albanian, reading fluency plays an important role in explaining variance in higher-level comprehension skills directly and also through interactions with executive functions. This is surprising, because it was expected that due to highly regular grapheme/phoneme mapping, children of this language would acquire broadly fluent reading skills around the age of 6 or 7 years, and by the time they become independent readers (i.e. around 8 to 10 years of age) their reading would be sufficiently fluent that reading fluency skills would not play a major role in predicting their reading comprehension. However, the results of this study suggest that reading fluency plays a key role in helping children to use their working memory and executive functions to achieve the five higher-level comprehension tasks. This study also indicates that the role played by reading fluency becomes less important as children get older. However, it continues to contribute to some aspects of reading comprehension even in 10-year-old children.

This finding contrasts with previous research which reported that reading fluency did not play any moderating role in the relationship between working memory and higher-level comprehension skills. For example, in the study of Chrysochoou and colleagues (2011), reading fluency did not moderate the effect of working memory on any higher-level comprehension skills in 8- and 9-year-old Greek-speaking children. Albanian, like Greek, has a highly transparent orthography with a regular mapping between the grapheme and phonemes. For that reason, one might expect to find a similar pattern of findings across these studies. However, the results from this thesis suggest that in Albanian-speaking children, reading fluency plays a crucial role for both 8- and 10-year-old children. This discrepancy is somewhat surprising.

One possible explanation is that the ongoing role played by reading fluency to reading comprehension in Albanian could be due to these children's educational background: the majority of Albanian-speaking children in Kosovo do not receive preschool education, and therefore word recognition skills only start to be introduced when they start their first year of education (at around the age of 6 years). It may be that the Albanian-speaking children tested as part of the present study were relatively less experienced than the Greek-speaking children reported in the study by Chrysochoou and colleagues (2011), and that while their chronological ages were similar, the less experienced readers in the present study had not yet reached the stage where their reading fluency was fully developed. Furthermore, another speculative suggestion for the late development of reading fluency in Albanian-speaking children could be the grammatical complexity of the language. The grammatical structure of text read by children of these age groups could be an important factor to consider in the development of reading fluency skills, mainly due to length of sentences and the structure of clauses in the language used in the Albanian language. In other words, while Albanian's transparent orthography may suggest reading should be relatively easy, its more complex syntax may pose additional challenges for new readers. Thus, more research is needed to examine the role of reading fluency; such research should consider not just languages with different orthographies, but should take account of their syntactic complexity too.

To explain the current findings, the following sections will focus on each higher-level comprehension skill in turn. The discussion is organized based on the three developmental patterns identified in this study. Each developmental pattern is based on the broad combination of domain-general skills that children rely on to achieve the five higher-level comprehension skills of interest to this thesis. Thus these developmental patterns relate to: a) literal comprehension; b) necessary inference and simile comprehension; and c) elaborative inference and comprehension control. Also, in each of these patterns there will be a separate discussion on the role of moderators in the relationship between working memory, executive function and each of the higher-level comprehension skills. Following the discussions on the three developmental patterns, a separate section discusses the role of orthographic transparency in reading comprehension. Finally, an overall conclusion about the findings is presented.

3.10.1. Explaining Literal comprehension. Literal comprehension is the ability to understand information stated explicitly in the text. The results from this study show that both 8- and 10-year-old children rely on their working memory to achieve literal comprehension.

However, 10-year-old children also rely on their cognitive flexibility. This finding partially supports the hypothesis relating to literal comprehension: as expected, both working memory and cognitive flexibility predicted literal comprehension. However, contrary to what was expected, their predictive role to literal comprehension was just as great as their predictive role in other aspects of comprehension.

Literal comprehension in the younger group of children was significantly predicted by working memory, accounting for 7% of the variance in this task. To literally comprehend a text, readers must understand the main ideas presented, based on information stated explicitly in the text. Thus, in terms of how working memory specifically helps children to do this: based on the results of this thesis, it seems plausible to suggest that working memory helps children of this age group to hold in mind information read in one sentence and/or paragraph, while processing information read from other sentences or paragraphs. Thus, it could be suggested that 8-year-old children achieve literal comprehension by relying on their working memory capacity to hold and maintain explicitly stated information across a series of sentences and paragraphs, thus enabling them to build a full mental model for the text being read.

Literal comprehension in the younger group of children was significantly predicted by reading fluency accounting for 2% of the variance in this task. To understand the main ideas presented in the text, the reader must connect different pieces of information from the words, sentences and paragraphs. Thus, it is plausible that the faster children are able to decode words the better they can connect words and sentences so as to understand the literal meaning of the text read.

Literal comprehension in the older group also relied on working memory; however, in addition, these children also relied on cognitive flexibility. This suggests that the way children achieve literal comprehension changes between 8 and 10 years of age, with the older children not only relying on their ability to mentally retain and process information, but also shifting attention between different pieces of information in the text to integrate it across different sections of a text. One possible explanation for this finding is that older children likely employ a different, higher, standard of coherence as compared to younger children to understand a text. Standard of coherence refers to the criteria that the reader adopts when attempting to comprehend the text, reflecting the desired level of understanding of that text (van den Broek, Bohn-Gettler, Kendeou, Carlson, & White, 2011). Thus the standard of coherence readers set for themselves when reading a text depends on their specific goals – for example, they might want to read quickly to just get a basic grasp of the gist of a text, or they might want to take in every detail, and to focus on following all aspects of the text. The present results are consistent with the idea that at age 10, children are able to set higher goals for themselves when reading. The present results are consistent with the idea that when children set a high standard of coherence for themselves, they rely on their ability to flexibly shift their attention between different demands of the task. A plausible reason for this could be that 10-year-old children possess a good level of experience in lower-level comprehension skills, and so have surplus resources that they can use in other aspects of reading comprehension. Thus, it could be suggested that due to their better lower-level skills, 10-year-old children may not need to focus on the word level to the extent that 8-year-old children do, and so can focus their efforts on building a higher standard of mental model.

3.10.2. Explaining Literal comprehension: The role of moderators. Taken as a whole, these results indicate that the contribution of working memory in literal comprehension depends on the reader's experience in reading fluency, hence their relationship is significantly moderated by reading fluency. However, this picture changes slightly when breaking the results down by age. The results also show that while reading fluency significantly moderates the effect of working memory on literal comprehension at the age of 10, but it does not moderate the relation between working memory and literal comprehension at the age of 8.Nevertheless at the age of 8 reading fluency has a significant direct prediction to literal comprehension, indicating that the rate at which children decode words determines their ability to literally comprehend a text, Thus these results suggest that the rate at which children read printed words determines the contribution of working memory to literal comprehension, regardless of the high orthographic transparency of the Albanian language. That is, even though reading written text in the Albanian language entails a regular conversion between the graphemes and phonemes, the rate at which these children read these words still appears to be effortful for 10-year-old children. Thus it is likely that children of this age group have to rely on their working memory to help them to read written words fluently. At the same time, working memory resources are also needed to achieve literal comprehension, specifically in helping to maintain and process information from different sentences and paragraphs of the text. Therefore, the better children's reading fluency – in other words, the faster children are able to read words in the text – the more available working memory capacity they have for achieving literal comprehension. The interaction between reading fluency and working memory in this age group of children also suggests that for children who have poor working memory, reading fluency is especially important to help them extract the literal meaning from the text read.

These findings appear somewhat surprising, given that they are found in a language with a highly transparent orthography. The hypothesis of this thesis was that reading fluency would *not* play a moderating role in the relationship between domain-general cognitive skills and literal comprehension. This hypothesis was based on the idea that when learning to read in a language with highly transparent orthography, children's reading fluency becomes automatized early (around 6 or 7 years of age) because converting graphemes into phonemes is straightforward. This in turn spares working memory resources to be used for higher-level comprehension skills. This was what was found in Chrysochoou and colleagues' (2011) study with Greek-speaking children, in which there was no mediating role of reading fluency in a relationship between working memory and literal comprehension in 8- and 9-year-olds. The Albanian language, similar to Greek, is a highly transparent orthographic language. We would therefore expect that Albanian-speaking children would show very good reading fluency in their early years of education, so the present findings are slightly surprising.

Based on the results of this study, for Albanian-speaking children, reading fluency is not fully developed by 10 years. One reason for this relatively late development of reading fluency skills in Albanian-speaking children, as compared to children who speak other orthographically transparent languages, could be due to their lack of preschool education. A recent report of early childhood education programs by UNICEF (2019) reported that only 33.9% of 3- to 6- year old Kosovan children attended early childhood education programmes, compared to an EU average of 80%. Thus it could be that for the majority of Albanian-speaking children in Kosovo, word recognition skills start later than in other countries: they are only introduced at the age of 6 (when they start their first year of education). This may consequently delay their automatization of reading fluency, meaning that reading fluency will continue to play a role in reading comprehension at a later age than for children who start formal reading earlier. Future studies comparing Albanian-speaking children with and without preschool education would clarify further our understanding on this issue. This way we could have a clearer picture of the role that reading fluency plays in reading comprehension, as well as better understanding the development of reading fluency itself.

In sum, the data from this study confirm that literal comprehension relies on children's working memory capacity, but also on their cognitive flexibility. However, this study also confirms that there are changes in how literal comprehension is achieved between the ages of 8 and 10 years. At age 8, children rely only on their working memory to maintain and process information from the text to achieve literal comprehension. Furthermore, to achieve literal comprehension they also rely on their ability to decode words fluently, although the rate at which they decode words does not necessarily affect their working memory to achieve this task. This reliance on reading fluency plausibly suggests that their reading fluency is not yet fully developed and due to this for 8-year-old children literal comprehension appears to be an effortful task. In contrast, 10-year-olds also rely on working memory for literal comprehension – but their working memory capacity is affected by their reading fluency. This interaction between reading fluency and working memory suggests that the rate at which 10-year-old children decode words is crucial for helping children with poor working memory achieve literal comprehension. Furthermore, these findings also suggest that reading fluency in Albanian-speaking children does not fully develop at the age of 10.

Another difference between 8- and 10-year-old children may be explained by children at age 10 employing a higher standard of coherence for text than younger children. To achieve this goal, they rely on their cognitive flexibility. This higher standard of coherence could plausibly come about because of their slightly better experience in reading skills. These more advanced skills allow them to free up cognitive resources, which they use to flexibly switch their attention between different pieces of information to achieve literal comprehension.

3.10.3. Explaining Necessary inference. Necessary inference is the ability to integrate information explicitly stated in the text with information that is external to the text, so as to understand its intended meaning. Results from this study show that both 8- and 10-year-old children draw necessary inferences from a text by relying on their working memory. However, 10-year-old children also rely on inhibition. These findings are partially consistent with the hypothesis that working memory and executive functions predict necessary inference (based on the idea that working memory and executive functions allow readers to integrate information from the text with their previous knowledge).

Necessary inference in the younger group of children relied on working memory capacity, with working memory scores accounting for 15% of the variance in necessary inference scores. Based on these results, it seems plausible to suggest that the role of working memory in this aspect of reading is twofold. First, it helps the reader to hold in mind information read from earlier sentences, while also then processing additional information from subsequent sentences and paragraphs. Second, it can help them to retrieve information from their previous knowledge, as required, which can then be integrated with information from the text to allow them to draw necessary inferences.

Necessary inference in the younger group of children also relied on reading fluency, indicating that the rate at which children decode words determine their ability to infer the meaning from the text read. This is not surprising knowing that to generate necessary inferences the reader must integrate different pieces of information from different sentence and paragraphs and also integrate this information with what he already knows. Thus, the faster children are able to decode words the better they can work out the grammar and connect information from different parts of the text. By doing so the reader then can identify which information must be retrieved from previous knowledge to understand the implicit meaning from the text read.

Necessary inference in the older group of children also relied on working memory; however, these children also relied on inhibition (specifically, resistance to proactive interference scores explained 13% of variance in necessary inference scores). This suggests that the way children achieve necessary inference develops between 8 and 10 years, with older children additionally relying on their ability to inhibit irrelevant information. Inhibition, as the ability to suppress irrelevant information, appears to be particularly important for necessary inferences, perhaps as it may help readers to suppress information that is not relevant for extracting the implied meaning of the text. This way inhibition could allow readers to ignore irrelevant information, and maintain in memory only information that is relevant for the gist of the story. One possible reason why inhibition is important for 10-year-olds but not 8-year-olds may be that the older children, who are slightly better readers, may generate and hold in mind more ideas and information about the text being read. 10-year-old children may have a lot of ideas which they build based both on the information read, and also on information stored in their long-term memory. Thus, when drawing necessary inferences, older children may be dealing with a larger amount of information about the text, and may accordingly benefit from using inhibition to suppress information that is not relevant to extract its implied meaning – so as to allow only relevant information be integrated in the mental model.

Necessary inference in the older group of children also relied on vocabulary knowledge. These results indicate that the more children are able to identify word meanings the better they are at integration information to infer the implicit meaning from the text. This is not surprising knowing that to be able to integrate relevant information from previous knowledge with explicitly stated information in the text the reader must be able to understand the main ideas of the text. Therefore, it seems plausible to suggest that the ability to identify the meanings of the words read is a prerequisite for deeper understanding of the implicit meaning of the text.

The current study used two measures of inhibition. Resistance to Proactive Interference significantly predicted necessary inference scores, whereas resistance to distractor interference did not. Based on these results it could be suggested that for 10-year-olds, the role that inhibition plays is to suppress information that is no longer relevant. It may be that 10-year-olds retain more of the information they read than 8-year-olds – plausibly due to a greater memory capacity, or perhaps to a greater ease with reading in general. If these older children do have more text-related information in mind than younger children, then they may well need inhibition to suppress information which is no longer relevant for generating necessary inferences. For example, consider one item from the necessary inference measure: a story about Alex, a boy who was supposed to say his poem at a school event, but who was feeling tired and so took a nap. The story went on to mention that when Alex arrived at school later, he saw his friends leaving school. For this item, children are asked: “How do we know that Alex was late for the school event?". To answer this question, children must infer that Alex knew he was late for school *because when he arrived at the school he saw his friends leaving*. However, for this item there were many other pieces of information presented earlier in the text which could be related to this question. As such, older children might conceivably try to rely on previous information – for example, that Alex was late because his bike was damaged on his way to school, or because his alarm didn't wake him on time (all factually correct information, but not the answer to the question asked). Thus, to avoid incorrectly integrating these ideas into their mental model, older children use inhibition to suppress irrelevant information, ensuring that they focus only on information relevant to the question asked.

These results also suggest that while older children draw necessary inferences by relying on their resistance to proactive interference, they don't seem to rely on their resistance to distractor inhibition. Based on these data, it seems plausible to suggest that for children of this age group, information from their previous knowledge doesn't arise as distracting information to them. This could be because the information they retrieve from their long-term memory is specifically implied by the information stated in the text; as such, it makes it easier for these readers to draw relevant information from their previous knowledge. For example, consider another item from the necessary inference measure: "Alex was feeling exhausted, and had to rest. When he woke up, he saw the clock and realized that he was an hour late for school". If children are asked "What happened when Alex had a rest?", then based on the information explicitly stated in these sentences, children could easily identify that *Alex fell asleep*, so that's why he was late for school. Therefore, the results of this study suggest that while some inhibition mechanisms are needed to draw necessary inferences, others do not. Resistance to distractors inference doesn't appear to underpin the generation of necessary inferences.

An alternative interpretation regarding the role of inhibition in inference generation is that these two tasks are essentially measuring very similar things. In the current study, two measures of inhibition were used: the Resistance to Proactive interference task, and the Eriksen flanker task. Because both tasks involve rapidly suppressing interfering information, it could be that these measures draw on the same inhibition mechanisms in children. To test this speculation, a further analysis was conducted. It was found that when the Resistance to Proactive Interference task was removed from the regression, and the Eriksen Flanker task was added instead, the Flanker task made a significant prediction to necessary inference. (In addition, Pearson's correlation showed a positive moderate correlation between the two the Resistance to Proactive Interference and Eriksen Flanker task.) Based on these analyses, it may well be that the reason why the Eriksen Flanker task did not predict necessary inference scores was because the contribution of inhibition was already accounted for by scores on the Resistance to Proactive interference task.

Taken together, these results suggest that both 8- and 10-year-olds draw necessary inferences by relying on their working memory and vocabulary knowledge, allowing them to hold in mind new and old information read from the text, as well as information from their previous knowledge. Also, to draw necessary inferences, older children rely on inhibition – perhaps because older children retain more information in mind than younger children, so there is greater scope for that information to potentially interfere as they construct their mental model of the text. Therefore, inhibition can help to suppress that extra information, making it easier for children to draw appropriate necessary inferences.

3.10.4. Explaining Necessary inference: The role of mediators. Reading fluency plays an important role in drawing necessary inferences around age 8, as the present results show that it moderates the contribution of working memory. However, this is no longer the case around age 10. Instead, at this age, the relationship between working memory and necessary inferences is significantly moderated by vocabulary knowledge. Based on these results, it seems plausible to suggest that 8-year-olds' reading fluency is still developing, and so to frequently identify printed words, these children have to use extra working memory capacity. Thus, it is likely that the faster these children are able to read words, the more spare working memory capacity they have available – spare capacity that can be used generate necessary inferences.

For older children, vocabulary knowledge significantly moderated the relationship between working memory and necessary inference. There are two plausible accounts to explain the role that vocabulary knowledge plays. First, it may be that vocabulary knowledge doesn't *just* allow readers to identify the meaning of the words they read – it *also* allows readers to connect the semantic meanings of the words they read, so as to be able to work out the meaning of any words they don't understand. This would be important, because even if a child did not know the meaning of a particular word, they might nevertheless be able to work out its meaning from their knowledge of the words around it. To consider the example given by Cain et al. (2013): "*Kevlar is an ideal material for making sails".* If readers do not know the word 'Kevlar', they can still acquire some information about its qualities from the text, since the text says that it is a material used to make sails. By combining the meaning of the related words "material", "boats" and 'sails", and relying on their general knowledge about materials used for sails, then you might conclude that such material should be both strong and light. Therefore, readers will infer that Kevlar is a material that is likely to have these qualities.

Thus, children with larger vocabularies may be better able to draw inferences, because they are likely to have rich and well-connected semantic representations of words, which can provide the foundation for inference making. On the other hand, children with poorer vocabulary knowledge require more working memory capacity to compensate for their poorer understanding of word meanings. Thus in the example given in the previous sections, for children to be able to understand what happened when Alex had a rest, children could use their vocabulary knowledge to connect the meanings of the following words: “rest”, “exhausted”, “woke up” – and identify the word they need to use in order to draw the necessary inference (i.e. *Alex slept*).

