A longitudinal study of the predictors of reading in children from low and high socioeconomic backgrounds

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To Carolina and Maite.

Thanks for your invaluable love and support in all these years

I, Jaime Balladares Hernández, confirm that the work presented in this thesis my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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Signature 

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Chapter I: Introduction

Chilean students achieve poor results in international reading tests. The Organization for Economic Cooperation and Development (OECD) evaluates the performance of students at age 15 from all OECD countries, through the Programme for International Student Assessment (PISA). In this test, Chilean students perform significantly lower than average (OECD, 2013, 2016). Educational systems in which poor and rich children study together tend to reach higher scores in the PISA test than the ones in which students are social and economically segregated (OECD, 2013). However, the Chilean education system *is* segregated, with students likely to study with their peers from a similar socioeconomic background (Aguirre, 2009; Mizala & Torche, 2012).

Among OECD countries, Chile is the one in which socioeconomic variables are most closely related to academic success (OECD, 2010). Given Chile's huge social stratification (Posner, 2012), only students from higher high-income backgrounds can access better educational provision (in fee-paying schools), whereas students whose families are unable to pay for education are likely to receive a lower quality of teaching in their schools (Castillo, 2011). As a result, significant differences in reading according to socioeconomic status (SES) are found. For instance, 69% of students from high-income families can be categorized as advanced readers, whereas just 20% of students from low-income backgrounds are placed in this category, according to the Chilean Ministry of Education (MINEDUC, 2007, 2013, 2014).

While the effect of socioeconomic level on reading is accentuated in highly segregated countries such as Chile, it is possible to find differences in other countries too (Aikens & Barbarin, 2008; Arnold & Doctoroff, 2003; MINEDUC, 2007, 2013, 2014; OECD, 2013). In a study of 43 countries using the PISA database, SES was found to be a key predictor of reading achievement (Chiu & McBride-Chang, 2006). In a longitudinal study conducted in the United States, with 3rd grade students, rates of reading growth were found to be strongly affected by students' SES (Kieffer, 2011). In the case of the United

Kingdom the situation is similar, and reading performance is related to SES not just in the school years, but also in adulthood (Ritchie & Bates, 2013).

The reading gap between children from low and high SES groups starts at young age (A. Fernald, Marchman, & Weisleder, 2013), and tends to widen through academic life (Walpole, 2003). In Chile, children already show significant differences in reading ability at age of 7 when they are compared by SES (MINEDUC, 2013, 2014). These differences are more accented when the students' reading performance is compared again at the age of 15 (OECD, 2013).

In order to understand why differences in SES impact on children's reading outcomes at school, we must go one step further back and evaluate how the predictors of reading develop *before* children go to school. Three skills – phonological awareness, letter knowledge, and rapid automatic naming (RAN) – have been labelled as foundational predictors of reading (Caravolas, Lervag, Defior, Seidlova Malkova, & Hulme, 2013; Guardia, 2010; Hulme, Caravolas, Malkova, & Brigstocke, 2005; Jong & Vrielink, 2004; Mann, 1986; Muter, Hulme, Snowling, & Stevenson, 2004; Nation & Cocksey, 2009; Pallante & Kim, 2013; Savage & Frederickson, 2005; Wagner & Torgesen, 1987; P. Walton & Walton, 2002). While these are the three core predictors of reading in different languages, the process of learning to read is complex, and these predictors need to be understood as part of a set of variables (Hulme, Caravolas, et al., 2005; Muter et al., 2004) that also includes cognitive (domain general) skills (Cain & Oakhill, 1999; Farrington-Flint, Wood, Canobi, & Faulkner, 2004; Welsh, Nix, Blair, Bierman, & Nelson, 2010), vocabulary knowledge (Moghadam, Zainal, & Ghaderpour, 2012; Muter et al., 2004; Nation & Cocksey, 2009), and other social and environmental factors, such as home literacy environment (Burgess, Hecht, & Lonigan, 2002; Crain-Thoreson & Dale, 1992; Laplante et al., 2004; Mistry, White, Benner, & Huynh, 2009; Roberts, Jurgens, & Burchina, 2005; Weigel, Martin, & Bennet, 2006). There is strong evidence that this set of predictors contribute to the process of learning to read.

While each of the listed variables contributes to explaining reading achievement, it is less clear whether these foundational, language, and cognitive skills are, in turn, affected by SES, particularly in terms of Home literacy environment. Understanding the contribution of these factors and evaluating the influence of socioeconomic status on them will allow future studies and interventions to be more precise about what aspects should be improved to decrease the academic gap between those children from low and high SES. These findings have implications both for theory and practice. In theoretical terms, they permit a clearer understanding of what happens before children learn to read in a non-English and monolingual context. In a practical sense, they provide information to promote the development of policies, plans and programs for minimizing the gap in reading between those children from low and high socioeconomic backgrounds, by offering teacher and parental support. The current study makes novel contributions in two areas. Firstly, it aims to evaluate whether Chilean preschoolers show SES differences in a large number of foundational skills for reading and, if so, to estimate the magnitude of these differences. Secondly, it aims to identify the contribution of those less studied predictors - which include cognitive skills, certain early language skills and the influence of the home literacy environment - to these same children's reading abilities when they are 7 years old.

Chapter 2: Literature review

2.1. Reading

Reading is a key life skill. A good level of reading during the early years predicts later academic success (Roberts et al., 2005). Without the ability to read, most of the opportunities related to personal fulfillment and employment will be lost (Anderson, Hiebert, Scott, & Wilkinson, 1985). Reading is also important from a macro perspective. A country with a high proportion of literate people is more likely to have a better life quality standard (Comisión Económica para América Latina y el Caribe - CEPAL, 2005).

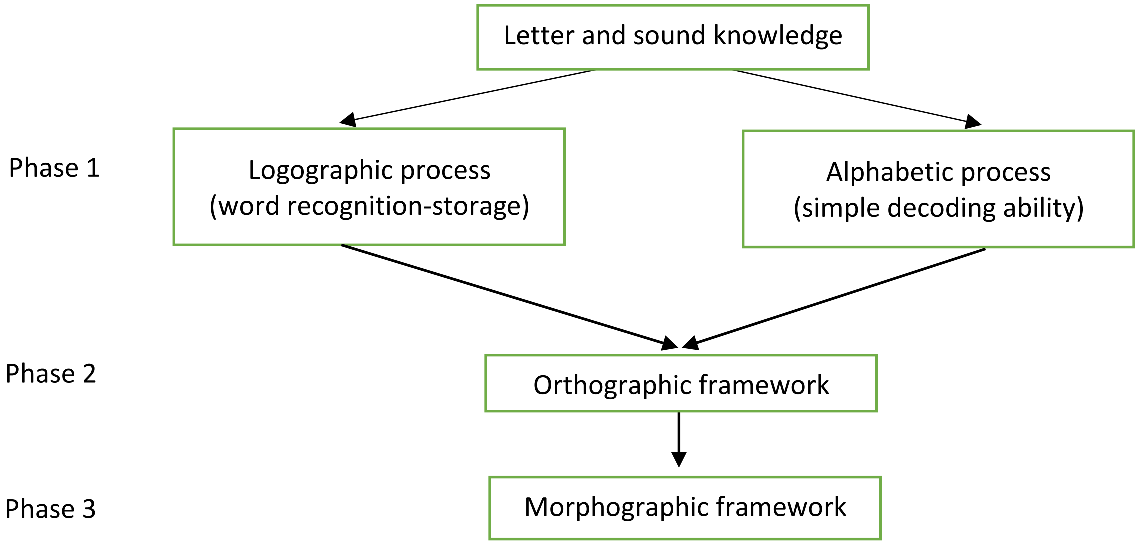
Reading is a very complex task which involves language, phonological, and cognitive skills that act in a coordinated fashion (Frost, 2005; Fuchs, Fuchs, Hosp, & Jenkins, 2001; Gough, Hoover, & Peterson, 1996). Vocabulary (Kamil & Hiebert, 2005; Ouellette, 2006), letter knowledge (Caravolas, Hulme, & Snowling, 2001), and grammar (Deacon, 2012; Givón, 1995; Mecartty, 2000) have been shown to be involved in the process of reading. In terms of phonological skills, the ability to identifying and manipulating units of oral language is considered crucial for learning to read (Christo & Davis, 2008; de Jong & van der Leij, 1999; Hulme & Snowling, 2014). Finally, a set of cognitive skills are also involved in reading. These include general cognitive ability (Harlaar, Hayiou-Thomas, & Plomin, 2005; Naglieri, 2001), executive functions (Altemeier, Abbott, & Berninger, 2008; Altemeier, Jones, Abbott, & Berninger, 2006), categorization, and analogical and causal reasoning (Graesser, Singer, & Trabasso, 1994). These cognitive skills can contribute directly to reading as in the case of general cognitive ability and executive functions, or indirectly through the development of strategies to understand a text, such as analogical and causal reasoning (P. D. Walton, Walton, & Felton, 2001).