The second account to explain the moderating role of vocabulary knowledge in the relationship between working memory and necessary inference assumes that vocabulary scores also correlate with other language skills. The measure of receptive vocabulary used in this study, the British Picture Vocabulary Scale, has also been found to predict children’s performance on general language skills such as grammatical knowledge and lexical organization (e.g. Lee, 2011; Moyle, Weismer, Evans, & Lindstrom, 2007). Thus it could plausibly be suggested that it’s not children’s vocabulary *itself* that is crucial for drawing inferences, but rather that children’s performance on the BPVS task may reflect their broader language ability – and it is this general linguistic ability that is the crucial determiner of how well children can draw inferences. For example, children with better understanding of syntax may be better able to correctly follow the structure of a sentence, which may be crucial to understanding the meaning of a text. Better syntactic understanding would likely also help readers to further connect meanings between different events across the text. Thus, the apparent mediating role of vocabulary knowledge in the relationship between working memory and necessary inferences could in fact be a reflection of the importance of linguistic ability in general in drawing necessary inferences. Future studies aiming to understand the cognitive processes involved in necessary inferences should consider using other measures of linguistic skills in order to test this account, and to identify the direct and indirect contribution it may play to this aspect of reading comprehension.

In sum, this study confirms that drawing necessary inferences is significantly underpinned by executive functions, with both 8- and 10-year-olds relying on working memory, and 10-year-olds relying also on their inhibition. Based on these results it could be suggested that at the age of 8, inferences are drawn by children using their working memory to hold in mind information previously read, and/or drawn from their own knowledge, and to integrate that information with new knowledge read from the text. Additionally, the moderating role of reading fluency suggests that children who identify printed words more efficiently can devote more resources to drawing inferences. By the age of 10, children continue to rely on their working memory to draw necessary inferences; however, they also use inhibition, potentially to help them to cope with the additional amount of information they are able to hold in mind, by suppressing information that is not relevant. Moreover, for 10-year-olds, the influence of working memory to necessary inference is moderated by vocabulary knowledge, possibly reflecting the importance of having good semantic representations, or possibly reflecting the broader importance of good language skills in general in drawing necessary inferences.

3.10.5. Explaining Simile comprehension. Simile comprehension is the skill that enables a reader to understand and interpret figurative language. Because the words that express a simile are not meant to convey their literal meaning, the reader cannot simply interpret these words at face value. Instead, the reader needs to recognize that language has been used in a non-literal way, and must then interpret that language appropriately. The present results show that simile comprehension is underpinned by both working memory and inhibition. The results also show that while inhibition significantly predicts simile comprehension for both 8- and 10-year-olds, the two groups use different inhibition mechanisms to achieve simile comprehension.

The present findings show that simile comprehension relies, in part, on working memory capacity. This is perhaps not surprising. It would seem plausible to suggest that the role of working memory in simile comprehension is to help readers hold in memory the narrative, while they pause briefly to interpret the non-literal language of the simile, and then resume the narrative from where they left off. Therefore, working memory helps readers to comprehend the simile, by ensuring that key information about the main narrative is retained, while figurative or other non-literal text is interpreted appropriately. Children with greater working memory capacity are better able to cope with the additional demands of resolving non-literal language than children with lesser working memory capacity.

Simile comprehension was also significantly predicted by inhibition – however, different measures of inhibition predicted simile comprehension at different ages. Taken together, these findings imply that suppressing irrelevant information is an important part of understanding similes while reading. In the current study, 8-year-olds' simile comprehension was predicted by their resistance to distractor interference. This finding plausibly suggests that when interpreting a simile, children must ignore information relating to the *literal* meaning of a simile, in order to be able to attend to the aspect of the simile that relates to the main narrative.

For example, in one of the stories presented to the children of this study comprised the following simile: "Alex was feeling like a dead body". When children retrieve information from their long-term memory related to "dead bodies", much of this information is unlikely to be relevant to the overall meaning of the text being read. For example, the knowledge that dead bodies should be buried would be relevant for a literal consideration of dead bodies, but would not help with – and would likely distract from – understanding the main meaning of the text (that Alex was extremely tired). Thus, the better able children are to suppress literal but irrelevant information of the simile, the better they can understand its intended meaning.

Conversely, 10-year-old children appear to rely on a different inhibition mechanism to achieve simile comprehension, namely resistance to proactive interference. This would suggest that when 10-year-olds encounter a simile, they suppress information they have previously read in the text. In other words, to comprehend the simile, they not only rely on their previous knowledge, but also on information they have read in previous paragraphs of the text. However, after running further regression analyses, it was found out that when the Eriksen Flanker task was entered alone in the model, it significantly predicted simile comprehension. And when the Resistance to Proactive Interference task was added to the model and the Eriksen Flanker task removed, Resistance to Proactive Interference was found to significantly predict simile comprehension. Therefore, it may be that the two distinct inhibition measures used in this study in fact tap fundamentally similar aspects of cognition. Performance on the two tasks moderately correlates (with a correlation coefficient of .34), consistent with the idea that these two inhibition tasks may be measuring the same thing.

3.10.6. Explaining Simile comprehension: The role of mediators. The current data show that in the younger group of children none of the moderators interacted with working memory and inhibition in predicting simile comprehension. However, in the older group of children, non-verbal intelligence significantly interacted with resistance to proactive interference in predicting simile comprehension. The role of non-verbal intelligence here could be explained in terms of the role that intelligence plays in reader's cognition in general. Specifically, intelligence can help readers to identify relevant relationships, similarities and differences between information they encounter. Thus, when trying to comprehend similes, it is possible that intelligence helped children to identify relevant relationships between information presented in the text and information drawn from their previous knowledge. Intelligence may especially help children with poor inhibition in their attempt to interpret the simile. For example, to interpret the simile " *Alex was feeling like a dead body* ", children are likely to compare explicitly stated information about Alex (e.g. he was tired, he went to bed late, he had to say a poem in school early morning) and what they know about dead bodies (e.g. they do not move, they should be buried) so as to understand the simile. Thus, it could be that non-verbal intelligence allows them to compare the differences and similarities between these concepts so as to pull out only relevant points of comparison in order to understand the simile (that Alex was feeling very tired). Therefore, the better 10-year-old children are able to recognize contextual connections between information presented in the text with their previous knowledge, the better can they suppress information which may otherwise damage the accurate comprehension of a simile.

Alternatively, or in addition, intelligence may help children to realize *when* a non-literal reading of a text is appropriate – or in other words, it may help them to identify similes and other figurative language ore easily. Whatever the precise reason, the present results, indicate that intelligence plays an important role for 10-year-olds when it comes to comprehending similes.

In sum, these results demonstrate that to achieve simile comprehension, both working memory and inhibition play a role. Both 8 and 10-year-olds rely on working memory likely to ensure the key information about the narrative is retained, while figurative or other non-literal is interpreted appropriately. Furthermore, children also rely on inhibition, likely to suppress information that is not relevant for comprehension of the simile – perhaps information that is related to a *literal* interpretation of the simile. For 10-year-olds, the relationship between inhibition and simile comprehension is moderated by non-verbal intelligence. It may be that intelligence – or the ability to identify abstract patterns and relationships – may be vital especially in children with poor inhibition to allow them to better understand which information in the simile is relevant to the main text, and which information is not.

3.10.7. Explaining Elaborative inference. Elaborative inferences are inferences that are not necessary to understand the basic informational content of the text, but which enrich the mental model by providing additional contextual information. To draw elaborative inferences, readers have to integrate information presented in the text with information from their previous knowledge which is not implied by specific words in the text. The present results show that drawing elaborative inferences is significantly predicted by updating, working memory, cognitive flexibility but also by reading fluency and vocabulary knowledge. However, the precise contributions of these skills differ as a function of age. For 8-year-old children, the ability to generate elaborative inferences is significantly predicted by updating, reading fluency and vocabulary knowledge. However, for 10-year-old children, the ability to generate elaborative inference is significantly predicted both by working memory and by cognitive flexibility.

For 8-year-olds, the ability to draw elaborative inferences was significantly underpinned by updating. This suggests that when they draw elaborative inferences, children of this age do so by revising information stored in working memory to incorporate newly read information. To draw elaborative inferences, children typically rely on their prior knowledge to come up with information that is not stated by the text, but is nevertheless important for enriching the context of the text. For example, consider the following story, taken from the measures of elaborative inference: "Alex was riding his bike to school – but he came across some broken glass, and had to walk to school afterwards*"*. The children are asked the question "Why did Alex have to walk the rest of the way to school?". To reach the correct answer, children are expected to infer that because Alex came across broken glass, he must have damaged his bike tire, meaning that he couldn't ride his bike anymore, and therefore had to walk afterwards. Thus, in this example, to draw an elaborative inference, children need to integrate information explicitly stated – “he came across some broken glass” – and combine it with their prior knowledge – in this instance, the knowledge that broken glass is very sharp, and can damage a bike’s tires. Therefore, based on the results of this study it seems plausible to suggest that when drawing elaborative inferences, children rely on their updating to update their mental model of the text in the light of relevant information retrieved from their prior knowledge.

Elaborative inference in younger group of children was significantly predicted by reading fluency and vocabulary knowledge. These results indicate that to generate this type of inferences children must have be able to decode words quickly and accurately as well as identify their meanings. It is therefore plausible that the faster children can decode words the better they can work out the grammatical structure of the sentences and paragraphs and accurately understand the explicitly stated information. Also, identifying the meaning of the words read in different sentences and paragraphs would allow these children to identify this information with information from previous knowledge. Therefore, the current data suggest that the ability to decode words quickly and accurately and understand their meanings determines the ability of 8-year-old children to generate elaborative inferences.

For 10-year-olds, drawing elaborative inferences relied on working memory, but also on cognitive flexibility. To draw elaborative inferences, children need to integrate information presented in the text with relevant information from their previous knowledge. Thus, it seems plausible to suggest that for 10-year-olds, this function is served by working memory. The involvement of children’s ability to flexibly shift attention in the task may be because drawing elaborative inferences requires children to retrieve from prior knowledge information that is not implied by the text but is important for enriching the context of the text. Because the information that must be retrieved from long-term memory is not signalled by a single word in the text then children may need to concurrently monitor the information deriving from their long-term memory and only select the relevant information so as to accurately enrich their mental model of the text. Therefore, cognitive flexibility may be what allows them to switch from their mental model to their retrieved information from long-term memory.

3.10.8. Explaining elaborative inference: The role of moderators. The current data show that none of the moderating variables significantly moderates working memory, updating and cognitive flexibility in their prediction to elaborative inferences. These results indicate that while reading fluency and vocabulary are important for 8-year-old children to be able to generate elaborative inference, these skills do not interact with working memory nor with executive functions. Therefore, it is plausible to suggest that while reading fluency and vocabulary knowledge experience of children of both age groups is sufficient to allow them to use their working memory and executive functions to draw elaborative inference, this experience determines integration of information needed for elaborative inferences.

3.10.9. Explaining Comprehension control. Comprehension control requires readers to monitor and evaluate their mental model of a text as they read it, in order to be able to identify any inconsistencies and remedy them. The present results show that comprehension control is significantly predicted by working memory, updating, and cognitive flexibility. Specifically, to achieve comprehension control, 8-year-olds rely on cognitive flexibility. Conversely, 10-year-olds rely on cognitive flexibility, but they also use working memory as well as updating to achieve this task.

Comprehension control in 8-year-olds was predicted by their cognitive flexibility explaining 4% of the variance in this task. A crucial aspect of controlling comprehension is to evaluate one’s understanding of the text, in order to be able to correct any inconsistencies that may have occurred. Based on these results, it may be that children of this age group use their cognitive flexibility to help them to monitor the quality of their mental model, by switching back and forth between two different perspectives – one being the mental model they are building about the text, and the other being the text itself, which continues to provide new information as they read. If any differences or inconsistencies are noted between the two perspectives, the child will know that their mental model needs to be corrected. In this way, cognitive flexibility plausibly provides an essential support for comprehension control, allowing children to accurately identify the inconsistencies in their mental model as they build it and take actions to remedy them, For example, consider the following story taken from the comprehension control measure: “Alex waited until he was alone in the house… He pushed a chair in front of the sink. Like an acrobat, Alex reached the biscuit tin. The tin was behind the sugar. Alexis stretched and managed to lift the lid up. As he reached inside the tin, the door opened. There stood his sister smiling at him. However, Alexis’s face looked like a lemon”. For this story, children are asked “Why was the boy happy when he saw his sister?”. To respond correctly, children must be able to identify the inconsistency in the question. In other words, they need to be able to identify the mismatch between what they read in the question, and their mental model of the text: that the boy was not happy, but upset that his plan to secretly take a biscuit had been discovered. Then, they need to provide an answer to the corrected question – that the boy was not happy to see his sister, but rather upset, because she had caught him secretly trying to take a biscuit. Based on these results, it seems plausible to suggest that to maintain good comprehension control, 8-year-olds must perform several tasks at once and so they need to use their cognitive flexibility to monitor the text as they read it and in cases where a mismatch is identified between the text and the mental model, children also need to be able to identify where the error has come from, and work out how to make an appropriate repair to fix the inconsistencies. To achieve this, cognitive flexibility is likely to be particularly important.

Comprehension control in 10-year-olds relied on cognitive flexibility, and also on working memory capacity and updating. The data show that the contribution of cognitive flexibility remains constant between 8 years and 10 years. However, working memory and updating only emerge as significant predictors of comprehension control around the age of 10 years; they do not appear to be important for comprehension control in 8-year-olds. Why is it that 10-year-olds and 8-year-olds differ in this regard? One possible explanation is that because older children have slightly more experience in reading than younger children, they also possess more concepts derived from both the information they read and their previous knowledge. Thus in an attempt to evaluate their mental model and fix any inconsistent information, older children develop a richer and more complex mental model for the text than younger children. Therefore, this complexity of the mental model places greater cognitive demands on monitoring processes, and so there is a greater role to be played by working memory and updating. This suggestion would be consistent with the idea that 10-year-olds have a higher standard of coherence than 8-year-olds, and that the richer and more detailed mental model that they build then takes more effort to monitor for consistency and accuracy.

Explaining Comprehension control: The role of moderators. The current study shows that in the younger group of children, none of the moderating variables moderate the relationship between cognitive flexibility and comprehension control. These results indicate that the rate at which 8-year-old children decode does not determine the relationship between cognitive flexibility and comprehension control.

The results of this study show that in the older group of children, reading fluency plays a significant moderating role in the contribution made by working memory. How specifically might reading fluency contribute to comprehension control? To control their own comprehension, children must evaluate their own understanding of the text as they build their mental model; in addition, they must fix any inconsistencies in their understanding as they occur. This process requires an ongoing monitoring of the child's mental model as it is updated in real time, in the light of new information being constantly read. Both because of its ongoing nature over time, and because comprehension control is a particularly effortful process for children who are learning to read, it is a cognitively demanding process. Thus, the more available cognitive resources children have to achieve this task, the better they will be able to ensure the integrity and accuracy of their mental model. Thus, reading fluency may well play a vital role in helping these readers to use their working memory efficiently: the better children are able to identify words, the less resource-demanding the process of decoding a word's written form will be, and the more resources will be available for other aspects of reading comprehension. Thus, it could be that for both older children, the more easily they can identify the written form of a word, the more cognitive resources are available to use to monitor and repair their mental model of the text.

Why did then reading fluency only occurred as a moderating variable in the relationship between working memory and comprehension control in the older group of children but not in younger group of children? Perhaps because older children have a higher standard of coherence and thus tend to retrieve more information from their previous knowledge and from previous text. To do that they need to have more spared working memory resource which could not be available if the same children are using it to decode words.

The current data also show that non-verbal intelligence significantly interacted with working memory to predict comprehension control in the older group of children. These findings indicate that intelligence may in particular help children with poor working memory in controlling their comprehension. Because for children who are better at recognizing difference and similarities among the information presented in the text and the information in their mental model would help them easily use their working memory content to detect any inconsistencies and also take certain steps to remedy them. Furthermore, non-verbal intelligence could be more important for older children as compared to younger children plausibly because older children have a higher standard of coherence and tend to retrieve more information from their previous knowledge and from previous text. To do that they need to have more spared working memory resource which could not be available if the same children are ot able to recognize the similarities and differences between different pieces of information during comprehension control

Taken together, the results of this study suggest that to achieve comprehension control, 8-year-old children use their cognitive flexibility to monitor the quality of their mental model by switching back and forth between their mental model they are building about the text and the text itself and also to fix any inconsistencies encountered. Conversely, 10-year-old children also use their cognitive flexibility to switch their attention between the text being read, and their mental model of that text –but they also rely on their working memory capacity and updating to succeed in this task. Their reliance on working memory as well as updating seems likely to be due to their need to hold and select, among many ideas, those that are relevant to the task. Finally, it seems likely that reading fluency plays an important role in helping readers of the older group of children to preserve their limited cognitive resources, in that the fewer resources children spend on decoding a word, the more resources they are able to devote to comprehension control, and therefore to ensuring the quality and integrity of their mental model of the text. Also, it seems that the better children are at recognizing logical patterns and combining them correctly the more working memory resources they will have for controlling their comprehension for the text read.

3.10.10. The role of orthographic transparency. One of the most surprising observations from this study is that reading fluency plays a significant predictive role, and in some cases, a significant moderating role in the relationship between domain-general skills and all five higher-level comprehension skills. This finding goes against the original hypothesis regarding the role of reading fluency in reading comprehension in Albanian-speaking children. To recap, it was expected that reading fluency would not play a major role in any aspect of reading comprehension, for the reason that Albanian is a language that has a highly transparent orthography – and as such, we would expect it to be much easier for children to decode the written form of words, because of the highly predictable grapheme-phoneme correspondences in Albanian. That being the case, one might expect individual differences in reading fluency to be much less important than in languages with more opaque orthographies. Contrary to this expectation, however, the results showed that reading fluency played an important moderating role in helping readers use their domain-general cognitive skills to assist in comprehending written text. Furthermore, the data also revealed that the role of reading fluency to reading comprehension changes with age. Focusing on the role of reading fluency in particular can shed light on how reading comprehension emerges in a language with highly transparent orthography. It is this matter that will be discussed in this section.

There are two main findings from this study relating to the role of reading fluency in an orthographically transparent language. First, the results show that individual differences in reading fluency account for significant variance in measures of higher-level reading comprehension in both age groups of children. The second main finding suggests that reading fluency plays a moderating role in some aspects of reading comprehension, but not all. In the current study, the moderating role of reading fluency is present around age 8, helping in necessary inference (that is, tasks involving integration of information from the text with reader's previous knowledge. However, by around the age of 10, reading fluency emerges its moderating role only in literal comprehension (that is the task that involves extraction of explicitly stated information in the text) as well as in comprehension control (that is the task that involves monitoring and evaluation of the mental model as well as remedy of inconsistencies encountered in the text).. These results suggest reading fluency continues to play an important role in reading comprehension between the age of 8 and 10, however its role decreases in some tasks but emerges in some other tasks.