The 'simple view of reading' is one of the most important theoretical models of reading (Hoover & Gough, 1990). It proposes that reading is captured by two domains: decoding and listening comprehension (Adlof, Catts, & Little, 2006; Hoover & Gough, 1990). Decoding can be defined as the ability to convert printed words into spoken words, facilitating access to the word in the mental lexicon (Hoover & Gough, 1990). On the other hand, listening comprehension refers to the child's ability to understand the meaning of words and sentences. Hoover and Gough (1990) propose that the relative contribution that decoding and listening comprehension make to reading comprehension might change throughout reading development, as decoding processes become automated. Thus, Gough and Hoover (1986) state that deficits in reading comprehension can be associated with failures in decoding or listening comprehension, or in both.

2.2 Reading acquisition

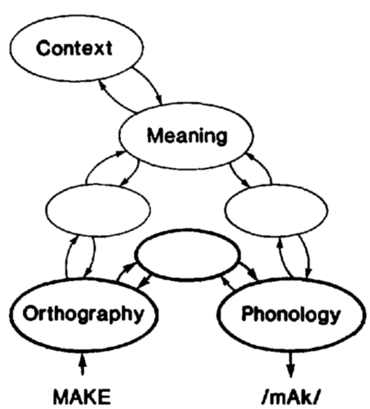
The way people learn to read single words has been theorized in the past decades. Two of these models are presented: the sequential and the triangle model. Seymour (1997) proposed a sequential model, based on three stages or phases of development. In phase 1, basic foundational reading components are established. These basic elements are divided into logographic and alphabetic processes, both of which support sequential decoding. Phase 2 includes the acquisition of orthographic features in the language, and phase 3 is focused mainly on the morphographic characteristics (see figure 1). Small units such as phonemes are emphasized in the phase 1, while larger units such as rhymes and syllables appear in the phases 2 and 3 (Seymour, Aro, & Erskine, 2003). In order to test the development of these components in each of the phases, Seymour and Evans (1999) administered a number of tasks to Scottish primary children from 1st and 2nd grade (5 and 6 years old). The results showed that letter-sound knowledge was acquired before the end of the 1st grade, while logographic and alphabetic foundations were developed later in 2nd grade. Children from poor backgrounds showed one or more years of delay compared to other students (Duncan & Seymour, 2000).

Figure 1. Sequential reading acquisition model (Seymour et al., 2003)



The triangle model proposed by Seidenberg and McClelland (1989) suggests that the process of learning to read consists of creating associations between visual representations of the letters that create words (orthographic representations) and the phonological and semantic representations of oral language which, in turn, correspond to those words. This process is interactive and affected by the context (as it is shown in figure 2). When children learn to read, the phonological and semantic pathways develop simultaneously, however in the first stages of reading development, the child's cognitive resources are focused on establishing the phonological pathway (mapping letters to sounds), and later, when reading becomes automatic, words are read via semantic pathway (Hulme & Snowling, 2014).

Figure 2. Triangle model (Seidenberg & McClelland, 1989)



It is important to note that any theory of reading acquisition cannot ignore the fact that not all languages are equal in terms of grapheme-phoneme consistency, i.e. in the predictability of the relationship between letters and their phonemes. The consistency of grapheme-phoneme correspondences in a language affects the rate at which children learn to read: children are faster to acquire reading in orthographies with higher grapheme-phoneme consistency (Caravolas et al., 2013; Georgiou, Parrila, & Kirby, 2006; Goswami, 2002). This fact is a consequence that children that learn to read in a language highly consistent in terms of phoneme and grapheme can trust in the regularity of the rules, while those children learning in less consistent orthography cannot trust in the cues because often, they are ambiguous (Ellis, et al., 2004).

To evaluate the differences in reading acquisition across languages, commonly the number of non-real words accurately read by several children was considered. However, the way in which items often were designed did not allow a fair comparison across languages (Ziegler & Goswami, 2005). To solve this issue Goswami, Gombert and de Barrera (1998) conducted a study with English, French, and Spanish 7-, 8-, and 9-year-old children. This study considered non-words designed in a non-familiar way to participants. Each grapheme in the presented word had to be decoded individually into an unfamiliar phonological string. The results showed a gradient among language transparency and the number of non-words correctly read by participants.

Another traditional issues in the comparisons about reading acquisition among different languages is to control some socio-cultural differences associated with participants within countries. This it includes school system, curricula, teaching methods, etc. (Ziegler & Goswami, 2005). These studies are quite novel ones and most of them have been conducted in developed countries [i.e. Canada (Bruck, Genesee, and Caravolas, 1997), England, and Welsh (Ellis & Hooper, 2001)].

Different hypotheses have been proposed to explain how the grapheme-phoneme consistency of languages affects the reading acquisition rate. In the case of the sequential model, Seymour et al. (2003) suggest two hypotheses. The first possibility is that basic foundational reading components precede the formation of an orthographic framework. In this sense, the foundational components appear in an equivalent way in different languages, and then differences related to grapheme-phoneme consistency emerge later, when the orthographic framework is already formed. The second possibility is that orthographic complexity has a stronger effect on reading acquisition, affecting the process from the very beginning of learning to read (Seymour et al., 2003). Thus, foundation literacy acquisition advances slower in less consistent grapheme-phoneme orthographies than in more consistent ones. In the case of the triangle model, Seidenberg (2006) proposes that the same processes and mechanisms are applied to languages with different level of grapheme-phoneme consistency, but in more consistent orthographies the mapping between orthography and phonology proceeds faster than in less consistent orthographies. In any case, the processes involved in reading become more efficient with practice.

Despite the differences in the orthographic features such as the transparency and the rate in which children learn to read among different languages, it is possible to find three common reading predictors among them: phonological awareness, rapid automatic naming and letter knowledge, which are universal cognitive prerequisites for learning to read in alphabetic orthographies (Caravolas et al., 2013). These three predictors will be discussed later in the foundational reading skills section.

2.3. Spanish language features

Several cross-linguistic studies have been carried out on languages with different grapheme-phoneme consistency. Spanish is usually included in the consistent group (Caravolas et al., 2013; Kim & Pallante, 2012). Some authors have noted that the majority of studies have been carried out in developed countries, and that findings about Spanish are based on the Spanish spoken in Spain, and not on other varieties of Spanish, such as the Spanish from Latin America (Anthony & Francis, 2005; Guardia, 2010; Strasser & Lissi, 2009).

In terms of orthography, the Spanish language can be considered consistent in terms of their grapheme and phoneme (Defior, Martos, & Cary, 2002). In Spanish language, inconsistencies in grapheme-phoneme mapping can be categorized into three types: a) one grapheme with no phonemes; b) one grapheme that can be expressed by two different phonemes; and c) one phoneme that can be represented by two graphemes.

In the first case, under certain circumstances, h and u can be considered silent letters. In Spanish, ‘h’ will always be silent when this letter starts a word. For example, hija ['i xa] (*daughter*), hilo ['i lo] (*thread*), and hogar [o 'ɣar] (*home*). 'U’ is silent when it appears after ‘g‘ and ‘q’ and before ‘e’, and ‘i’. For example, it is silent in the words guinda ['gin da] (*cherry*), guía ['gja] (*guide*), and guión ['gjon] (*script*), and in queso ['ke so] (*cheese*), queja ['ke xa] (*complaint*), and quieto ['kje to] (*quiet*). In the case of one grapheme with two phonemes, Spanish language shows two examples, letters ‘c’ and ‘g’. The grapheme <c> is pronounced as /k/ before [a], [o], and [u], but as /s/ before [e], and [i]. ‘C’ is pronounced differently, for example, in the words **c**alma [kalma] (*calm*) and **c**ielo [sjelo] (*sky*). Similarly, <g> is pronounced as [g], before [a], [o], and [u], but as [x] before [e], and [i]. ‘G’ is pronounced differently in the words gato ['gato] (*cat*) and gesto ['xes to] (*gesture*), for example. The third case is one phoneme represented by two different graphemes. This situation appears in the phonemes /s/ and /x/. The phoneme /s/ can be represented by the letters s, c, and z, for example in the words be**s**o ['be so] (*kiss*), tre**c**e ['tre se] (*thirteen*), and **z**umo ['su mo] (*juice*), while the phoneme /x/ can be represented by the graphemes g and j, for example in the words ángel ['an^{j} xel] (*angel*), and tejer [te 'xer] (*to knit*) (Quilis, 1993).

Regarding c, s, and z, Spanish shows some phonological variations between certain Spanish regions and the Spanish from Latin America. As previously mentioned, ‘c’ is pronounced as /k/ unless the following vowel is <e> or <i>, in that case it is pronounced as /s/. Spanish speakers in some Spanish regions have different sounds for this case to differentiating between /c/, /s/ and /z/. Thus, in the isolated words cirio (*religious candle*) and Sirio (*Sirian*), /c/ and /s/ are pronounced differently. People from some Spanish regions pronounce it as (cirio=[θirjo] and Sirio=[sirjo]), while in Latin America this phonological differentiation does not exist, and both words are pronounced exactly in the same way [sirjo]. In the case of the letter <z>, speakers from some Spanish regions pronounce it as θ, for example in [man'θana] (*apple*), while speakers from Chile pronounce it as s [man'sana] (*apple*) (Quilis, 1993).