It is noteworthy that for 10-year-olds, reading fluency moderates the relationship between reading comprehension and domain-general skills. The previous literature suggests that in languages with transparent orthographies, reading fluency *doesn't* contribute to reading comprehension at the age of 10 (possibly because in languages with highly regular conversion between graphemes and phonemes, the pronunciation of each letter of the alphabet is almost always the same irrespective of the word they appear in, leading to a rapid automatization of reading accuracy in children). Thus it is surprising to see reading fluency playing an important role in reading comprehension at this age. There are two possible explanations for this.

First, we know that reading fluency describes children's ability to read words quickly and accurately. To develop good reading fluency, children need to gain quite extensive experience in reading words letter by letter, before they are able to identify words by recognition (a quicker and a more efficient route than letter-by-letter reading). It is a basic truism of reading that initial attempts to decode words tend to be slow and hesitant, but that with continued experience of reading, this process becomes faster and easier, until eventually becoming automatized in fluent readers. In languages with transparent orthographies, this process happens more quickly than in languages with opaque orthographies, due to the smaller number of words that don't adhere to regular grapheme-phoneme correspondence rules. So for this reason, we might expect orthographically transparent languages to rely on reading fluency much less. Arguably, we might also expect the contribution of reading fluency to reading comprehension in general to decrease and stop at an earlier age in transparent than in opaque orthographies. However, for Albanian-speaking children specifically, the developmental course of reading fluency could very well be much longer than in other orthographically transparent languages – because of a relative lack of preschool education. The majority of

Kosovan children start their formal education without having attended preschools, and without receiving a preschool education of any kind. Therefore, most 6-year-old children in Kosovo enter school with little or no letter- or written-word awareness. For these children, word recognition skills are only introduced at around the age of 6. Thus, it could be that these children do not manage to automatize these fundamental reading skills until their late childhood. If this were the case, then it would follow that for a 10-year - old Albanian-speaking child in Kosovo, his/her levels of reading fluency would still play a role in reading comprehension, since not all children would have attained automaticity in their reading skills. For children with better reading fluency, they would have additional cognitive resources to use for higher-level reading skills; but for children with poorer reading fluency, those cognitive resources would still be needed to help with decoding words. Thus, while the Albanian language has a transparent orthography, the benefits of that transparency may be offset by slower-developing reading fluency arising as a consequence of a lack of preschool education, and, therefore, a consequent delay in basic reading skills.

A further factor to consider is that reading fluency is known to be associated with *motivation* for reading (e.g. Meyer & Felton, 1999). That means that the slower the developmental course of reading fluency, the less motivated children would be to read. For many children, reading is an effortful thing to do, particularly in the early years of reading, and to achieve this goal they need to put a lot of effort into deploying their domain-general cognitive skills for building their mental model for the text. However, children with poor reading fluency – that is, children who read printed words more slowly – may find reading harder, and therefore they may be less motivated to persist with reading. Therefore, future research could further contribute to our understanding of the role reading fluency plays by also including measures of motivation, to allow these distinct possible contributory factors to be confounded.

The second possible explanation for the moderating role of reading fluency in older children relates to the grammatical structure of a language. Specifically, when reading written texts, children are not simply focusing on language at the level of individual words. They are also having to follow and engage with other aspects of language, including syntax and pragmatics. They must be aware of the need to segment sentences into appropriate phrases, and to use information from the grammatical structure of a sentence to inform their interpretation of the meaning of the text – these are all crucial components of the qualitative aspect of their reading fluency. A noteworthy aspect of the Albanian language is that while its orthography is straightforward, its syntax is often much less so. Frequently it can involve long subordinate clauses. In addition, in order to fully understand a written text, children must also be aware of the five different tenses of Albanian grammar, two different voices and five moods (Hoxhallari, 2006). Therefore, it could be suggested that while the orthography of Albanian is highly transparent, it may nevertheless be premature to characterize Albanian as a relatively easy language for young readers. Thus, for children learning to read in Albanian, the long developmental course of reading fluency could also occur due to the complex structure of grammar of the language, especially for those children who were introduced to these complexities only at the age of 6 in the first grade of schooling. Therefore, a future question to address is whether it is easier to read efficiently in a language with opaque orthography but simple grammatical structures, or in languages with transparent orthography but complex grammatical structures. To answer this question, it seems necessary to test grammar skills alongside reading fluency in languages with different orthographic depths, which also have grammars with different levels of difficulty, so as to be able to have a clearer picture of what impact it can have on reading fluency and on reading comprehension in general.

In sum, for Albanian-speaking children, reading fluency plays an important role in reading, specifically by helping them to use their working memory and executive functions efficiently to comprehend text. This is true for both age groups of children tested in this study. These results suggest that the developmental course of reading fluency in Albanian-speaking children is long, regardless of the orthographic transparency of the language. Reading fluency in Albanian-speaking children does not appear to be fully developed by 8 years, and it continues to develop by 10 years. Due to this protracted development, it seems that children must devote cognitive resources to efficiently reading printed words, which limits the resources available for higher-level reading comprehension. This delay in reading fluency development could likely be offset if levels of preschool education were to be increased.

3.10.11. Conclusion. In conclusion, there are three main findings to be drawn from the current study. The first finding is that domain-general cognitive skills play a vital role in *all* aspects of reading comprehension for 8- to 10-year-old children. Specifically, all five higher-level comprehension skills of interest to this thesis were shown to be underpinned by working memory and executive functions. Based on the supporting role played by domain-general skills, it's possible to categorize these higher-level reading skills into three groups. First, literal comprehension was found to be underpinned by (i) working memory and (ii) cognitive flexibility. Second, necessary inference and simile comprehension were both found to be underpinned by (i) working memory and (ii) inhibition. Third, generation of elaborative inferences and comprehension control were found to be underpinned by (i) working memory and (ii) and three core executive functions.

The second finding of this study is that the contribution of working memory and executive functions to higher-level comprehension skills changes as a function of age. Working memory and executive functions play more of a role in higher-level comprehension skills in 10-year-old children as compared to 8-year-old children. The contribution of working memory and executive functions to literal comprehension, necessary inference, elaborative inference and comprehension control increased with age, and the contribution of working memory and inhibition to simile comprehension remained constant. This developmental change may reflect a tendency for older children to adopt a higher standard of coherence, as their improving reading skills lead to increased expectations for how deeply they should engage with a text.

The third finding of this study is that reading fluency plays an important role in reading comprehension, plausibly by helping children save cognitive resources for achieving higher-level comprehension skills. However, the contribution of reading fluency decreases in necessary inferences as children get older. Nevertheless, it emerges to contribute to literal comprehension and comprehension control at 10 years of age. This is a surprising finding given the highly transparent orthography of the Albanian language. It would suggest that when considering how the specific features of a language affect the development of reading skills in that language, it is not enough to focus solely on orthographic transparency. Rather, it is possible that syntactic complexity will also play a role. Whether in the case of Albanian-speaking children the difficulties arising from the language's syntactic complexity could be offset by an earlier start in reading – such as is seen in preschool reading interventions – remains a question for future research to address.

Chapter 4: General discussion

The objective of this thesis was to better understand how reading comprehension happens in children, and in this attempt it asked two main research questions. The first question was to study the relationship between domain-general cognitive skills and the five higher-level reading comprehension skills at a crucial period of development – the time when children are becoming independent readers (8 to 10 years of age). The second question was to examine to what extent these relationships are moderated by lower-level comprehension skills, in a language with a transparent orthography (specifically the Albanian language).

To address these two research questions, two experiments were run. The first experiment was a pilot study, aimed at developing appropriate measures for testing reading comprehension in Albanian, as few such measures existed. The second experiment directly addressed the two main research questions of this thesis. The novel contribution of this research is that unlike previous studies, it i) looked at all five higher-level comprehension skills separately, and their relationship to domain-general cognitive skills; ii) it examined domain-general cognitive skills simultaneously, rather than in isolation, in order to better account for shared variance; iii) it considered the moderating role of lower-level comprehension skills in these relationships; and iv) it provided valuable insight on how reading comprehension is achieved in a language with transparent orthography.

Table 15. *Summary of the main results in chapter three regarding the predictors and moderators of each higher-level comprehension skill by age group.*

Dependent variable	Age group	Significant Predictors	Significant Interactions

Literal comprehension	Younger	Working Memory	-
	Older	Working Memory	Moderated by Reading fluency
Necessary Inference	Younger	Working Memory Reading fluency	Moderated by Reading fluency
	Older	Working Memory Resistance to PI Vocabulary knowledge	Moderated by Vocabulary knowledge
Elaborative inference	Younger	Updating Reading fluency Vocabulary knowledge	-
	Older	Working Memory Cognitive flexibility	-
Simile comprehension	Younger	Working Memory Inhibition (RDI)	-
	Older	Working Memory Inhibition (PI)	 Moderated by non-verbal intelligence

		Non-verbal Intelligence	
Comprehension control	Younger	Cognitive flexibility	-
	Older	Cognitive flexibility	
		Working memory	Moderated by Reading fluency
			Moderated by non-verbal intelligence
		Updating	

Note. Inhibition (PI)= Resistance to Proactive Interference; Inhibition (RDI)= Resistance to Distractor Interference.

The current data suggest that each of the five higher-level comprehension skills (i.e. literal comprehension, necessary inference, elaborative inference, simile comprehension and comprehension control) are substantially underpinned by domain-general cognitive skills. The findings show that the relationship between domain-general cognitive skills and higher-level comprehension skills changes between the ages of 8 and 10 years. While 8-year-old children mainly rely on their working memory to support their reading comprehension, 10-year-old children rely on a much wider variety of domain-general skills – possibly because as children get older and more adept at reading, they accordingly raise their standard of coherence, meaning that reading becomes both more challenging, but also more rewarding.

In relation to the second question of this thesis, the study shows that reading fluency plays an important role in how domain-general cognitive skills support reading. Reading fluency moderates the relationship between working memory and necessary inferences in 8-year-old children; the moderating role of reading fluency emerges in 10-year-old children in literal comprehension and comprehension control The importance of reading fluency to reading comprehension in Albanian-speaking children is surprising, since findings from other languages indicate that the importance of reading fluency declines with age, and is typically not an important factor in reading for 10-year-olds in many languages (Ellis & Hooper, 2001; Frith, et al., 1998; Seymour et al., 2003; Wimmer & Goswami, 1994). The findings of the present thesis may be attributable to two distinct factors: first, a lack of preschool education for the children who took part in these studies. As a consequence, word recognition skills are introduced to these children much later in their development than is typical in other countries. Second, the complex grammatical structure of Albanian could be an important consideration in the development of reading fluency skills. The characteristics of long words and complex sentences in Albanian may very well make reading fluency more effortful in children.

From a broader point of view, three major findings are identified from this thesis. The first finding concerns similarities and differences in how the separate higher-level comprehension skills rely on domain-general cognitive skills. The second finding concerns developments in reading-related cognition between the ages of 8 and 10 years. The third finding concerns the role that reading fluency plays during this period.

The *first* finding of this thesis reveals the similarities and differences between the ways that the five higher-level comprehension skills are supported by domain-general processes. The most notable similarity between the five higher-level comprehension skills is that all rely, to some extent, on working memory: in the current thesis, working memory significantly predicted all five higher-level comprehension skills. This is not entirely surprising. These results indicate that the ability to maintain existing information about a text while simultaneously processing new information about it is crucial to helping readers construct a successful mental model for the text. Therefore, the current thesis suggests that even though the five higher-level comprehension skills are importantly different from each other, they nevertheless all rely on working memory.

This finding is broadly in line with the majority of studies demonstrating that working memory plays a key role in supporting reading comprehension in general (Cain, 2006; Cain et al., 2004; Christopher et al., 2013; Goff, Pratt, & Ong, 2005; Oakhill, 1993; Swanson, 1999; Yuill, Oakhill, & Parkin, 1989). However, the current results do not completely match up with results from the existing literature when it comes to explaining each of the five higher-level comprehension skills. Specifically, the present findings appear to corroborate earlier studies looking at inference generation and comprehension control, but not those looking at literal comprehension and simile comprehension.

In general, previous work looking at inference generation has shown that this skill is significantly predicted by working memory (e.g. Currie & Cain, 2015; Potocki et al., 2017). This is in line with the current findings. Inference generation as a whole comprises separable aspects, namely necessary inference and elaborative inference. Each of these skills have been reported to be significantly predicted by working memory (Currie & Cain, 2015; Chrysochoou et al., 2011). The findings from the present thesis provide further support for this view, and show both that this finding is robust, and can be extended to Albanian readers.

For comprehension control, the present findings also support prior research. They are broadly in line with data reported in the study of Chrysochoou and colleagues (2011) demonstrating that working memory is an important predictor of comprehension control. Thus, this replication of the findings that working memory is a significant predictor to necessary inference, elaborative inference and comprehension control shows that this finding is robust.

In contrast, the present findings regarding literal comprehension contrast with findings from the existing literature (e.g. Chrysochoou et al., 2011; Potocki et al., 2017; Silva & Cain, 2015). For example, Chrysochoou and colleagues (2011) found no significant relationship between working memory and literal comprehension in a study with 8- and 9-year-old children. Similarly, Potocki and colleagues (2017) reported no significant relationship between working memory and literal comprehension in 10-year-old children. The age groups from these two studies are very similar to the children tested in Chapter 3, and one might therefore expect to see similar results. However, the results from Chapter 3 suggest that working memory is crucial to literal comprehension. One possible interpretation for this difference could be the level of experience these children have in basic reading skills. In the study of Chrysochoou and colleagues (2011), testing Greek-speaking children, reading fluency skill did not mediate any of the associations between higher-level comprehension skills and working memory. Thus it could be that because Greek-children had good levels of reading fluency, they had sufficient cognitive resources to successfully extract the literal meaning. In contrast, the findings of the current thesis indicated that Albanian-speaking children had less well developed reading fluency, and as a consequence may have needed to devote additional cognitive resources to identifying the written form of words. Thus it could be that because of the late development of reading fluency skills for Albanian-speaking-children, working memory significantly predicted literal comprehension.

Furthermore, the finding from the present study that working memory significantly predicted simile comprehension is also inconsistent with results reported in the study of Chrysochoou and colleagues (2011). In this study, measures of working memory did not predict performance in simile comprehension in 8- and 9-year-old children. Again, this reflects a surprising difference between findings from the present study and those reported in the previous literature. However, it should be noted that there are important methodological differences between these studies. Notably, there are differences in the structure of the simile comprehension questions used. In the current study, children were asked to *produce* the simile. For example, they were asked: "*In what way did Alex manage to reach the biscuit tin*?", and were expected to respond that Alex reached the tin *like an acrobat.* In contrast, in the study of Chrysochoou and colleagues (2011), children were asked to *interpret the meaning* of the simile. For example, children were asked: "*Like an acrobat, Alexis reached the biscuit tin* – what does this mean?". Thus it could be that the ability to produce a simile requires extra support from working memory, whereas interpreting a simile does not. If this were the case, then it would suggest that working memory provides the means for children to produce similes, but not to interpret them.

This thesis also demonstrates other similarities between higher-level comprehension skills when it comes to the supporting contributions made by executive functions. Both necessary inference and simile comprehension were supported by working memory and inhibition. This would suggest that these two skills share important commonalities in how they are achieved. Based on the present results, it would appear that both higher-level skills share the requirements that (i) readers keep track of the text as they read it, while simultaneously (ii) retrieving necessary information from their prior knowledge, in order (iii) to make sense of an unusual or discrepant part of the text (such as a point in a story where the reader has to draw a necessary inference themselves in order to follow the intended meaning; or where the reader has to understand figurative language used in a simile). To generate necessary inference, readers need to use relevant prior knowledge to help resolve incomplete or surprising information in the text (for example, realising that when Alex sees his friends leaving school, it must mean he is very late). On the other hand, to comprehend a simile, readers should use information from their prior knowledge to correctly interpret non-literal language presented in a text (for example, in the sentence "Alex was feeling like a dead body when he woke up"). Thus for both higher-level skills, the process of information integration between prior knowledge and the current text is similarly demanding, and the two skills may thus be similar in the domain-general demands they make. Moreover, both necessary inference and simile comprehension rely on inhibition. The information that must be inhibited could be either coming from the text itself, or from reader's long-term memory. The current data shows that both types of irrelevant information coming from reader's long term memory (as measured by a Resistance to Interference Task) and information coming from the text (as measured by the Proactive Interference task) must be inhibited to allow readers to generate necessary inference and simile comprehension.

Marked similarities were also found between drawing elaborative inferences and comprehension control. Both skills rely on working memory, updating, and cognitive flexibility. This finding suggests that in terms of their domain-general demands, elaborative inferences and comprehension control come about in similar ways. To generate elaborative inferences, readers must retrieve information from their previous knowledge – information which is not implied by specific words in the text, but which provides important additional context, with which the reader can embellish their mental model for the text. To integrate information from one's own prior knowledge with information drawn from the text requires significant amounts of cognitive capacity, well in excess of what would be required for a literal reading of a straightforward text. Conversely, for successful comprehension control, readers must be able to continuously monitor incoming information from the text being read, and compare it with their mental model for the text, built on information presented previously in the text as well as their previous knowledge (e.g. Magliano et al., 1999). This also requires significant cognitive resources, since the reader is simultaneously tracking what their mental model leads them to expect from a text, as well as what the text itself says. It should be unsurprising, therefore, that both skills are reliant on updating and working memory.

Results from Chapter 3 also show that both drawing elaborative inferences and comprehension control rely on cognitive flexibility. This reflects the fact that both skills make greater demands than simple processing capacity. Drawing elaborative inferences requires readers to engage in a relatively unguided process of going beyond the written text, to identify additional information from the reader's own previous knowledge that can augment the mental model for the text. Therefore, when making an elaborative inference – for example, when a reader imagines how Alex feels when he's late for school, by recalling a time the reader themselves was late – the reader needs to monitor how much of their prior knowledge is appropriate for enhancing the current text. Similarly, to achieve comprehension control, children need to check the integrity of their understanding for the text, by moving between the text as they read it, and their expectations for the text based on their mental model. In addition, in cases where an inconsistency is identified, the reader must be able to make an appropriate correction, drawing on their mental model to select only relevant information which allows them to resolve the inconsistency. Both higher-level skills require some flexibility, depending on the specific circumstance (according to the elaborative inference being drawn, or depending on whether and how inconsistencies are encountered). Based on the results of the present study, it seems that both drawing elaborative inferences and comprehension control require a complex interaction between working memory and long-term memory which ultimately calls for cognitive flexibility.