In terms of syllabic structure, most Spanish words have two or three syllables, and mainly are paroxytone words, this is, stressed on the penultimate syllable. Words usually follow the CVC (sol/sun), CVCV (casa/*house*) and CVC-CV (pista/*track*) structures. The CCV structure is more frequent at the beginning of a word than word-medially, for instance (tristeza/*sadness*). Monosyllabic words are less frequent and they are usually function words such as prepositions, determiners, or pronouns, among others (Seymour et al., 2003).

In addition to the language features, the child's socioeconomic status (SES) in which a child grows up is also considered a crucial factor for variability in reading performance. The following pages describe the main motivation of this study, that is, to evaluate the impact of SES on reading and the predictors of reading in a sample of Spanish-speaking monolingual children.

2.4. Socioeconomic status

Children's socioeconomic status (SES) has strong effects on their reading development (Bowey, 1995; Duncan & Seymour, 2000; Noble, Farah, & McCandliss, 2006). SES is compound of a number of factors, such as parent educational attainment, family income, birth weight, nutrition, housing quality, and access to health care (R. Bradley & Corwyn, 2002). These factors have strong repercussions on parenting and children's cognitive and language functioning, affecting particularly educational attainment (Brooks-Gunn & Duncan, 1997).

SES has been characterized as a fluid and multidimensional factor, which is needed in order to evaluate the nature, timing, and persistence of poverty in the population

(Brooks-Gunn & Duncan, 1997). However, there is no agreement about how to evaluate SES. Most authors agree to include some quantification of, at least, parental education, family income, and occupational status. The debate about which of these factors should be considered 'the most important' varies according to the representation of this construct. 'Financial', 'Social' and 'Human capital' are three typical ways to operationalize SES.

'Financial capital' emphasizes those aspects related to family income and material resources as the main components of SES (R. Bradley & Corwyn, 2002). To evaluate these components, some authors prefer to gather information about how much families pay for renting a house (as an estimative value) (Entwisle & Astone, 1994), while others prefer to directly ask the total value of their belongings (Ostrove, Feldman, & Adler, 1999). 'Social capital' emphasizes those aspects related to the environment where a child grows up in terms of relationships. In this line, Entwisle and Astone (1994) suggest asking some questions regarding 'social capital', such as the number of parents in the home and the presence of a grandparent/grandmother in the same place. The argument is that parents' occupational status is related to their parenting practices, while the number of adults at home is related to the number of networks in which a child develops. Finally, the 'human capital' perspective highlights aspects related to educational attainment and parents' professions (White, 1982).

Despite the different ways to evaluate SES, such as 'Financial', 'Social' and 'Human capital', the relevance of these factors is still a matter of debate (R. Bradley & Corwyn, 2002). To deal with this issue, it has been suggested that SES should be evaluated by estimating the predictive value of composite SES score or the contribution of the single factors previously presented. However, the results are not consistent (Liberatos, Link, & Kelsey, 1988; White, 1982). One plausible scenario is that the three factors are tapping the same underlying phenomenon. However, in other studies, this composition does not work, and the effect of SES is not significant, or barely modest (Ostrove et al., 1999). In fact, it has not been clearly established that the same underlying SES mechanism works in the same way for all ethnic and cultural groups (D. R. Williams & Collins, 1995).

2.4.1. Socioeconomic status (SES) and reading

Children from high SES families show better performance in reading, and language skills compared to their peers from low SES families (Bowey, 1995; Hoff, 2003; Rowe, Raudenbush, & Goldin-Meadow, 2012). These differences associated with SES start from the first years of school and the educational gaps between children from different SES become wider in secondary and tertiary education (OECD, 2010). The hypotheses to explain this relationship vary. For example, it has been suggested that parents in low SES families are less likely to purchase learning and reading materials for their children, less likely to take children to cultural events, and less likely to regulate the time children spend watching TV (R. Bradley, Corwyn, Burchinal, McAdoo, & Garcia, 2001). As a result, children from low SES groups present poor academic achievement and poor reading outcomes (Battin-Pearson et al., 2000). It has also been suggested that children growing up in a more disadvantaged environment acquire language skills more slowly than their peers from higher socioeconomic backgrounds, delaying processes such as letter recognition and phonological sensitivity (Whitehurst & Lonigan, 1998).

The relationship between SES and reading is not direct, but mediated. Aikens and Barbarin (2008) propose that SES affect reading through a) the quality of environments, and b) the quality of social relations. The quality of environments includes factors such as activities, and resources. On the other hand, the quality of social relations includes resources, experiences, interactions, families, schools, and neighborhoods creating protective or risky environments for children´s reading development. The proposed model is based on the ecological systems theory (Bronfenbrenner, 1979, 1989), which proposes that development is affected by the quality of the relationships between children and close and distant people.

2.4.2. Home literacy environment

'Home literacy environment' has been characterized as an umbrella term to describe those literacy-related interactions, resources and attitudes that children experience at home (Hamilton, Hayiou-Thomas, Hulme, & Snowling, 2016). One of the ways to understand how the home literacy environment factors affect reading performance is through direct and indirect processes. Direct processes are those closer to the child's development, and they include, for instance, the interactions between children and significant caregivers. It has been also labelled as proximal factors (McKean et al., 2015). These factors are in turn influenced by more external conditions, or distal factors, including for example, the typical indicators of socioeconomic environment, such as family income, educational attainment, and occupation (Mendive, Lissi, Bakeman, & Reyes, 2016).

No studies have established a direct, unidirectional causal relationship between one particular SES factor and reading ability (Buckingham, Beaman, & Wheldall, 2013). It has been proposed that the influence of SES factors on reading is mediated by direct and indirect factors (McKean et al., 2015; Park, 2008). For example, it has been found that SES, measured through family income, is related to child care quality, which in turn has an impact on reading achievement (Downer & Pianta, 2006). Another study, using data from 25 countries, found that SES, measured through parent education, had an impact on the availability of literacy tools at home, which in turn affects reading performance (Park, 2008). Concordantly with the previous studies, it was found that parents' educational attaintment affected the frequency with which they read books to their children, which in turn, affected their children's reading performance. 62% of parents with tertiary education tend to read to their children every day, whereas this percentage significantly decreases to 28% in the case of parents with incomplete education (Australian Institute of Family Studies, 2011).

Home literacy environment factors do not always show a perfect fit between the environment and reading attaintment. This lack of fit could be explained by the fact that families have different values, attitudes, expectations and behaviours about literacy, which in turn affect reading acquisition. In addition, the literacy practices at home are not linearly related to family income, educational attainment, or parent occupations. For example, families from low and medium-high environments show a wide range of literacy-related practices, some of poor and others of good quality (Australian Institute of

Family Studies, 2011; Phillips & Lonigan, 2009; Son & Morrison, 2010). In a study conducted by Park (2008), it was found that an important proportion of parents with poor educational attaintment showed positive attitudes toward reading, engaging children in literacy activities and having a large number of books at home. These findings invite the discovery of new ways in which SES is related to reading performance.

In a review, Snow, Burns, and Griffin (1998) evaluated the magnitude of the link between home literacy environment and literacy, and discovered a 'modest' relationship between them. Other studies also show a significant, but not strong, correlation between both elements (Foster, Lambert, Abbott-Shim, McCarty, & Franze, 2005; Molfese, Modglin, & Molfese, 2003; Park, 2008). However, it is not possible to establish a definitive statement about the relationship, since all of these studies used different ways of evaluating both home literacy environment and literacy (Buckingham et al., 2013). In line with these findings, Whitehurst and Lonigan (1998) investigated the specific role of certain components of home literacy environment. Their study portrayed that some aspects seem to be more important than others. The authors also suggest that there is an 'inside-out' and an 'outside-in' typology of literacy skills. The 'inside-out' group includes phonological awareness and letter knowledge skills, whereas the 'outside-in' group includes vocabulary and conceptual knowledge of print letters. Both domains are acquired differentially through different components of the home literacy environment. Storch and Whitehurst (2001) found that activities such as reading and exposure to books in the early years improve oral language and vocabulary (outside-in), but not those abilities such as word-letter knowledge or phonological skills (inside-out). Good word-letter knowledge at age 4 was associated with parents having taught their children explicitly about the alphabet and printed letters.

Another distinction in the home literacy environment is between informal and formal (Senechal & LeFevre, 2002), or passive and active features (Burgess et al., 2002). Informal or passive aspects of the home literacy environment include having materials such as educational toys, books, or participating in literacy-related activities, such as visiting libraries and museums, or shared reading with parents (Buckingham et al., 2013).

The activities included in the 'formal' or 'active' group are those in which parents make a direct contribution to their children's learning, and those which pursue a goal, including the direct teaching of letters, sounds, and print concepts. This distinction has allowed researchers to establish that higher levels of informal or passive early home literacy environment activities (or materials) significantly predict higher emergent literacy skills in vocabulary, oral language, and receptive language, but not phonological awareness or word-letter knowledge (Baroody & Diamond, 2010; Bracken & Fischel, 2008). Instead, phonological awareness and word-letter knowledge are predicted by higher levels of active or formal early home literacy environment activities (Burgess et al., 2002).