Finally, literal comprehension appears distinct from the other four higher-level comprehension skills. In Chapter 3, literal comprehension performance was significantly predicted by cognitive flexibility and working memory. This result suggests that both working memory and cognitive flexibility are required for literal comprehension. This finding suggests that to comprehend the literal meaning of a text, readers hold in mind information from one sentence while processing newly read information in the text. Furthermore, these results suggest that in order to integrate ideas from different parts of the text so as to construct a coherent representation of what the text is about, they rely on their cognitive flexibility. For example, to link the main points of the text – such as the events that took place in the story, the characters involved, their motives, and time the events happened – readers must be able to concurrently switch between the mental model they have already constructed and the information they retrieve from their long-term memory and information from non-adjacent sentences in the text. To successfully achieve this, they use their cognitive flexibility to hold necessary information in memory, while shifting attention appropriately from one piece of information to another.

The *second* major finding of this thesis is that the supporting role of executive functions to reading comprehension develops significantly between the ages of 8 and 10 years. In the current study, both 8-year-olds and 10-year-olds used executive functions to bolster aspects of their reading. This general finding is consistent with what one would expect from developing readers. In contrast with adults, whose years of experience with reading means that they are able to automate many aspects of the process, the majority of 8- and 10-year-old children aren't able to do that yet. Executive functions are used in situations where we have to carry out novel or difficult tasks – which for many children is what reading *is*. However, as children get more experienced, then they rely on executive functions less as they increasingly automate aspects of reading. However, for developing readers – like those tested in Chapter 3 – reading is a deliberate, effortful process, and as such it is not surprising that executive functions should be involved.

Why then were there differences between the two age groups with regard to their reliance on executive functions? There are two plausible accounts that might explain this difference. The first account is based on children' level of experience in reading. Although both 8- and 10-year-old children are considered independent readers, 10-year-old children will typically have more practice with reading in general, and with lower-level reading comprehension skills, than 8-year-old-children. Their superior lower-level comprehension skills may in turn allow 10-year-olds to save more cognitive resources for extracting the meaning from the text read. Therefore, more practiced lower-level skills mean that the child can deploy different executive functions which would ultimately help them to build a coherent and accurate mental model for the text read.

The second account explaining the increasing role of executive functions with age relates to the standard of coherence children set when reading a text. The results of this study seem to suggest that 10-year-old children adopt a higher standard of coherence than 8-year-old children. Standard of coherence refers to readers' implicit and explicit criteria for comprehension (van den Broek, et al., 2011). Readers that want to gain a particularly deep understanding of a text would adopt a higher standard of coherence than readers who are satisfied with a shallower engagement. Thus, one interpretation of the current findings is that 10-year-olds adopt a higher standard of coherence than 8-year-olds. As a result, reading becomes a more challenging and involved process, since they set high goals for their understanding (for example, they may want to enrich their mental model for the text by using their prior knowledge to provide greater context for all of the critical points of information that arise in the text). Therefore, to meet these higher criteria, they deploy executive functions to help them to integrate necessary and relevant information needed to enhance the mental model for the text.

The third major finding of this thesis is that reading fluency plays a moderating role in the relationship between domain-general skills and some higher-level comprehension skills. This shows that reading fluency interacts with working memory and executive functions in explaining reading comprehension. Therefore, it is plausible to suggest that faster children decode words in the text the more cognitive resources they spare for using it for constructing the mental mode for the text read. Conversely the slower children decode words in the text the more cognitive resources they need for this task, leaving only few cognitive resources available for the construction of the mental model. The finding that the relation between most of the higher-level comprehension skills and working memory is moderated by reading fluency provides a clear picture of how reading comprehension comes about. For younger children reading fluency seems to be crucial when it comes to using their working memory to integrate information from their previous knowledge with information in the text so as to draw necessary inference. This shows that reading fluency is particularly important for younger children when drawing inferences, which for most of them must be an effortful task. For older children, reading fluency is also important but for other higher-level comprehension skills, namely literal comprehension and comprehension control. Although older children are expected to be more experienced in reading fluency as compared to younger children, it seems that they still need to acquire a certain threshold in reading fluency to be able to deploy working memory to achieve literal comprehension and comprehension control. This threshold could especially help children with poor working memory to work out the literal comprehension and comprehension control. Therefore, taken together the third finding of this thesis brings an important insight in reading comprehension research in showing the important moderating role of reading fluency in the relationship between working memory and higher-level comprehension skills in both age groups of children.

This finding is surprising. It was expected that reading fluency would not play a major role in reading comprehension, due to the highly transparent orthography of the Albanian language. This prediction was made based on the idea that decoding the written form of words would be straightforward for Albanian-speaking readers, because of the highly regular and predictable grapheme-phoneme correspondences. That being the case, one might expect individual differences in reading fluency to be much less important in Albanian than in languages with more opaque orthographies. Contrary to predictions, however, reading fluency was found to play an important role in reading comprehension in Albanian-speaking children. This was true for both 8- and 10-year-olds.

There are two possible explanations for why reading fluency played a role in the study reported in Chapter 3. The first explanation relates to a lack of preschool education in the current sample of children. The majority of children in Kosovo don't attend preschool. This is important, because it means that word recognition skills are introduced to these children much later than is typically the case in other countries – commonly this begins in Kosovo at around 6 or 7 years of age. As a result, at the time when children are typically becoming independent readers (by around 8 years of age), the process of decoding the written form of words could still be disproportionately effortful for Kosovan children; their relatively late start in reading means they have less practice and less experience in these skills, compared to what one would expect from the samples typically reported in the literature. Moreover, if this were the case, it could very well be that even 10-year-old children have not yet managed to automatize these skills. As a consequence, their reading fluency skills would still play a role in reading comprehension: for these children, decoding words effectively would take up cognitive resources, which might otherwise be used for higher-level reading skills. Therefore, it seems plausible to suggest that although the Albanian language has a highly transparent orthography, with a regular mapping between graphemes and phonemes, this is not sufficient on its own to make reading easy for children. The lack of preschool education may mean that word recognition does not become automated until late childhood or adolescence.

The second possible reason for the later-than-expected contribution of reading fluency in Albanian relates to the grammatical structure of the language. When reading written texts, readers are not only working out the structure and meanings of isolated words. Rather, they are engaging with other aspects of language, including syntax and pragmatics. Being familiar and comfortable with the structure of sentences is a crucial component of the reading comprehension process as a whole. However, the Albanian language has a very complex grammatical structure, with long subordinate clauses and a high proportion of multisyllabic words. Thus, for children learning to read in Albanian, the long developmental course of reading fluency could also arise due to the complex grammar of the language. It may also be the case that difficulties with grammar are exacerbated for those children who were introduced to these complexities only at the age of 6, in the first grade of schooling. Thus, *both* of the possible accounts offered to explain the role of reading fluency in Albanian may be valid.

4.1. Theoretical implications

The research presented in this thesis has a number of implications for theoretical frameworks of reading comprehension. The data presented here broadly confirm the assumptions on the role of working memory in reading comprehension proposed by the Construction-Integration (CI) model (Kintsch, 1988). The CI model posits that working memory plays a central role in reading comprehension, both by maintaining and processing incoming information from the text being read, and also by enabling the retrieval of information from long-term memory. This view is strongly supported by the data presented in this thesis. However, the data in this thesis also suggest incorporation of executive functions in the CI model. In particular, it proposes that the model should incorporate the role of inhibition and cognitive flexibility in the process of constructing mental model for the text read. The data presented in this thesis demonstrate a key role of inhibition in drawing necessary inferences, *and* in simile comprehension. Furthermore, the current thesis reveals that cognitive flexibility plays a significant role in reading comprehension, particularly for drawing elaborative inferences and for comprehension control. Therefore, this thesis suggests an inclusion of executive functions to the CI model of Kintsch (1988), as a key component in reading comprehension among the early independent readers (i.e. 8- and 10-year-old children).

A further theoretical contribution of the current thesis is in highlighting the role of reading fluency as a key moderator of the relationship between domain-general skills and reading comprehension. The current findings on the significant role of reading fluency in reading comprehension suggest that children first need to form a solid basis in reading accuracy and efficiency, in order to free up working memory resources for higher-level comprehension skills. This finding is in line with automaticity theory of LaBerge and Samuels (1974), which posits that better reading fluency allows readers to devote their limited attentional resources to higher-order processes involved in reading comprehension. The data presented in this thesis support this account. Therefore, the current thesis suggests an additional dimension to the CI model of reading comprehension: to integrate the role of reading fluency into the model, to reflect its mediating function as a way of optimising the contribution of domain-general processes to higher-level comprehension.

4.2. Directions for future research

While the current thesis has focused largely on domain-general processes as a way of understanding reading comprehension, there remain other important contributors to reading that also merit study. Of these, arguably the most important is motivation. Motivation is conceived as a psychological process that determines the effort and persistence of an individual's behaviour to take a certain action (Ford, 1992). General theories of motivation suggest that a child's reading ability is strongly associated with their motivation, since readers who are motivated tend to show greater persistence and put more effort into the task, by their own volition (e.g. Lepper & Henderlong, 2000; Logan, Hedfords, & Hughes, 2011). Empirical evidence has also shown that motivation significantly predicts reading comprehension, independent of cognitive skills (e.g. Taboada, Tonks, Wigfield & Guthrie, 2009). Reading comprehension is a process involving a variety of cognitive activities, many of which may prove challenging for inexperienced readers. To successfully carry out all these cognitive tasks, readers must remain actively engaged with the text – even when they find aspects of the process difficult or effortful. Therefore, it is highly likely that motivation could influence a reader's ability to successfully engage with a text. For that reason, studying motivation as a key individual difference may well offer important insights into the development of reading comprehension.

To date, the studies looking at the role of motivation in reading comprehension have tended to look at motivation separately from domain-general cognitive skills. Given the likely important role of motivation in reading comprehension, it would be important to further examine whether motivational factors can explain significant variance in reading comprehension, over and above domain-general cognitive skills – and to see whether these factors interacted. As discussed in previous chapters, deploying working memory and executive functions in reading comprehension is effortful and not a straightforward thing to do. For readers who struggle with the demands of decoding written text and building a mental model of a narrative, motivation might play a crucial role. Equally, for children who set themselves a higher standard of coherence, their success or failure to engage with a text at a deeper level may depend in part on their motivation. It is likely to be informative to unpick the developmental relationship between motivation and domain-general skills – for example, it may be that more motivated readers are able to use potentially limited domain-general skills more effectively than less motivated readers. Conversely, it may be that better domain-general skills lead to more early success with reading, which may increase a child's motivation to read. Pulling apart the developmental relationship between these factors will be an important advance in our understanding of the emergence of reading comprehension.

Another potential role that motivation might play in reading comprehension is through an interaction with sustained attention – that is, the ability to focus on a task for a long time. Knowing that reading comprehension is a complex task, it would not be surprising if sustained attention played a supporting role in this process – not least as sustained attention reportedly helps children transform printed words and sentences into their acousticform (LaBerge & Samules, 1974). Thus, children with poor sustained attention might disengage from a reading comprehension task because they find it difficult, whereas children with better sustained attention might persist in their attempts to understand the text. Empirical evidence has also shown a strong relationship between sustained attention and reading fluency in children, suggesting that children who are better able to sustain their attention over longer durations are better able to decode words. In this way, better attentional skills can lead to better text comprehension (Yildiz & Cetinkaya, 2017). Therefore, because (i) motivation and (ii) sustained attention might *both* play a role in helping children stay on task, it would be beneficial for future work to assess these skills side by side, in order to fully account for the role of each in children's reading. To understand the relationship between motivation and sustained attention in reading comprehension, the following two research questions could be tested in children: i) are there differences in motivation and sustained attention between good and bad readers? And ii) is the relationship between motivation and sustained attention greater in more demanding higher-level comprehension tasks (i.e. necessary inference, elaborative inference and comprehension control) as compared to less demanding comprehension tasks (i.e. literal comprehension)? By answering these questions, we can better understand the role that motivation and sustained attention can play in reading comprehension.

Finally, it would be informative to study the relationship between reading motivation and standard of coherence. Research from the motivation literature shows that readers with high interest and more ambitious goals in reading were better readers than those with lower interests and goals (McWhaw & Abrami, 2001). Moreover, empirical evidence has shown that children who receive training in reading motivation strategies show higher engagement in a reading task (Wigfield, Guthrie, Prenecevich, Taboada, Klauda, McRae, & Barbosao, 2008). In the main study of this thesis, the two age groups of children differed in terms of their reliance on executive functions to achieve the higher-level comprehension skills. Ten-year-olds deployed more domain-general cognitive skills to comprehend the text. This difference has been discussed in terms of older and younger children setting different standards of coherence during reading. This is a plausible suggestion, though clearly it would be informative to have direct empirical evidence on this question. Thus, examining reading motivation *alongside* consideration of the goals that children set for themselves in reading comprehension, would help to address other important and understudied aspects of reading comprehension.

A second research question that would strengthen our understanding of reading comprehension is the role of grammatical knowledge. The use of grammatical knowledge to work out the meanings of individual sentences is obviously an essential part of reading comprehension (Silva & Cain, 2015). In general research suggest that poor readers perform more poorly than good readers on grammatical processing tasks (Catts, Adlof, Weismer, 2006; Goff et al., 2005; Nation et al., 2004; Silva & Cain, 2015). However, the construct of grammar has mostly been examined in its direct relationship with reading comprehension (Cain, 2006; Cain, Oakhill, & Bryant, 2004; Goff et al., 2005; Nation, Clark, Marshall, & Durant, 2004) rather than in its indirect relationship between domain-general cognitive skills and reading comprehension. The data from this thesis show that reading fluency and vocabulary knowledge moderate the influence of domain-general cognitive skills on reading comprehension. It would not be surprising, therefore, if other important foundational reading skills such as grammar knowledge also mediated this relationship. For example, readers with poorer grammatical knowledge could be disadvantaged in multiple ways – they might need to spend additional time and cognitive resources to correctly parse the grammar of a sentence; or they might misinterpret the meaning of a text; or they may face increased requirements to use their comprehension control to monitor and repair errors in their understanding arising from their poor grammatical knowledge.

It would be particularly important to consider the role of grammar alongside the orthography of a language. We know that reading in languages with transparent orthographies is generally easier than reading languages with opaque orthographies. We also know that reading in languages with straightforward grammatical rules is easier than reading in languages with more complex rules. However, since these two factors may call on the same cognitive resources, it is possible that these demands of these two factors will interact during development. If so, we would expect to see the greatest challenge in languages with both opaque orthographies and complex grammatical rules. Conversely, we would expect to see fewer challenges, and earlier emerging reading competence, in languages with both a transparent orthography, and with more straightforward grammatical rules. It would also be informative to see how these factors might interact. For example, Albanian is a language with a highly complex grammatical structure, but a highly transparent orthography. So for readers in Albanian, being able to work out the structure of words in sentences could be a hard thing to do, which would ultimately require extra usage of their cognitive resources – and this in turn might affect their reading comprehension. On the other hand, readers of languages with opaque orthographies (i.e. English), which has a relatively straightforward syntax, would be better able to work out grammar structures in the text they read, and as a result would spare cognitive resources for their reading comprehension. Therefore, an intriguing future question could be whether it is easier to read in a language with opaque orthography but simpler grammar, or in a language with transparent orthography but complex grammar. Testing a plausible interaction between grammar and orthography would help us better understand the extent to which, and under what conditions, grammatical structure plays a role in reading comprehension in languages with different orthographic transparency.

4.3. Practical implications

The present findings also have a number of practical implications of relevance to those who may be teaching children to read. Overall, the current findings are entirely consistent with the view that executive functions, working memory and reading fluency are important domains that aid reading comprehension in children. This view represents a potentially valuable starting point for identifying children who may struggle with reading comprehension – and for identifying possible ways of supporting children as they learn to read. Thus, the first important practical implication of the current data is the observation that executive functions play a central part in reading comprehension. By extension, children who struggle with executive functions may very well also have difficulty when learning to read. Since it is possible to measure executive functions with reasonably good accuracy from the age of 4 years, it is also possible that early assessments of executive function could identify children who might later struggle with reading, and who may potentially benefit from additional support early in the process of learning to read. Given the likely contribution that motivation has in helping children to develop reading skills, it would be positive and advantageous to be able to proactively engage with children who may find reading difficult, and to provide both support and encouragement as they learn to read. Such an approach would avoid the potentially negative spiral that may ensue from leaving reading difficulties unidentified and unsupported.

The second implication follows on from the finding that reading fluency interacted with working memory in explaining the majority of the higher-level comprehension skills. is a crucial determiner of how well children read. That being the case, it may be beneficial for teachers to consider implementing reading fluency training for readers who may be struggling with reading comprehension. This could be mainly done by giving children the opportunity to read and then re-read the same text so as to practice word reading. Also, another good strategy would be to have children practice their reading orally with an opportunity to receive corrections and guidance. Educators could promote this skill, by inviting children to read aloud and receive specific feedback through systematic feedback progress monitoring also helps them improve their reading fluency. Therefore, considering the findings of this thesis, future practitioners might be able to decrease or even overcome reading comprehension difficulties in children through the targeted use of intensive working memory training.

Finally, the findings in this thesis showing the vital role of domain-general skills to different aspects of reading comprehension could also help practitioners to adapt teaching methods that assist children with the executive demands of reading comprehension. This could be achieved via two distinct routes. First, by helping children to build a mental model for the text, by making explicit ideas that may have otherwise been implicit and perhaps unclear. This is mainly achieved by helping children analyse pieces of the text and then gradually bring the pieces together. If we look at the example made by Oakhill and colleagues (2014); with the sentence "Sleepy Jack was late for school again", teachers can help children explore information that each of the words in the sentence provide. For example, *sleepy* suggests that the character may have overslept, and indicating that this could be a reason for being late for school, *Jack* combined with *school* suggests that this is a schoolchild and not a teacher, etc. This way children can gradually move to analysing paragraphs and entire story and eventually be able to build accurate mental models for the text read. And second, by adapting reading comprehension methodologies that can reduce demands on executive functions. For example, for readers who find reading comprehension overwhelming, teachers could encourage children to take brief notes of main points of the text as they read, or could highlight key information in the text (i.e. character names, motives and places where events take place). Taken together, this thesis calls for a comprehensive approach in teaching reading comprehension to children, with a core focus on executive functions and working memory.

4.4. Conclusion

In summary, the work presented in this thesis contributes to our understanding of the processes involved in reading comprehension in children. Firstly, it demonstrates that all five higher-level comprehension skills are significantly underpinned by working memory and executive functions. Based on the supporting role played by domain-general cognitive skills, in this thesis the higher-level comprehensions have been categorized into three main groups: i) literal comprehension was found to be underpinned by working memory and cognitive flexibility; ii) necessary inference and simile comprehension were both found to be underpinned by working memory and inhibition; and iii) generation of elaborative inferences and comprehension control were found to be underpinned by working memory and executive functions. Based on these findings, this thesis calls for a greater and better specified role for executive functions in the current theoretical models of reading comprehension.

On a practical level, the findings from this thesis can also help educators in both identifying causes of failures in reading comprehension tasks, and in designing training programs which integrate reading comprehension skills and domain-general cognitive skills in children who struggle with reading comprehension. Secondly, the work presented in this thesis shows that the contribution of domain-general cognitive abilities to reading changes as a function of age, playing a more of a role in older children as compared to younger children – though we would also expect this contribution to decrease further with age, as aspects of reading become more automated. It was suggested that this developmental change may arise due to i) differences in children’s level of experience in lower-level skills, with older children having gained more practice in these skills, and/or ii) children's standard of coherence, and specifically because older (and typically more proficient) readers may adopt a higher standard of coherence, which in turn places additional requirements on children's domain-general skills. Thirdly, the work presented in this thesis reveals a vital role played by reading fluency in reading comprehension, plausibly by helping children save cognitive resources, meaning that they can devote greater capacity to higher-level comprehension skills. This thesis expands on executive functions research by highlighting reading fluency as a mechanism by which domain-general cognitive skills contribute to reading comprehension. Finally, the work presented in this thesis demonstrate a plausible interaction between orthographic transparency and domain-general cognitive skills in the process of building a mental model for the text.

Appendix A

The order of Items in the original adapted British Picture Vocabulary Scale task

Item	Prompt-English	Albanian	Set	Correct
0a	Ball	Topi	W	2
0b	Crying	Vaji	W	4
0c	Tooth	Dhëmbi	W	2
0d	Mowing	Kositja	W	3
1	Hand	Dora	1	1
2	Baby	Beba	1	2
3	Cat	Macja	1	2
4	Jumping	Kërcimi	1	4
5	Bus	Autobusi	1	4
6	Drinking	Pija	1	3
7	Tractor	Traktori	1	4
8	Running	Vrapimi	1	1
9	Gate	Porta	1	3
10	Reading	Leximi	1	2
11	Cow	Lopa	1	1
12	Drum	Daulle	1	3
13	Ladder	Shkallët	2	2
14	Plant	Bima	2	1
15	Circle	Rrethi	2	4
16	Candle	Qiriu	2	2

17	**Wooden**	**Drurit**	**2**	**2**
18	**Nest**	**Foleja**	**2**	**4**
19	**Dancing**	**Vallëzimi**	**2**	**4**
20	**Tortoise**	**Breshka**	**2**	**1**
21	**Farmer**	**Fermeri**	**2**	**3**
22	**Cobweb**	**Gracka**	**2**	**3**
23	**Neck**	**Qafa**	**2**	**3**
24	**Penguin**	**Penguin**	**2**	**1**
25	**Wrapping**	**Paketim**	**3**	**4**
26	**Fruit**	**Frutat**	**3**	**1**
27	**Smelling**	**Nuhatja**	**3**	**3**
28	**Arrow**	**Shigjeta**	**3**	**1**
29	**Teacher**	**Mësuesi**	**3**	**2**
30	**Full**	**Plot**	**3**	**3**
31	**Panda**	**Panda**	**3**	**4**
32	**Exercising**	**Ushtrimi**	**3**	**4**
33	**Coin**	**Monedhë**	**3**	**2**
34	**Claw**	**Kthetra**	**3**	**1**
35	**Measuring**	**Mat**	**3**	**2**
36	**Peeling**	**Qërim**	**3**	**3**
37	**Tambourine**	**Dajre**	**4**	**1**
38	**Castle**	**Kështjellë**	**4**	**2**
39	**Lock**	**Dry**	**4**	**4**
40	**Telescope**	**Teleskop**	**4**	**3**
41	**Dripping**	**Pikon**	**4**	**2**
42	**Huge**	**Gjigante**	**4**	**3**

43	**Furry**	**Leshatuke**	**4**	**4**
44	**Nostril**	**vrimë hunde**	**4**	**1**
45	**Roots**	**Rrënjë**	**4**	**1**
46	**Vegetable**	**Perime**	**4**	**3**
47	**Diving**	**Zhytja**	**4**	**2**
48	**Liquid**	**Lëng**	**4**	**4**
49	**Luggage**	**Valixhe**	**5**	**3**
50	**Dentist**	**Dentist**	**5**	**3**
51	**Weasel**	**Nuselale**	**5**	**2**
52	**Tugging**	**Terheqje**	**5**	**1**
53	**Hive**	**Koshere**	**5**	**1**
54	**Delighted**	**Gëzuar**	**5**	**4**
55	**Globe**	**Glob**	**5**	**3**
56	**Furious**	**Inatosur**	**5**	**4**
57	**Swamp**	**Moçal**	**5**	**1**
58	**Waiter**	**Kamarier**	**5**	**2**
59	**Target**	**Shenjestër**	**5**	**2**
60	**Eagle**	**Shqiponjë**	**5**	**4**
61	**Pair**	**Pale**	**6**	**2**
62	**Coming**	**Vjen**	**6**	**4**
63	**Tubular**	**Gypor**	**6**	**2**
64	**Interviewing**	**Interviston**	**6**	**1**
65	**Snarling**	**Hungërim**	**6**	**1**
66	**Medication**	**Ilaq**	**6**	**4**
67	**Pod**	**Bishtajë**	**6**	**1**
68	**Grain**	**Drith**	**6**	**4**

69	**Pedal**	**Pedale**	**6**	**3**
70	**Predatory**	**Grabitqar**	**6**	**2**
71	**Balcony**	**Ballkon**	**6**	**3**
72	**Polluting**	**Ndot**	**6**	**3**
73	**Greeting**	**Mirëpritje**	**7**	**4**
74	**Antlers**	**bri degë**	**7**	**1**
75	**Orbit**	**Orbitë**	**7**	**1**
76	**Collision**	**Përplasje**	**7**	**1**
77	**Inflated**	**Fryrë**	**7**	**4**
78	**Applauded**	**Duartrokitur**	**7**	**3**
79	**Nutritious**	**Ushqyes**	**7**	**3**
80	**Adjustable**	**Përshtatëse**	**7**	**2**
81	**Scalp**	**Kafkë**	**7**	**2**
82	**Reptile**	**Zvarranik**	**7**	**2**
83	**Resuscitation**	**Ringjallje**	**7**	**3**
84	**Links**	**Lidhë**	**7**	**4**
85	**Arctic**	**Arktike**	**8**	**2**
86	**Glider**	**Fluturake**	**8**	**2**
87	**Lecturing**	**Ligjërim**	**8**	**3**
88	**Engraving**	**Gdhendje**	**8**	**1**
89	**co-operation**	**Bashkëpunim**	**8**	**2**
90	**Fictional**	**Imagjinare**	**8**	**3**
91	**Hoisting**	**Ngritje**	**8**	**1**
92	**Isolation**	**Izolim**	**8**	**3**
93	**Syringe**	**Shiringë**	**8**	**4**
94	**Composing**	**Komponuar**	**8**	**4**

95	**Fern**	**Fier**	**8**	**1**
96	**Weary**	**Molisje**	**8**	**4**
97	**Parallel**	**Parallel**	**9**	**4**
98	**Dilapidated**	**Rrenuar**	**9**	**3**
99	**Departing**	**Nisje**	**9**	**2**
100	**Easel**	**Këmbalec**	**9**	**4**
101	**Embracing**	**Përqafuar**	**9**	**3**
102	**Utensil**	**Vegel**	**9**	**2**
103	**Quartet**	**Kuartet**	**9**	**4**
104	**Citrus**	**Agrume**	**9**	**3**
105	**Digit**	**Shifër**	**9**	**1**
106	**Feline**	**e maces**	**9**	**2**
107	**Pillar**	**Shtyllë**	**9**	**1**
108	**Timer**	**Kohëmatës**	**9**	**1**
109	**Detonation**	**Detonim**	**10**	**2**
110	**Summit**	**Majë**	**10**	**4**
111	**Salutation**	**Nderim**	**10**	**1**
112	**Agricultural**	**Bujqësore**	**10**	**4**
113	**Geriatric**	**Geriatrike**	**10**	**3**
114	**Talon**	**Thunder**	**10**	**3**
115	**Consuming**	**Konsumim**	**10**	**3**
116	**Dwelling**	**Vendbanim**	**10**	**1**
117	**Emaciated**	**Holluar**	**10**	**2**
118	**Lubricating**	**Vajosje**	**10**	**1**
119	**Descending**	**Zbritur**	**10**	**2**
120	**Spherical**	**Sferike**	**10**	**4**

121	**Exterior**	**Jashtme**	**11**	**1**
122	**Trestle**	**Kercimtar**	**11**	**2**
123	**Perforated**	**Shpuar**	**11**	**2**
124	**Fowl**	**Shpend**	**11**	**3**
125	**Cascade**	**Kaskadë**	**11**	**4**
126	**Vagrant**	**Endacak**	**11**	**1**
127	**Trajectory**	**Trajektore**	**11**	**1**
128	**Inoculating**	**Depërtoj**	**11**	**2**
129	**Arable**	**Lërueshme**	**11**	**3**
130	**Beacon**	**Sinjalizim**	**11**	**4**
131	**Deciduous**	**Gjethërënës**	**11**	**4**
132	**Submerging**	**Zhytje**	**11**	**3**
133	**Physician**	**Mjeku**	**12**	**1**
134	**Attire**	**Petkë**	**12**	**4**
135	**Converging**	**Konvergjente**	**12**	**2**
136	**Receptacle**	**Kasë**	**12**	**1**
137	**Festoon**	**Stoli**	**12**	**3**
138	**incarcerating**	**Prangosje**	**12**	**3**
139	**Incline**	**Pjerrtësi**	**12**	**4**
140	**Encumbered**	**Ngarkuar**	**12**	**3**
141	**Caster**	**Hedhës**	**12**	**1**
142	**Equestrian**	**Kalorës**	**12**	**2**
143	**Convex**	**Konveks**	**12**	**4**
144	**Culinary**	**Kulinare**	**12**	**2**
145	**Munificence**	**Dorëgjëresi**	**13**	**1**
146	**Nautical**	**Lundrim**	**13**	**4**

147	**Incertitude**	**Pasiguri**	**13**	**2**
148	**Gaff**	**Kanxhë**	**13**	**1**
149	**terpsichorean**	**Kërcimtar**	**13**	**2**
150	**Bovine**	**Gjedhit**	**13**	**3**
151	**Pedagogue**	**Pedagog**	**13**	**4**
152	**Succulent**	**Lëngshëm**	**13**	**3**
153	**Altercation**	**Zënkë**	**13**	**3**
154	**Copious**	**Bollëk**	**13**	**2**
155	**Objurgating**	**Qortim**	**13**	**4**
156	**Cenotaph**	**Përmendore**	**13**	**1**
157	**Nidificating**	**Vendosje**	**14**	**3**
158	**perambulating**	**Shëtites**	**14**	**2**
159	**Vitreous**	**Qelqor**	**14**	**3**
160	**Supine**	**Plogët**	**14**	**4**
161	**Osculating**	**Puthitur**	**14**	**1**
162	**Laciniated**	**Dentelle**	**14**	**1**
163	**Lugubrious**	**Ngrysur**	**14**	**2**
164	**Pachyderm**	**Pakiderm**	**14**	**2**
165	**Imbibing**	**Absorbim**	**14**	**4**
166	**Casement**	**Kornizë**	**14**	**3**
167	**Tonsorial**	**Qethës**	**14**	**4**
168	**Calyx**	**Kaliks**	**14**	**1**

Appendix B

List of re-adapted item order in the British Picture Vocabulary Scale task

Item	Prompt-English	Albanian	Set	Correct
0a	Ball	Topi	W	2
0b	Crying	Vaji	W	4
0c	Tooth	Dhëmbi	W	2
0d	Mowing	Kositja	W	3
1	Hand	Dora	1	1
2	Baby	Beba	1	2
3	Cat	Macja	1	2
4	Jumping	Kërcimi	1	4
5	Bus	Autobusi	1	4
6	Drinking	Pija	1	3
7	Tractor	Traktori	1	4
8	Running	Vrapimi	1	1
9	Gate	Portë	1	3
10	Reading	Lexim	1	2
11	Cow	Lopa	1	1
12	Drum	Daulle	1	3
13	Ladder	Shkallët	2	2
14	Plant	Bima	2	1
15	Circle	Rrethi	2	4
16	Candle	Qiriu	2	2
17	Wooden	Drurit	2	2
18	Nest	Foleja	2	4

19	**Dancing**	**Vallëzimi**	**2**	**4**
20	**Tortoise**	**Breshka**	**2**	**1**
21	**Farmer**	**Fermeri**	**2**	**3**
22	**Cobweb**	**Gracka**	**2**	**3**
23	**Neck**	**Qafa**	**2**	**3**
24	**Penguin**	**Penguin**	**2**	**1**
25	**Wrapping**	**Paketim**	**3**	**4**
26	**Fruit**	**Frutat**	**3**	**1**
27	**Smelling**	**Nuhatje**	**3**	**3**
28	**Arrow**	**Shigjeta**	**3**	**1**
29	**Teacher**	**Mësuesi**	**3**	**2**
30	**Full**	**Plot**	**3**	**3**
31	**Panda**	**Panda**	**3**	**4**
32	**Exercising**	**Ushtrimi**	**3**	**4**
33	**Coin**	**Monedhë**	**3**	**2**
34	**Claw**	**Kthetër**	**3**	**1**
35	**Measuring**	**Mat**	**3**	**2**
36	**Peeling**	**Qërim**	**3**	**3**
37	**Tambourine**	**Dajre**	**4**	**1**
38	**Castle**	**Kështjellë**	**4**	**2**
39	**Lock**	**Dry**	**4**	**4**
40	**Telescope**	**Teleskop**	**4**	**3**
41	**Dripping**	**Pikon**	**4**	**2**
42	**Huge**	**Gjigante**	**4**	**3**
43	**Furry**	**Leshatuke**	**4**	**4**
44	**Nostril**	**vrimë hunde**	**4**	**1**

45	**Roots**	**Rrënjë**	**4**	**1**
46	**Vegetable**	**Perime**	**4**	**3**
47	**Diving**	**Zhytja**	**4**	**2**
48	**Liquid**	**Lëng**	**4**	**4**
49	**Luggage**	**Valixhe**	**5**	**3**
50	**Dentist**	**Dentist**	**5**	**3**
51	**Weasel**	**Nuselale**	**5**	**2**
52	**Tugging**	**Terheqje**	**5**	**1**
53	**Hive**	**Koshere**	**5**	**1**
54	**Delighted**	**Gëzuar**	**5**	**4**
55	**Globe**	**Glob**	**5**	**3**
56	**Furious**	**Inatosur**	**5**	**4**
57	**Swamp**	**Moçal**	**5**	**1**
58	**Waiter**	**Kamarier**	**5**	**2**
59	**Target**	**Shenjestër**	**5**	**2**
60	**Eagle**	**Shqiponjë**	**5**	**4**
61	**Pair**	**Pale**	**6**	**2**
62	**Coming**	**Vjen**	**6**	**4**
63	**Tubular**	**Gypor**	**6**	**2**
64	**Interviewing**	**Interviston**	**6**	**1**
65	**Snarling**	**Hungërim**	**6**	**1**
66	**Medication**	**Ilaq**	**6**	**4**
67	**Pod**	**Bishtajë**	**6**	**1**
68	**Grain**	**Drith**	**6**	**4**
69	**Pedal**	**Pedale**	**6**	**3**
70	**Predatory**	**Grabitqar**	**6**	**2**

71	**Balcony**	**Ballkon**	**6**	**3**
72	**Polluting**	**Ndot**	**6**	**3**
73	**Greeting**	**Mirëpritje**	**7**	**4**
74	**Antlers**	**bri degë**	**7**	**1**
75	**Orbit**	**Orbitë**	**7**	**1**
76	**Collision**	**Përplasje**	**7**	**1**
77	**Inflated**	**Fryrë**	**7**	**4**
78	**Applauded**	**Duartrokitur**	**7**	**3**
79	**Nutritious**	**Ushqyes**	**7**	**3**
80	**Adjustable**	**Përshtatëse**	**7**	**2**
81	**Scalp**	**Kafkë**	**7**	**2**
82	**Reptile**	**Zvarranik**	**7**	**2**
83	**Resuscitation**	**Ringjallje**	**7**	**3**
84	**Links**	**Lidhë**	**7**	**4**
85	**Arctic**	**Arktike**	**8**	**2**
86	**Glider**	**Fluturake**	**8**	**2**
87	**Lecturing**	**Ligjërim**	**8**	**3**
88	**Engraving**	**Gdhendje**	**8**	**1**
89	**co-operation**	**Bashkëpunim**	**8**	**2**
90	**Fictional**	**Imagjinare**	**8**	**3**
91	**Hoisting**	**Ngritje**	**8**	**1**
92	**Isolation**	**Izolim**	**8**	**3**
93	**Syringe**	**Shiringë**	**8**	**4**
94	**Composing**	**Komponuar**	**8**	**4**
95	**Fern**	**Fier**	**8**	**1**
96	**Weary**	**Molisje**	**8**	**4**

97	**Parallel**	**Parallel**	**9**	**4**
98	**Dilapidated**	**Rrënuar**	**9**	**3**
99	**Departing**	**Nisje**	**9**	**2**
100	**Easel**	**Këmbalec**	**9**	**4**
101	**Embracing**	**Përqafuar**	**9**	**3**
102	**Utensil**	**Vegel**	**9**	**2**
103	**Quartet**	**Kuartet**	**9**	**4**
104	**Citrus**	**Agrume**	**9**	**3**
105	**Digit**	**Shifër**	**9**	**1**
106	**Feline**	**e macës**	**9**	**2**
107	**Pillar**	**Shtyllë**	**9**	**1**
108	**Timer**	**Kohëmatës**	**9**	**1**
109	**Detonation**	**Detonim**	**10**	**2**
110	**Summit**	**Majë**	**10**	**4**
111	**Salutation**	**Nderim**	**10**	**1**
112	**Agricultural**	**Bujqësore**	**10**	**4**
113	**Geriatric**	**Geriatrike**	**10**	**3**
114	**Talon**	**Zhunder**	**10**	**3**
115	**Consuming**	**Konsumim**	**10**	**3**
116	**Dwelling**	**Vendbanim**	**10**	**1**
117	**Emaciated**	**Holluar**	**10**	**2**
118	**Tonsorial**	**Qethës**	**10**	**1**
119	**Descending**	**Zbritur**	**10**	**2**
120	**Spherical**	**Sferike**	**10**	**4**
121	**Exterior**	**Jashtme**	**11**	**1**
122	**Trestle**	**Kercimtar**	**11**	**2**