In sum, significant differences in reading outcomes depend strongly on the opportunities that children experience as they develop. Growing up in an enriched home literacy environment, where reading is a daily family activity, increases the likelihood of achieving a better reading performance in later years. Opportunities for growing up in an enriched environment depend, although not exclusively, on the family's SES, particularly in those segregated countries where reading outcomes are linearly associated with factors such as family income or parents' educational attainment (OECD, 2010). Children from low SES in countries with unequal income distribution, such as Chile, tend to study in the same schools as their peers of similar SES. These schools, in turn, devote very little time to literacy activities, thereby affecting the reading acquisition process (Strasser, Lissi, & Silva, 2009).

2.5. Components of reading

In this section, three components of reading are presented: accuracy, fluency and comprehension. These components are based on the 'simple view of reading' model, which proposes that reading includes two domains: decoding and listening comprehension (Hoover & Gough, 1990). Decoding refers to the ability to convert printed words into spoken words. In this section, decoding will be described as reading accuracy and fluency, while the second component of the simple view of reading will be analysed as reading comprehension.

2.5.1. Decoding - Reading accuracy

2.5.1.1. Reading accuracy: definition

In a very simple definition, reading accuracy can be understood as the ability to read single printed words with accuracy, including the pronunciation of words in a way that the whole meaning of the utterances can be understood (Pasquarella, Chen, Gottardo, & Geva, 2015). Accuracy is a skill that is progressively developed in the early grades and involves links between orthographic, phonological, and meaning representations (Seidenberg & McClelland, 1989). Reading accuracy is one of the requirements for reading comprehension. As reading accuracy improves, more attention can focus on other aspects of decoding, allowing reading to become more automatic, which in turn improves reading comprehension (Wolf & Katzir-Cohen, 2001).

2.5.1.2. Reading accuracy: predictors

It has been commonly held that phoneme awareness and letter knowledge are crucial foundational skills to enable children to learn how to read. Both skills allow children to understand the alphabetic code, and in combination allow them to develop basic reading accuracy (Foulin, 2005). However, separating reading accuracy and reading speed is important in order to precisely identify the predictors and the mechanisms involved in each one of the processes (Juul, Poulsen, & Elbro, 2014). In this line, the results of a study conducted with students in fourth grade with slow reading speed and low accuracy, found that both groups showed different and unique profiles, with general deficit in speed of processing affecting particularly the group of slow readers, while phonological awareness and morphological awareness strongly affected the inaccurate readers (Shany & Share, 2011).

Regarding the effect of phonological awareness and rapid automatic naming (RAN) on reading accuracy, it has been found that phonological awareness is a strong predictor of reading accuracy in the first year of primary school, although its predictive power tends to decrease over the years. In contrast, rapid automatic naming (a task which evaluates processing speed of a number of items) seems to be a good predictor of reading accuracy even in older readers (Christo & Davis, 2008; de Jong & van der Leij, 1999; Hulme, Snowling, & Clarke, 2005; Kirby, Parrila, & Pfeiffer, 2003).

2.5.1.3. Reading accuracy: assessment

There are at least two ways to assess reading accuracy: word/non-word (pseudo words) lists, and passage reading. In the first case, participants are required to read a list of graded words. Usually, non-word or pseudo word lists are included, to avoid the effect of word knowledge on reading accuracy scores (Leslie & Caldwell, 2011). In the case of passage reading, participants are usually required to read graded passages of text aloud, while the test administrator monitors this reading (Beaver, 2006). The scoring process varies from a qualitative approach, where the type of mistakes is recorded, to a quantitative approach, where the proportion of words/non-words that are read correctly is calculated.

2.5.2. Decoding - Reading fluency

2.5.2.1. Reading fluency: definition

Reading fluency is understood as the ability to read lists of words or words in a text quickly and accurately, and, for text reading, with appropriate expression ([NICHD], 2000; Fuchs et al., 2001). Reading fluency has proved to be associated with better reading performance (Meisinger, Bloom, & Hynd, 2010; Rasinski et al., 2005), while difficulties in reading fluency are associated with the avoidance of reading (Leinonen et al., 2001; Pinnell et al., 1995). Reading fluency in the early years is a strong predictor of later reading fluency (Geva & Farnia, 2011). In addition, several studies have showed that reading fluency can be considered an effective screening measure in determining the at-risk status among beginning readers (Compton et al., 2010; Fuchs, Fuchs, & Compton, 2004).

The fluency in reading is closely related to reading comprehension (Fuchs et al., 2001; Jenkins, Fuchs, van den Broek, Espin, & Deno, 2003). In a large study, the National Assessment of Educational Progress (NAEP) found that children who got low scores in fluency tasks had more difficulties understanding the meaning of what they were reading (Pinnell et al., 1995). It has been proposed that adequate progress in reading in English (or any other language) requires sufficient practice to achieve automaticity in different texts (Snow et al., 1998). In this line, LaBerge and Samuels (1974) proposed the theory of automaticity in reading, which establishes that a fluent reader should be able to recognize and identify words automatically, and then connect these words with their meanings. Perfetti (1985), extended this theory by proposing that children who have not yet reached automaticity in word recognition have to spend a significant amount of energy in order to decode the letters in a written text, which affects the processes involved in reading comprehension.