123	**Perforated**	**Shpuar**	**11**	**2**
124	**Fowl**	**Shpend**	**11**	**3**
125	**Cascade**	**Kaskadë**	**11**	**4**
126	**Vagrant**	**Endacak**	**11**	**1**
127	**Trajectory**	**Trajektore**	**11**	**1**
128	**Inoculating**	**Depërtoj**	**11**	**2**
129	**Arable**	**Lërueshme**	**11**	**3**
130	**Beacon**	**Sinjalizim**	**11**	**4**
131	**Deciduous**	**Gjethërënës**	**11**	**4**
132	**Submerging**	**Zhytje**	**11**	**3**
133	**Physician**	**Mjek**	**12**	**1**
134	**Attire**	**Petkë**	**12**	**4**
135	**Converging**	**Konvergjente**	**12**	**2**
136	**Receptacle**	**Kasë**	**12**	**1**
137	**Festoon**	**Stoli**	**12**	**3**
138	**incarcerating**	**Prangosje**	**12**	**3**
139	**Incline**	**Pjerrtësi**	**12**	**4**
140	**Encumbered**	**Ngarkuar**	**12**	**3**
141	**Funner**	**Hinkë**	**12**	**1**
142	**Equestrian**	**Kalorës**	**12**	**2**
143	**Convex**	**Konveks**	**12**	**4**
144	**Culinary**	**Kulinare**	**12**	**2**
145	**Munificence**	**Dorëgjëresi**	**13**	**1**
146	**Nautical**	**Lundrim**	**13**	**4**
147	**Incertitude**	**Pasiguri**	**13**	**2**
148	**Gaff**	**Kanxhë**	**13**	**1**

149	**Trestle**	**Skele**	**13**	**2**
150	**Osculating**	**Puthitje**	**13**	**3**
151	**Pedagogue**	**Pedagog**	**13**	**4**
152	**Succulent**	**Lëngshëm**	**13**	**3**
153	**Altercation**	**Zënkë**	**13**	**3**
154	**Copious**	**Bollëk**	**13**	**2**
155	**Objurgating**	**Qortim**	**13**	**4**
156	**Cenotaph**	**Përmendore**	**13**	**1**
157	**Nidificating**	**Vendosje**	**14**	**3**
158	**perambulating**	**Shëtites**	**14**	**2**
159	**Vitreous**	**Qelqor**	**14**	**3**
160	**Supine**	**Shpinor**	**14**	**4**
161	**Bovine**	**Gjedhit**	**14**	**1**
162	**Laciniated**	**Dentelle**	**14**	**1**
163	**Lugubrious**	**Ngrysur**	**14**	**2**
164	**Pachyderm**	**Pakiderm**	**14**	**2**
165	**Imbibing**	**Absorbim**	**14**	**4**
166	**Casement**	**Kornizë**	**14**	**3**
167	**Lubricating**	**Vajosje**	**14**	**4**
168	**Calyx**	**Kaliks**	**14**	**1**

Appendix C

A full list of items in the adapted version of the Reading Fluency task

Të	**Ai**	**Kam**	**Prokurori**	**Liderit**
E	**Si**	**Policisë**	**Yt**	**Mjegull**
Në	**Tij**	**Ose**	**Firmosur**	**Thelluar**
De	**Kanë**	**Cilët**	**Rrethit**	**Grindjet**
I	**Po**	**Mënyrë**	**Mal**	**Përhershme**
Që	**Duke**	**Tjerë**	**Njihet**	**Deklarimi**
Për	**Janë**	**Nëpër**	**Lashtë**	**Premtimeve**
Me	**Kishte**	**O**	**Datë**	**Klani**
Një	**Shumë**	**Lidhur**	**Qëndrimi**	**Llum**
Nga	**Këtë**	**Jenë**	**Personale**	**Rivaliteti**
Ka	**Ta**	**Deklaruar**	**Paguajë**	**Numrash**
Me	**Prej**	**Rast**	**Flasim**	**Mirënjohjeje**
Se	**Gjithë**	**Jezu**	**Organizatë**	**Servilizmi**
Është	**Qenë**	**Ditët**	**Prodhimit**	**Milleniumit**
Do	**Sipas**	**Ati**	**Varrit**	**Nishan**
Nuk	**Disa**	**Vrarë**	**Verifikuar**	**Parakalimin**
Se	**Ne**	**Bëra**	**Sështë**	**Tepërtit**
U	**Para**	**Gjithnjë**	**Ndan**	**Imperialiste**
Por	**Deri**	**Komisariatit**	**Valën**	**Lëvdoni**
Edhe	**Jetë**	**Rakipi**	**gjashtëdhjetë**	**shkumës**

Appendix D

A full list of items in the adapted version of the Listening Recall task

	Lista e ushtrimeve	Sakt/Pasakt	Përkujtimi	Rezultati(1 ose 0)
P1	Elefantët kanë katër këmbë	S	Këmbë	
P2	Ananaset luajnë futboll	P	Futboll	
P3	Peshqit kanë shumë flokë	P	Flokë	
	Librat kanë faqe	S	Faqe	
P4	Patat notojnë në liqe	S	Liqe	
	Veturat kanë veshë	P	Veshë	
Span	Lista	Sakt/Pasakt	Perkujtimi	Rezultati(1 ose 0)
1	Gërshërët prejnë letra	S	Letra	
	Peshku ka flokë	P	Flokë	
	Thikat janë të mprehta	S	Mprehta	
	Marimangat krijojnë rrjeta	S	Rrjeta	
	Orat hajnë molla	P	Molla	
	Topat janë katror	P	Katror	
2	Portokajt jetojnë në ujë Trëndafilët kanë aromë të mire	P S	Ujë Mire	
	Karriget bëjnë vezë Bananet kanë dhëmbë	P P	Vezë Dhëmbë	
	Këpucët mbathen në këmbë Mollet rriten në drunjë	S S	Këmbë Drunjë	
	Njerëzit kanë veshë	S	Veshë	

	Portokajt kanë tinguj	**P**	**Tinguj**	
	Gishtërinjtë janë në duar **Delet kanë krahë**	**S** **P**	**Duar** **Krahë**	
	Macet punojnë në shkollë **Dërrkucët kanë të rrumbullakët bishtin**	**P** **S**	**Shkollë** **Bishtin**	
3	**Veturat kanë rrota** **Lepujt i kanë të gjatë veshët** **Biqikletat hajnë bari**	**S** **S** **P**	**Rrota** **Veshët** **Barin**	
	Elefantët janë të trashë **Autobuset mund të flasin** **Qejt mund të lehin**	**S** **P** **S**	**Trashë** **Flasin** **Lehin**	
	Peshqit jetojnë në tokë **Akullorja është e nxehtë** **Pijanoja ka tinguj**	**P** **P** **S**	**Tokë** **Nxehtë** **Tinguj**	
	Baballarët kanë krahë **Pulët bëjnë vezë** **Peshku mund të punoj**	**P** **S** **P**	**Krahë** **Veze** **Punoj**	
	Lopa mund të qeshë **Dhëmbët gjinden në gojë** **Qejt mund të flasin**	**P** **S** **S**	**Qeshë** **Gojë** **Flasin**	
	Njerëzit kanë dy këmbë **Gurët janë të rëndë** **Qielli është i gjelbër**	**S** **S** **P**	**Këmbë** **Rëndë** **Gjelbër**	
4	**Dielli është i nxehtë**	**S**	**Nxehtë**	

	Bananet veshin rroba **Shtëpia mund të këndoj** **Hundën e ke në fytyrë**	**P** **P** **S**	**Rroba** **Këndoj** **Fytyrë**	
	Rrotët janë katror **Gjirafat kanë të gjatë qafen** **Thikat janë të buta** **Fëmijët shkojnë në shkollë**	**P** **S** **P** **S**	**Katror** **Qafën** **Buta** **SHkollë**	
	Kutia është katrorë **Qejtë mund të luajnë gitar** **Karrotat janë të kaltra** **Aeroplanet kanë krahë**	**S** **P** **P** **S**	**Katrorë** **Gitarë** **Kaltra** **Krahë**	
	Peshqit jetojnë në ujë **Lepujt rriten në drunjë** **Patat kanë vija në këmbë** **Drunjtë kanë flokë**	**S** **P** **S** **P**	**Ujë** **Drunjë** **Këmbë** **Flokë**	
	Motrat janë vajza **Bretkosa mund të punoj** **Dërrkucët kanë rrota** **Lulet ndjekin minjtë**	**S** **S** **P** **P**	**Vajza** **Punoj** **Rrota** **Minjtë**	
	Macet luajnë futboll **Shtëpitë kanë dyer** **Peshkaqejt i kanë të mëdhenjë dhëmbët** **Autobuset luajnë me lodra**	**P** **S** **S** **P**	**Futboll** **Dyer** **Dhëmbët** **Lodra**	

5	**Protokajt kanë veshë**	**P**	**Veshë**	
	Motrat kanë të kaqurelt bishtin	**P**	**Bishtin**	
	Kamionet kalojnë në rrugë	**S**	**Rrugë**	
	Baballaret janë burra	**S**	**Burra**	
	Kapelat veshën në kokë	**S**	**Kokë**	
	Majmunët jetojnë në drunjë	**S**	**Drunjë**	
	Mësueset rriten në bimë	**P**	**Bimë**	
	Dimri është i nxehtë	**P**	**Nxehtë**	
	Portokajt shiten në dyqan	**S**	**Dyqan**	
	Bananet janë të verdha	**S**	**Verdha**	
	Dërrkucet ngasin trenin	**P**	**Trenin**	
	Molla mund të këndoj	**P**	**Këndoj**	
	Autobusët kanë shofer	**S**	**Shofer**	
	Zebrat tegojnë orën	**P**	**Orën**	
	Bora është e ftohtë	**S**	**Ftohtë**	
	Delet hajnë bari	**S**	**Bari**	
	Drunjtë kanë tinguj	**P**	**Tinguj**	
	GJirafet kanë dy rrota	**P**	**Rrota**	
	Dredhëzat janë të kuqe	**S**	**Kuqe**	
	Motocikletat mund të lehin	**P**	**Lehin**	
	Drunjtë mund të ecin	**P**	**Ecin**	
	Macet ndjekin minjtë	**S**	**Minjtë**	
	Bebet mund të qajnë	**S**	**Qajnë**	
	Elefantet janë të shkurtër	**P**	**Shkurtër**	

	Mësueset punojnë në shkollë	S	Shkollë	
	Njerëzit kanë dy sy Veturët kanë rrota Delet jetojnë në fusha Peshqit mund të flasin Dielli është i ftohtë	S S S P P	Veshë Rrota Fusha Flasin Ftohtë	
6	Bletët mund të shpojnë Bretkosat kanë të gjatë veshët Çorapet vishen në këmbë Vëllezërit qelin në oborr Krimbi ka eshtra Zjarri është i nxehtë	S P S P P S	Shpojnë Veshët Këmbë Oborr Eshtra Nxehtë	
	Motoçikletat kanë dy rrota Arushët janë të butë Dërrkucët shkojnë në shkollë Ora tregon kohën Pula mund të shkruaj Akullorja është e ftohtë	S S P S P S	Rrota Butë Shkollë Kohën Shkruaj Ftohtë	
	Zebrat kanë vija GJuhën e ke në bark Minjtë janë shumë të trashë Karriget kanë këmbë Librat janë për lexim	S P P S S	Vija Bark Ngadalt Trashë Lexim	

	Veshët janë për shiqim	P	Shiqim	
	Dyqanet shesin ushqim Veturave i duhet benzina Malet janë shumë të shkurtra Qejtë ndjekin macet Dredhëzat janë të kaltra Bankat kanë pare	S S P P P S	Ushqim Benzin Shkurtra Macet Kaltra Pare	
	Tortat janë të ëmbla Mjekrrën e ke në këmbë Lugët janë për të shkruar Femijët kanë tri duar Vëllezërit janë meshkuj Kërmijtë janë të ngadalt	S P P P S S	Ëmbla Këmbë Shkruar Duar Meshkuj Ngadalt	
	Koha e mbrëmjës është nata Bari është i bardhë NJerëzit kanë dy faqe Portokajt janë të gjelbër Anijet mund të qeshin Lulet hajnë pite	S P S P P P	Nata Bardhë Faqe Gjelbër Qeshin Pite	
			Numri i sakte i detyrave Span	

Appendix E

A full list of items in the adapted version of the Proactive Interference Task

Lista 1	Perkujtimi	Lista 2	Perkujitmi	Lista 3	Perkujtimi
kali		pula		luani	
gomari		dhija		qeni	
derrkuci		pëllumbi		delja	
zogu		lepuri		ariu	
53		44		62	
Lista 1	Perkujtimi	Lista 2	Perkujtimi	lista 3	Perkujtimi
molla		gështenja		dredhëza	
bostani		rrushi		shega	
pjepri		Fiku		bananja	
qershia		limoni		dardha	
52		68		87	
Lista 1	Perkujitmi	Lista 2	Perkujtimi	Lista 3	Perkujtimi
ndërtues		ushtar		shofer	
polic		frizer		postier	
mekanik		arkitekt		muzikant	
aktor		doktor		piktor	
68		90		36	
Lista 1	Perkujtimi	Lista 2	Perkujtimi	Lista 3	Perkujtimi
nofulla		vetulla		barku	
këmba		veshi		krahrori	
shpatulla		qerpiku		zorra	
shpina		gjuri		mëlqia	

Appendix F

An extract of a full story and questions to the story from the adapted version of the reading comprehension task

Alexis waited until he was alone in the house. The only sound he could hear was his father's axe in the shed. Alexis checked every room. His mother had gone shopping. He pushed a chair in front of the sink. Like an acrobat, Alexis reached the biscuit tin. The tin was behind the sugar. Alexis stretched and managed to lift the lid up. As he reached inside the tin, the door opened. There stood his sister, smiling at him. However, Alexis's face looked like a lemon.

Literal questions

What happened as Alexis reached inside the tin?

Where was the biscuit tin?

Necessary inference questions

Why did Alexis want to be alone?

What did he want the chair for?

Elaborative inference questions

Which room was Alexis in?

What was Alexis's father doing?

Simile comprehension questions

In what way did Alexis reach the biscuit tin?

How did he feel when he saw his sister?

Comprehension control questions

Why didn't Alexis ask his father to give him the biscuits?

Why was Alexis happy to see his sister?

Appendix G

A detailed grading procedure of the reading comprehension task

	PRACTICE STORY	STORY 1	STORY 2	STORY 3	STORY 4
Total number of words	**59**	**74**	**81**	**82**	**89**
Total number of sentences	**11**	**9**	**9**	**8**	**8**
Sentence 1 (number of words)	**6**	**6**	**10**	**9**	**12**
Sentence 2	**6**	**7**	**9**	**13**	**11**
Sentence 3	**5**	**9**	**10**	**9**	**13**
Sentence 4	**5**	**9**	**9**	**10**	**11**
Sentence 5	**4**	**6**	**9**	**10**	**11**
Sentence 6	**5**	**9**	**6**	**11**	**11**
Sentence 7	**4**	**11**	**8**	**11**	**11**
Sentence 8	**6**	**9**	**12**	**8**	**9**
Sentence 9	**7**	**8**			
Sentence 10	**5**				
Sentence 11	**5**				

	PRACTICE STORY	STORY 1	STORY 2	STORY 3	STORY 4
Nouns	**29**	**27**	**22**	**22**	**25**
Adjectives	**0**	**3**	**4**	**5**	**9**
Adverbs	**4**	**5**	**8**	**12**	**7**
Verbs	**16**	**19**	**21**	**22**	**23**
Prepositions	**8**	**9**	**6**	**10**	**12**
Pronouns	**2**	**1**	**3**	**4**	**3**
Logical Connections	**3**	**8**	**0**	**0**	**0**
Similes	**2**	**2**	**2**	**2**	**2**
Articles	**0**	**2**	**0**	**0**	**0**
Linking words	**0**	**0**	**7**	**7**	**5**

Conjunctions	**0**	**0**	**0**	**0**	**5**
Subordinate Clauses			**3**	**4**	**5**

4.5. References

Adams, M. J. (1990). Beginning to Read: Thinking and Learning about Print. Cambridge, MA: MIT Press.

Adlof, S. M., Catts, H. W., & Little, T. D. (2006). Should the simple view of reading include a fluency component?. *Reading and Writing*, *19*(9), 933-958.

Alloway, T. P., Gathercole, S. E., Willis, C., & Adams, A. M. (2004). A structural analysis of working memory and related cognitive skills in young children. *Journal of experimental child psychology*, *87*(2), 85-106.

Arbuthnott, K., & Frank, J. (2000). Trail Making Task, part B as a measure of executive control: validation using a set-switching paradigm. *Journal of clinical and experimental neuropsychology*, *22*(4), 518-528.

Baddeley, A. (2003). Working memory: looking back and looking forward. *Nature reviews neuroscience*, *4*(10), 829-839.

Baddeley, A. (2007). *Working memory, thought, and action* (Vol. 45). OuP Oxford.

Baddeley, A. D., & Hitch, G. (1974). Working memory. In *Psychology of learning and motivation* (Vol. 8, pp. 47-89). Academic press.

Baddeley, A. D., & Logie, R. H. (1999). Working memory: The multiple-component model.

Baker, L. (1989). Metacognition, comprehension monitoring, and the adult reader. *Educational Psychology Review*, *1*(1), 3-38.

Baker, L., & Brown, A. L. (1984). Metacognitive skills and reading. *Handbook of reading research*, *1*(353), V394.

Barnes, M. A., Dennis, M., & Haefele-Kalvaitis, J. (1996). The effects of knowledge availability and knowledge accessibility on coherence and elaborative inferencing in children from six to fifteen years of age. *Journal of experimental child psychology*, *61*(3), 216-241.

Barnes, M. A., Huber, J., Johnston, A. M., & Dennis, M. (2007). A model of comprehension in spina bifida meningomyelocele: Meaning activation, integration, and revision. *Journal of the International Neuropsychological Society*, *13*(5), 854-864.

Bernicot, J., Laval, V., & Chaminaud, S. (2007). Nonliteral language forms in children: In what order are they acquired in pragmatics and metapragmatics?. *Journal of Pragmatics*, *39*(12), 2115-2132.

Blakey, E., Visser, I., & Carroll, D. J. (2016). Different executive functions support different kinds of cognitive flexibility: Evidence from 2-, 3-, and 4-year-olds. *Child development*, *87*(2), 513-526.

Block, C. C., Rodgers, L. L., & Johnson, R. B. (2004). Comprehension process instruction: Creating reading success in grades K-3. Guilford Press.

Borella, E., Carretti, B., & Pelegrina, S. (2010). The specific role of inhibition in reading comprehension in good and poor comprehenders. *Journal of Learning disabilities*, *43*(6), 541-552.

Brown, A. L. (1980). Metacognitive development and reading. *Theoretical issues in reading comprehension: Perspectives from cognitive psychology, linguistics, artificial intelligence, and education*, 453-481.

Bull, R., & Scerif, G. (2001). Executive functioning as a predictor of children's mathematics ability: Inhibition, switching, and working memory. *Developmental neuropsychology*, *19*(3), 273-293.

Cain, K. (2006). Individual differences in children's memory and reading comprehension: An investigation of semantic and inhibitory deficits. *Memory*, *14*(5), 553-569.

Cain, K. (2009). Children’s reading comprehension difficulties: a consideration of the precursors and consequences. In *Contemporary perspectives on reading and spelling* (pp. 71-87). Routledge.

Cain, K., & 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. (2014). Reading comprehension and vocabulary: Is vocabulary more important for some aspects of comprehension?. *LAnnee psychologique*, *114*(4), 647-662.

Cain, K., & Oakhill, J. V. (1999). Inference making ability and its relation to comprehension failure in young children. *Reading and writing*, *11*(5-6), 489-503.

Oakhill, J., & Cain, K. (2017). Children with specific text comprehension problems. *Theories of reading development*, 359-375.

Oakhill, J., Cain, K., & Elbro, C. (2014). *Understanding and teaching reading comprehension: A handbook*. Routledge.

Cain, K., Oakhill, J. V., Barnes, M. A., & Bryant, P. E. (2001). Comprehension skill, inference-making ability, and their relation to knowledge. *Memory & cognition*, *29*(6), 850-859.

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.

Cain, K., Oakhill, J., & Lemmon, K. (2004). Individual differences in the inference of word meanings from context: The influence of reading comprehension, vocabulary knowledge, and memory capacity. *Journal of educational psychology*, *96*(4), 671.

Carlson, S. M., & White, R. E. (2013). Executive function, pretend play, and imagination. *The Oxford handbook of the development of imagination*, 161-174.

Carretti, B., Borella, E., Cornoldi, C., & De Beni, R. (2009). Role of working memory in explaining the performance of individuals with specific reading comprehension difficulties: A meta-analysis. *Learning and individual differences*, *19*(2), 246-251.

Carretti, B., Cornoldi, C., De Beni, R., & Romanò, M. (2005). Updating in working memory: A comparison of good and poor comprehenders. *Journal of experimental child psychology*, *91*(1), 45-66.

Cartwright, K. B. (2002). Cognitive development and reading: The relation of reading-specific multiple classification skill to reading comprehension in elementary school children. *Journal of Educational Psychology*, *94*(1), 56.

Cartwright, K. B. (2009). The role of cognitive flexibility in reading comprehension. *Handbook of research on reading comprehension*, 115-139.

Cartwright, K. B. (2015). Executive skills and reading comprehension: A guide for educators. Guilford Publications.

Cartwright, K. B., & DeWyngaert, L. U. (2014). The contribution of EF and motivation to reading comprehension in former elementary students with good and poor reading comprehension. In *annual meeting of the Literacy Research Association, Marco Island, FL*.

Chall, J. S. (1987). Two vocabularies for reading: Recognition and meaning.

Christopher, M. E., Miyake, A., Keenan, J. M., Pennington, B., DeFries, J. C., Wadsworth, S. J., ... & Olson, R. K. (2012). Predicting word reading and comprehension with executive function and speed measures across development: a latent variable analysis. *Journal of Experimental Psychology: General*, *141*(3), 470.

Chrysochoou, E., & Bablekou, Z. (2011). Phonological loop and central executive contributions to oral comprehension skills of 5.5 to 9.5 years old children. *Applied Cognitive Psychology*, *25*(4), 576-583.

Chrysochoou, E., Bablekou, Z., & Tsigilis, N. (2011). Working memory contributions to reading comprehension components in middle childhood children. *The American Journal of Psychology*, *124*(3), 275-289.

Chrysochoou, E., Bablekou, Z., Kazi, S., & Tsigilis, N. (2018). Differences in Vocabulary Knowledge as a Function of Children's Oral Comprehension Performance in Greek: A Cross-Sectional Developmental Study. *American Journal of Psychology*, *131*(2), 211-223.

Catts, H. W., Adlof, S. M., & Weismer, S. E. (2006). Language deficits in poor comprehenders: A case for the simple view of reading. Journal of Speech, Language, and Hearing Research, 49(2), 278–293. doi:10.1044/1092-4388(2006/023)

Clark, H. H., & Clark, E. V. (1977). *Psychology and language: An introduction to psycholinguistics*. New York: Harcourt Brace Jovanovich.

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). Applied multiple correlation/regression analysis for the social sciences.

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). Applied multiple correlation/regression analysis for the social sciences.

Coltheart, M., Rastle, K., Perry, C., Langdon, R., & Ziegler, J. (2001). DRC: a dual route cascaded model of visual word recognition and reading aloud. *Psychological review*, *108*(1), 204.

Cornoldi, C., De Beni, R., & Pazzaglia, F. (1996). Profiles of reading comprehension difficulties: An analysis of single cases.

Crowe, S. F. (1998). The differential contribution of mental tracking, cognitive flexibility, visual search, and motor speed to performance on parts A and B of the Trail Making Task. *Journal of clinical psychology*, *54*(5), 585-591.

Currie, N. K., & Cain, K. (2015). Children’s inference generation: The role of vocabulary and working memory. *Journal of Experimental Child Psychology*, *137*, 57-75.

Cutting, L. E., & Scarborough, H. S. (2006). Prediction of reading comprehension: Relative contributions of word recognition, language proficiency, and other cognitive skills can depend on how comprehension is measured. *Scientific studies of reading*, *10*(3), 277-299.

Cutting, L. E., Materek, A., Cole, C. A., Levine, T. M., & Mahone, E. M. (2009). Effects of fluency, oral language, and executive function on reading comprehension performance. *Annals of dyslexia*, *59*(1), 34-54.

Cutting, L. E., Materek, A., Cole, C. A., Levine, T. M., & Mahone, E. M. (2009). Effects of fluency, oral language, and executive function on reading comprehension performance. *Annals of dyslexia*, *59*(1), 34-54.

Daneman, M., & Carpenter, P. A. (1980). Individual differences in working memory and reading. *Journal of Memory and Language*, *19*(4), 450.

Daneman M, Merikle PM. Working memory and language comprehension: A meta-analysis. Psychonomic Bulletin & Review 1996;3:422–433.

De Beni, R., & Palladino, P. (2000). Intrusion errors in working memory tasks: Are they related to reading comprehension ability?. *Learning and individual differences*, *12*(2), 131-143.

Davidson, M. C., Amso, D., Anderson, L. C., & Diamond, A. (2006). Development of cognitive control and executive functions from 4 to 13 years: Evidence from manipulations of memory, inhibition, and task switching. *Neuropsychologia*, *44*(11), 2037-2078.

de Jong, P. F., & van der Leij, A. (2002). Effects of phonological abilities and linguistic comprehension on the development of reading. *Scientific studies of Reading*, *6*(1), 51-77.

Dumontheil, I., & Klingberg, T. (2012). Brain activity during a visuospatial working memory task predicts arithmetical performance 2 years later. *Cerebral cortex*, *22*(5), 1078-1085.

Dunn, L. M., & Dunn, D. M. (2009). *The British picture vocabulary scale*. GL AssessmentLimited.

Brown, A. L. (1982). Learning how to learn from reading. *Reader meets author: Bridging the gap*, 26-54.

Dunlosky, J., & Metcalfe, J. (2008). *Metacognition*. Sage Publications.

Ehri, L. C. (2005). Development of sight word reading: Phases and findings. *The science of reading: A handbook*, 135-154.

Ehri, L. C. (2005). Learning to read words: Theory, findings, and issues. *Scientific Studies of reading*, *9*(2), 167-188.

Ehri, L. C. (2014). Orthographic mapping in the acquisition of sight word reading, spelling memory, and vocabulary learning. *Scientific Studies of Reading*, *18*(1), 5-21.

Ehri, L. C., & Roberts, T. (2006). The roots of learning to read and write: Acquisition of letters and phonemic awareness. *Handbook of early literacy research*, *2*, 113-131.

Ehrlich, M. F., Remond, M., & Tardieu, H. (1999). Processing of anaphoric devices in young skilled and less skilled comprehenders: Differences in metacognitive monitoring. *Reading and writing*, *11*(1), 29-63.

Ellis, N. C., & Hooper, A. M. (2001). Why learning to read is easier in Welsh than in English: Orthographic transparency effects evinced with frequency-matched tests. *Applied Psycholinguistics*, *22*(4), 571-599.

Ellis, N. C., Natsume, M., Stavropoulou, K., Hoxhallari, L., Van Daal, V. H., Polyzoe, N., ... & Petalas, M. (2004). The effects of orthographic depth on learning to read alphabetic, syllabic, and logographic scripts. *Reading Research Quarterly*, *39*(4), 438-468.

Engle, R. W., Carullo, J. J., & Collins, K. W. (1991). Individual differences in working memory for comprehension and following directions. *The Journal of Educational Research*, *84*(5), 253-262.

Eriksen, B. A., & Eriksen, C. W. (1974). Effects of noise letters upon the identification of a target letter in a nonsearch task. *Perception & psychophysics*, *16*(1), 143-149.

Fender, M. (2001). A review of L1 and L2/ESL word integration skills and the nature of L2/ESL word integration development involved in lower-level text processing. *Language learning*, *51*(2), 319-396.

Fender, M. (2001). A review of L1 and L2/ESL word integration skills and the nature of L2/ESL word integration development involved in lower-level text processing. *Language learning*, *51*(2), 319-396.

FitzGibbon, L., Cragg, L., & Carroll, D. J. (2014). Primed to be inflexible: The influence of set size on cognitive flexibility during childhood. *Frontiers in psychology*, *5*, 101.

Florit, E., & Cain, K. (2011). The simple view of reading: Is it valid for different types of alphabetic orthographies?. *Educational Psychology Review*, *23*(4), 553-576.

Florit, E., Roch, M., & Levorato, M. C. (2011). Listening text comprehension of explicit and implicit information in preschoolers: The role of verbal and inferential skills. *Discourse Processes*, *48*(2), 119-138.

Foorman, B. R., Koon, S., Petscher, Y., Mitchell, A., & Truckenmiller, A. (2015). Examining general and specific factors in the dimensionality of oral language and reading in 4th–10th grades. *Journal of educational psychology*, *107*(3), 884.

Ford, M. E. (1992). *Motivating humans: Goals, emotions, and personal agency beliefs*. Sage Publications.

Friedman, N. P., & Miyake, A. (2004). The relations among inhibition and interference control functions: a latent-variable analysis. *Journal of experimental psychology: General*, *133*(1), 101.

Frith, U., Wimmer, H., & Landerl, K. (1998). Differences in phonological recoding in German-and English-speaking children. *Scientific Studies of reading*, *2*(1), 31-54.

Fuchs, L. S., Fuchs, D., Hosp, M. K., & Jenkins, J. R. (2001). Oral reading fluency as an indicator of reading competence: A theoretical, empirical, and historical analysis. *Scientific studies of reading*, *5*(3), 239-256.

Fuchs, L. S., Fuchs, D., & Maxwell, L. (1988). The validity of informal reading comprehension measures. *Remedial and Special Education*, *9*(2), 20-28.

Garnham, A. (1982). Testing psychological theories about inference making. *Memory & Cognition*, *10*(4), 341-349.

Gathercole, S. E., & Baddeley, A. D. (1993). Phonological working memory: A critical building block for reading development and vocabulary acquisition?. *European Journal of Psychology of Education*, *8*(3), 259.

Gathercole, S., & Pickering, S. (2001). Research Section: Working memory deficits in children with special educational needs. *British Journal of special education*, *28*(2), 89-97.

Gathercole, S. E., Pickering, S. J., Ambridge, B., & Wearing, H. (2004). The structure of working memory from 4 to 15 years of age. *Developmental psychology*, *40*(2), 177.

Georgiou, G. K., & Das, J. P. (2018). Direct and indirect effects of executive function on reading comprehension in young adults. *Journal of Research in Reading*, *41*(2), 243-258.

Gernsbacher, M. A., & Faust, M. E. (1991). The mechanism of suppression: a component of general comprehension skill. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *17*(2), 245.

Godbee, K., & Porter, M. (2013). Comprehension of sarcasm, metaphor and simile in Williams syndrome. *International Journal of language & Communication disorders*, *48*(6), 651-665.

Goff, D. A., Pratt, C., & Ong, B. (2005). The relations between children's reading comprehension, working memory, language skills and components of reading decoding in a normal sample. *Reading and writing*, *18*(7-9), 583-616.

Goswami, U., Gombert, J. E., & de Barrera, L. F. (1998). Children's orthographic representations and linguistic transparency: Nonsense word reading in English, French, and Spanish. *Applied Psycholinguistics*, *19*(1), 19-52.

Goswami, U., Gombert, J. E., & de Barrera, L. F. (1998). Children's orthographic representations and linguistic transparency: Nonsense word reading in English, French, and Spanish. *Applied Psycholinguistics*, *19*(1), 19-52.

Grabe, W. (2009). Reading in a second language: Moving from theory to practice. Ernst Klett Sprachen.

Grabe, W. (2009). Reading in a second language: Moving from theory to practice. Ernst Klett Sprachen.

Guajardo, N. R., & Cartwright, K. B. (2016). The contribution of theory of mind, counterfactual reasoning, and executive function to pre-readers' language comprehension and later reading awareness and comprehension in elementary school. *Journal of Experimental Child Psychology*, *144*, 27-45.

Guéraud, S., Harmon, M. E., & Peracchi, K. A. (2005). Updating situation models: The memory-based contribution. *Discourse Processes*, *39*(2-3), 243-263.

Hacker, D. (1997). Metacognitive: Definitions and Empirical Foundations. *Metacognition in Educational Theory and Practice*, 23-6.

Happé, F. G. (1995). Understanding minds and metaphors: Insights from the study of figurative language in autism. *Metaphor and symbol*, *10*(4), 275-295.

Hasher, L., Chung, C., May, C. P., & Foong, N. (2002). Age, time of testing, and proactive interference. *Canadian Journal of Experimental Psychology/Revue canadienne de psychologie expérimentale*, *56*(3), 200.

Hirsch, E. D. (2003). Reading comprehension requires knowledge—of words and the world. *American Educator*, *27*(1), 10-13.

Holmes, J., Gathercole, S. E., & Dunning, D. L. (2009). Adaptive training leads to sustained enhancement of poor working memory in children. *Developmental science*, *12*(4), F9-F15.

Hoxhallari, L. (2006). *Learning to read and spell in Albanian, English and Welsh: the effect of orthographic transparency*. Bangor University (United Kingdom).

Hoxhallari, L., van Daal, V. H., & Ellis, N. C. (2004). Learning to read words in Albanian: A skill easily acquired. *Scientific Studies of Reading*, *8*(2), 153-166.

Hughes, C. (1998). Finding your marbles: Does preschoolers' strategic behavior predict later understanding of mind?. *Developmental psychology*, *34*(6), 1326.

Iglesias-Sarmiento, V., Carriedo-López, N., & Rodríguez-Rodríguez, J. L. (2015). Updating executive function and performance in reading comprehension and problem solving. [La función ejecutiva de actualización y el rendimiento en comprensión lectora y resolución de problemas]. *Anales de Psicología/Annals of Psychology*, *31*(1), 298-309.

Im-Bolter, N., Johnson, J., & Pascual-Leone, J. (2006). Processing limitations in children with specific language impairment: The role of executive function. *Child development*, *77*(6), 1822-1841.

Johnston, A. M., Barnes, M. A., & Desrochers, A. (2008). Reading comprehension: Developmental processes, individual differences, and interventions. *Canadian Psychology/Psychologie canadienne*, *49*(2), 125.

Joshi, R. M., & Aaron, P. G. (2000). The component model of reading: Simple view of reading made a little more complex. *Reading Psychology*, *21*(2), 85-97.

Just, M. A., & Carpenter, P. A. (1992). A capacity theory of comprehension: individual differences in working memory. *Psychological review*, *99*(1), 122.

Karbach, J., Strobach, T., & Schubert, T. (2015). Adaptive working-memory training benefits reading, but not mathematics in middle childhood. Child Neuropsychology, 21(3), 285-301.

Kendeou, P. (2015). A general inference skill. *Inferences during reading*, 160-181.

endeou, P., Bohn-Gettler, C., White, M. J., & Van Den Broek, P. (2008). Children's inference generation across different media. *Journal of research in reading*, *31*(3), 259-272.

Kendeou, P., Van Den Broek, P., Helder, A., & Karlsson, J. (2014). A cognitive view of reading comprehension: Implications for reading difficulties. *Learning disabilities research & practice*, *29*(1), 10-16.

Kieffer, M. J., Vukovic, R. K., & Berry, D. (2013). Roles of attention shifting and inhibitory control in fourth-grade reading comprehension. *Reading Research Quarterly*, *48*(4), 333-348.

Kieffer, M. J., & Christodoulou, J. A. (2020). Automaticity and control: How do executive functions and reading fluency interact in predicting reading comprehension?. Reading Research Quarterly, 55(1), 147-166.

Kintsch, W. (1988). The role of knowledge in discourse comprehension: A construction-integration model. *Psychological review*, *95*(2), 163.

Kintsch, W., & Kintsch, E. (2005). Comprehension. In *Children's reading comprehension and assessment* (pp. 89-110). Routledge.

Kintsch, W., & Rawson, K. a.(2005). Comprehension. *The Science of Reading: A Handbook*, 209-226.

Kintsch, W. (1998). *Comprehension: A Paradigm for Cognition*. Cambridge University Press.

Klauda, S. L., & Guthrie, J. T. (2008). Relationships of three components of reading fluency to reading comprehension. *Journal of Educational psychology*, *100*(2), 310.

Knoepke, J. (2016). Cognitive Component Skills of Reading Comprehension in Developing Readers.

Knoepke, J., Richter, T., Isberner, M. B., Naumann, J., & Neeb, Y. (2014). Phonological recoding, orthographic decoding, and comprehension skills during reading acquisition. *Zeitschrift für Erziehungswissenschaft*, *17*(3), 447-471.

Koda, K. (1992). The effects of lower-level processing skills on FL reading performance: Implications for instruction. *The Modern Language Journal*, *76*(4), 502-512.

Koda, K. (1992). The effects of lower-level processing skills on FL reading performance: Implications for instruction. *The Modern Language Journal*, *76*(4), 502-512.

Korkman, M., Kirk, U., & Kemp, S. (2007). *NEPSY II: Clinical and interpretive manual*. Harcourt Assessment, PsychCorp.

LaBerge, D., & Samuels, S. J. (1974). Toward a theory of automatic information processing in reading. *Cognitive psychology*, *6*(2), 293-323.

Landi, N., & Ryherd, K. (2017). Understanding specific reading comprehension deficit: A review. *Language and linguistics compass*, *11*(2), e12234.

Landi, N., Oakhill, J., & Perfetti, A. (2007). The Acquisition of Reading Comprehension Skill. *The Science of Reading. A Handbook.*

Latzman, R. D., Elkovitch, N., Young, J., & Clark, L. A. (2010). The contribution of executive functioning to academic achievement among male adolescents. *Journal of Clinical and Experimental Neuropsychology*, *32*(5), 455-462.

Lee, J. Y. (2011). Second language reading topic familiarity and test score: test-taking strategies for multiple-choice comprehension questions.

Lepola, J., Lynch, J., Laakkonen, E., Silvén, M., & Niemi, P. (2012). The role of inference making and other language skills in the development of narrative listening comprehension in 4–6-year-old children. *Reading Research Quarterly*, *47*(3), 259-282.

Lepper, M. R., & Henderlong, J. (2000). Turning "play" into "work" and "work" into "play": 25 years of research on intrinsic versus extrinsic motivation. In *Intrinsic and extrinsic motivation* (pp. 257-307). Academic Press.

Levin, H. S., Fletcher, J. M., Kufera, J. A., Harward, H., Lilly, M. A., Mendelsohn, D., ... & Eisenberg, H. M. (1996). Dimensions of cognition measured by the Tower of London and other cognitive tasks in head-injured children and adolescents. *Developmental Neuropsychology*, *12*(1), 17-34.

Locascio, G., Mahone, E. M., Eason, S. H., & Cutting, L. E. (2010). Executive dysfunction among children with reading comprehension deficits. *Journal of learning disabilities*, *43*(5), 441-454.

Logan, S., Medford, E., & Hughes, N. (2011). The importance of intrinsic motivation for high and low ability readers' reading comprehension performance. *Learning and Individual Differences*, *21*(1), 124-128.

Luna, B., Garver, K. E., Urban, T. A., Lazar, N. A., & Sweeney, J. A. (2004). Maturation of cognitive processes from late childhood to adulthood. *Child development*, *75*(5), 1357-1372.

Lynch, J. S., Van Den Broek, P., Kremer, K. E., Kendeou, P., White, M. J., & Lorch, E. P. (2008). The development of narrative comprehension and its relation to other early reading skills. *Reading Psychology*, *29*(4), 327-365.

Meneghetti, C., Carretti, B., & De Beni, R. (2006). Components of reading comprehension and scholastic achievement. *Learning and individual differences*, *16*(4), 291-301.

Magliano, J. P., Trabasso, T., & Graesser, A. C. (1999). Strategic processing during comprehension. *Journal of Educational Psychology*, *91*(4), 615.

Mahon, M., & Crutchley, A. (2006). Performance of typically-developing school-age children with English as an additional language on the British Picture Vocabulary Scales II. *Child Language Teaching and Therapy*, *22*(3), 333-351.

Mashal, N., & Kasirer, A. (2012). Principal component analysis study of visual and verbal metaphoric comprehension in children with autism and learning disabilities. *Research in developmental disabilities*, *33*(1), 274-282.

Mayr, U., & Keele, S. W. (2000). Changing internal constraints on action: The role of backward inhibition. *Journal of Experimental Psychology: General*, *129*(1), 4.

McKoon, G., & Ratcliff, R. (1990). Dimensions of inference. In *Psychology of Learning and Motivation* (Vol. 25, pp. 313-328). Academic Press.

McNamara, D. S., & Magliano, J. (2009). Toward a comprehensive model of comprehension. *Psychology of learning and motivation*, *51*, 297-384.

McWhaw, K., & Abrami, P. C. (2001). Student goal orientation and interest: Effects on students' use of self-regulated learning strategies. *Contemporary educational psychology*, *26*(3), 311-329.

Meneghetti, C., Carretti, B., & De Beni, R. (2006). Components of reading comprehension and scholastic achievement. *Learning and individual differences*, *16*(4), 291-301.

Meyer, M. S., & Felton, R. H. (1999). Repeated reading to enhance fluency: Old approaches and new directions. *Annals of dyslexia*, *49*(1), 283-306.

Miller, D. (2012). Creating a classroom where readers flourish. *The Reading Teacher*, *66*(2), 88-92.

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.

Moyle, M. J., Weismer, S. E., Evans, J. L., & Lindstrom, M. J. (2007). Longitudinal relationships between lexical and grammatical development in typical and late-talking children. *Journal of Speech, Language, and Hearing Research*.

Muter, V., Hulme, C., Snowling, M. J., & Stevenson, J. (2004). Phonemes, rimes, vocabulary, and grammatical skills as foundations of early reading development: evidence from a longitudinal study. *Developmental psychology*, *40*(5), 665.

Nagy, W. E., Herman, P. A., & Anderson, R. C. (1985). Learning words from context. *Reading research quarterly*, 233-253.

Nassaji, H. (2003). Higher–level and lower–level text processing skills in advanced ESL reading comprehension. *The Modern Language Journal*, *87*(2), 261-276.

Nassaji, H. (2003). Higher–level and lower–level text processing skills in advanced ESL reading comprehension. *The Modern Language Journal*, *87*(2), 261-276.

Nation, K., Clarke, P., Marshall, C. M., & Durand, M. (2004). Hidden language impairments in children. *Journal of Speech, Language, and Hearing Research*.

Nation, P., & Chung, T. (2009). Teaching and testing vocabulary. In *The handbook of language teaching*.

National Reading Panel (US), National Institute of Child Health, Human Development (US), National Reading Excellence Initiative, National Institute for Literacy (US), & United States Department of Health. (2000). *Report of the National Reading Panel: Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction: Reports of the subgroups*. National Institute of Child Health and Human Development, National Institutes of Health.

Nouwens, S., Groen, M. A., & Verhoeven, L. (2017). How working memory relates to children's reading comprehension: the importance of domain-specificity in storage and processing. *Reading and writing*, *30*(1), 105-120.

Oakhill, J. (1984). Inferential and memory skills in children's comprehension of stories. *British journal of educational psychology*, *54*(1), 31-39.

Oakhill, J. (1993). Children's difficulties in reading comprehension. *Educational Psychology Review*, *5*(3), 223-237.

Oakhill, J., & Cain, K. (2007). Introduction to comprehension development. Children's comprehension problems in oral and written language: A cognitive perspective, 3-40.

Oakhill, J., & Garnham, A. (1988). *Becoming a skilled reader*. Basil Blackwell.

Oakhill, J., & Garnham, A. (1988). *Becoming a skilled reader*. Basil Blackwell.

Oakhill, J. V., & Cain, K. (2012). The precursors of reading ability in young readers: Evidence from a four-year longitudinal study. *Scientific studies of reading*, *16*(2), 91-121.

Oakhill, J., Cain, K., & Elbro, C. (2014). Understanding and teaching reading comprehension: A handbook. Routledge.

Oakhill, J., Cain, K., McCarthy, D., & Nightingale, Z. (2012). Making the link between vocabulary knowledge and comprehension skill. In *Reading-From Words to Multiple Texts* (pp. 115-128). Routledge.

Oakhill, J., Hartt, J., & Samols, D. (2005). Levels of comprehension monitoring and working memory in good and poor comprehenders. *Reading and writing*, *18*(7-9), 657-686.

Ober, T. M., Brooks, P. J., Homer, B. D., & Rindskopf, D. (2020). Executive Functions and Decoding in Children and Adolescents: a Meta-analytic Investigation. *Educational Psychology Review*, 1-29.

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.

Palladino, P., Cornoldi, C., De Beni, R., & Pazzaglia, F. (2001). Working memory and updating processes in reading comprehension. *Memory & cognition*, *29*(2), 344-354.

Pearson, P. D., & Raphael, T. E. (1990). Reading comprehension as a dimension of thinking. *Dimensions of thinking and cognitive instruction*, *1*.

Perfetti, C. (2007). Reading ability: Lexical quality to comprehension. *Scientific studies of reading*, *11*(4), 357-383.

Perfetti, C. A. (1985). *Reading ability*. oxford university Press.

Perfetti, C. A., & Adlof, S. M. (2012). Reading comprehension: A conceptual framework from word meaning to text meaning. *Measuring up: Advances in how we assess reading ability*, 3-20.

Perfetti, C. A., Landi, N., & Oakhill, J. (2005). The acquisition of reading comprehension skill. *The science of reading: A handbook*, 227-247.

Perfetti, C. A., Landi, N., & Oakhill, J. (2005). The acquisition of reading comprehension skill. *The science of reading: A handbook*, 227-247.

Pickering, S. J., Gathercole, S. E., Hall, M., & Lloyd, S. A. (2001). Development of memory for pattern and path: Further evidence for the fractionation of visuo-spatial memory. *The Quarterly Journal of Experimental Psychology Section A*, *54*(2), 397-420.

Pimperton, H., & Nation, K. (2010). Suppressing irrelevant information from working memory: Evidence for domain-specific deficits in poor comprehenders. *Journal of Memory and Language*, *62*(4), 380-391.

Potocki, A., Sanchez, M., Ecalle, J., & Magnan, A. (2017). Linguistic and cognitive profiles of 8-to 15-year-old children with specific reading comprehension difficulties: The role of executive functions. *Journal of Learning Disabilities*, *50*(2), 128-142.

Pressley, M., & Gaskins, I. W. (2006). Metacognitively competent reading comprehension is constructively responsive reading: How can such reading be developed in students?. *Metacognition and Learning*, *1*(1), 99-113.

Protopapas, A., & Vlahou, E. L. (2009). A comparative quantitative analysis of Greek orthographic transparency. *Behavior research methods*, *41*(4), 991-1008.

Rapp, D. N., van den Broek, P., McMaster, K. L., Kendeou, P., & Espin, C. A. (2007). Higher-order comprehension processes in struggling readers: A perspective for research and intervention. *Scientific studies of reading*, *11*(4), 289-312.

Reitan, R. M., & Wolfson, D. (1995). Category Test and Trail Making Task as measures of frontal lobe functions. *The Clinical Neuropsychologist*, *9*(1), 50-56.

Richter, T., Isberner, M. B., Naumann, J., & Neeb, Y. (2013). Lexical quality and reading comprehension in primary school children. *Scientific Studies of Reading*, *17*(6), 415-434.

Riedel, B. W. (2007). The relation between DIBELS, reading comprehension, and vocabulary in urban first-grade students. *Reading research quarterly*, *42*(4), 546-567.

Schneider, B. A., Daneman, M., & Pichora-Fuller, M. K. (2002). Listening in aging adults: from discourse comprehension to psychoacoustics. *Canadian Journal of Experimental Psychology/Revue canadienne de psychologie expérimentale*, *56*(3), 139.

Seigneuric, A., & Ehrlich, M. F. (2005). Contribution of working memory capacity to children’s reading comprehension: A longitudinal investigation. *Reading and writing*, *18*(7-9), 617.

Sesma, H. W., Mahone, E. M., Levine, T., Eason, S. H., & Cutting, L. E. (2009). The contribution of executive skills to reading comprehension. *Child Neuropsychology*, *15*(3), 232-246.

Seymour, P. H. (2005). Early reading development in European Orthographies.

Seymour, P. H., Aro, M., Erskine, J. M., & Collaboration with COST Action A8 Network. (2003). Foundation literacy acquisition in European orthographies. *British Journal of psychology*, *94*(2), 143-174.

Seymour, P. H., Aro, M., Erskine, J. M., & Collaboration with COST Action A8 Network. (2003). Foundation literacy acquisition in European orthographies. *British Journal of psychology*, *94*(2), 143-174.

Shankweiler, D. (1999). Words to meanings. *Scientific Studies of Reading*, *3*(2), 112-127.

Shibata, M., Toyomura, A., Motoyama, H., Itoh, H., Kawabata, Y., & Abe, J. I. (2012). Does simile comprehension differ from metaphor comprehension? A functional MRI study. *Brain and Language*, *121*(3), 254-260.

Shinn, M. R., Knutson, N., Good III, R. H., Tilly III, W. D., & Collins, V. L. (1992). Curriculum-based measurement of oral reading fluency: A confirmatory analysis of its relation to reading. *School Psychology Review*, *21*(3), 459-479.

Silva, M., & Cain, K. (2015). The relations between lower and higher level comprehension skills and their role in prediction of early reading comprehension. *Journal of Educational Psychology*, *107*(2), 321.

Stanovich, K. E. (1986). Cognitive processes and the reading problems of learning disabled children: Evaluating the assumption of specificity. *Psychological and educational perspectives on learning disabilities*, 87-131.

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*(1), 1-31.

Swanson, H. L., Howard, C. B., & Sáez, L. (2007). Reading comprehension and working memory in children with learning disabilities in reading. *Children's comprehension problems in oral and written language: A cognitive perspective*, 157-185.

Tabachnick, B. G., Fidell, L. S., & Ullman, J. B. (2007). *Using multivariate statistics* (Vol. 5). Boston, MA: Pearson.

Taboada, A., Tonks, S. M., Wigfield, A., & Guthrie, J. T. (2009). Effects of motivational and cognitive variables on reading comprehension. *Reading and Writing*, *22*(1), 85.

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.

Tobia, V., & Bonifacci, P. (2015). The simple view of reading in a transparent orthography: The stronger role of oral comprehension. *Reading and Writing*, *28*(7), 939-957.

United Nations Children's Fund, *Report on Early Childhood Education in Kosovo,* UNICEF, Kosovo, April 2019.

van den Broek, P. (1997). Discovering the cement of the universe: The development of event comprehension from childhood to adulthood. *Developmental spans in event comprehension and representation: Bridging fictional and actual events*, 321-342.

Tunmer, W. E., & Chapman, J. W. (2012). The simple view of reading redux: Vocabulary knowledge and the independent components hypothesis. *Journal of learning disabilities*, *45*(5), 453-466.

Tunmer, W. E., & Hoover, W. A. (1993). Components of variance models of language-related factors in reading disability: A conceptual overview. In *Reading disabilities: Diagnosis and component processes* (pp. 135-173). Springer, Dordrecht.

van den Broek, P., & Espin, C. A. (2012). Connecting cognitive theory and assessment: Measuring individual differences in reading comprehension. *School Psychology Review*, *41*(3), 315-325.

van den Broek, P., & Espin, C. A. (2012). Connecting cognitive theory and assessment: Measuring individual differences in reading comprehension. *School Psychology Review*, *41*(3), 315-325.

van den Broek, P., Bohn-Gettler, C. M., Kendeou, P., Carlson, S., & White, M. J. (2011). When a reader meets a text: The role of standards of coherence in reading comprehension.

van den Broek, P., Rapp, D. N., & Kendeou, P. (2005). Integrating memory-based and constructionist processes in accounts of reading comprehension. *Discourse processes*, *39*(2-3), 299-316.

van den Broek, P., Young, M., Tzeng, Y., & Linderholm, T. (1999). The landscape model of reading: Inferences and the online construction of a memory representation. *The construction of mental representations during reading*, 71-98.

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 Dijk, T. A., & Kintsch, W. (1983). Strategies of discourse comprehension. New York: Academic Press.

Vellutino, F. R., Tunmer, W. E., Jaccard, J. J., & Chen, R. (2007). Components of reading ability: Multivariate evidence for a convergent skills model of reading development. *Scientific studies of reading*, *11*(1), 3-32.

Vivas, A. B., Ladas, A. I., Salvari, V., & Chrysochoou, E. (2017). Revisiting the bilingual advantage in attention in low SES Greek-Albanians: does the level of bilingual experience matter?. *Language, Cognition and Neuroscience*, *32*(6), 743-756.

Walker, I., & Hulme, C. (1999). Concrete words are easier to recall than abstract words: Evidence for a semantic contribution to short-term serial recall. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *25*(5), 1256.

Whitely, C., & Colozzo, P. (2013). Who's who? Memory updating and character reference in children's narratives. *Journal of Speech, Language, and Hearing Research*.

Wigfield, A., Guthrie, J. T., Perencevich, K. C., Taboada, A., Klauda, S. L., McRae, A., & Barbosa, P. (2008). Role of reading engagement in mediating effects of reading comprehension instruction on reading outcomes. *Psychology in the Schools*, *45*(5), 432-445.

Wimmer, H., & Goswami, U. (1994). The influence of orthographic consistency on reading development: Word recognition in English and German children. *Cognition*, *51*(1), 91-103.

Wimmer, H., Mayringer, H., & Landerl, K. (1998). Poor reading: A deficit in skill-automatization or a phonological deficit?. *Scientific studies of reading*, *2*(4), 321-340.

Xu, X. (2010). The effects of glosses on incidental vocabulary acquisition in reading. *Journal of language teaching and research*, *1*(2), 117-120.

Yuill, N., Oakhill, J., & Oakhill, O. J. (1991). *Children's problems in text comprehension: An experimental investigation*. Cambridge University Press.

Yuill, N., Oakhill, J., & Parkin, A. (1989). Working memory, comprehension ability and the resolution of text anomaly. *British journal of psychology*, *80*(3), 351-361.

Yildiz, M., & Çetinkaya, E. (2017). The Relationship between Good Readers' Attention, Reading Fluency and Reading Comprehension. *Universal Journal of Educational Research*, *5*(3), 366-371.

Yntema, D. B. (1963). Keeping track of several things at once. *Human factors*, *5*(1), 7-17.

Yussen, S. R., Mathews, S. R., Buss, R. R., & Kane, P. T. (1980). Developmental change in judging important and critical elements of stories. *Developmental psychology*, *16*(3), 213.

Ziegler, J. C., & Goswami, U. (2005). Reading acquisition, developmental dyslexia, and skilled reading across languages: a psycholinguistic grain size theory. *Psychological bulletin*, *131*(1), 3.