In different theoretical models of reading fluency, three components are commonly considered: accuracy (which has been discussed in the previous section), automaticity, and prosody. Each of these aspects are compound of several sub-processes. Automaticity, mistakenly confused with fluency, refers to the fast, effortless word recognition that is improved by reading practice, which allows that word recognition to become more automatic (Meisinger et al., 2010). Prosody, the music of language (Simpson, Oliver, & Fragaszy, 2008), has been defined as the use of appropriate expression or intonation in reading in the way that allows meaning to be determined (Cowie, Douglas-Cowie, & Wichmann, 2002; Kuhn, Schwanenflugel, Meisinger, Levy, & Rasinski, 2010; Miller & Schwanenflugel, 2008).

Regarding the development of reading fluency, it has been suggested that beginner readers follow a serial procedure of reading, in which sources such as phonology and semantic are used interchangeably in order to construct the meaning of a text (Kuhn et al., 2010; Kuhn et al., 2006). Logan (1997) suggested that every time a reader encounters new representations, these representations become part of their knowledge. This notion might have important implications for reading practice (Kuhn et al., 2010). In addition to the benefits that repetition has on fluency, it is also important to include the wide reading of texts (Schwanenflugel & Ruston, 2008). The presence of words or phrases in different contexts allows readers to determine different meanings and concepts. The notion of being exposed to a wider range of texts can be useful to understand the Matthew Effect proposed by Stanovich (1986). The Matthew effect can be summarised as the idea that '*the rich get richer and the poor get poorer*'. In terms of reading, children who read with a more accurate and automatic word recognition consequently have a more extensive vocabulary and are more likely to encounter a broader range of concepts than children who are struggling with reading.

2.5.2.2. Reading fluency: predictors

At least three skills have been proposed to predict the reading fluency in the first stages of reading, these are: letter knowledge, rapid automatic naming (RAN), and phonological awareness (Landerl & Wimmer, 2008; Norton & Wolf, 2012). However, the magnitude of the impact of the variables differs according to the child's age, or more specifically with their reading stage. In this regard, variables such as phonological awareness and RAN play a significant role in the first stages of reading, while, vocabulary, verbal short-term memory and visuospatial attention have proved to be significant predictors of reading fluency among older children (Tobia & Marzocchi, 2014). The decreasing explicative power of phonological awareness on reading fluency, has also been demonstrated in a study by Landerl and Wimmer (2008) who found that phonological awareness disappears as a predictor after the first year of primary school. In their study, they also found that the strongest predictor of reading fluency across age is the RAN.

It has also been studied whether the predictors of reading fluency are similar in languages with different grapheme-phoneme consistency. The results show a strong predictive power of RAN on reading fluency not only in a less consistent grapheme-phoneme orthography as Urdu (Farukh & Vulchanova, 2014), but also in a language with a more consistent grapheme-orthography such as Italian (Tobia & Marzocchi, 2014).

2.5.2.3. Reading fluency: assessment

There are at least two ways to evaluate reading fluency: isolated word lists and passage reading (Fuchs et al., 2001). In the isolated word list, participants are required to read correctly words from a graded word list (Shanker & Ekwall, 2009). In some cases, the list is associated with time to create a rate of words read by minute. In the case of reading a paragraph or short text, participants are required to read aloud while the test administrator records oral reading rate and oral reading expression (Beaver, 2006).

Jenkins, Fuchs, Espin, Van den Broek, and Deno (2000) conducted a study to evaluate which of the tools is the most pertinent to evaluate reading fluency. To this purpose, 113 fourth-grade students: 85 skilled readers, 21 students without disabilities who read below the 50th percentile, and 7 students with reading disabilities were asked to read both a list of words and a short text, and the results were compared with some scales of comprehension from the IOWA test. The results in the word list and the text were quite similar. However, there was greater variation in the text task than in the word list. Likewise, the text showed a higher correlation with reading comprehension, indicating that text fluency appears to have more in common with reading comprehension than with fluent word list reading.

Regarding fluency assessment scoring, the National Assessment of Educational Progress (NAEP) (2000) has proposed different levels for evaluating fluency at the level of the paragraph. The most basic level includes those children who read word-by-word. They might be able to occasionally read two or three words, but without understanding the meaning of the text. At higher levels, children can read larger and more complex phrase groups. Although it might be possible to find some errors in reading, these should not affect the main content and purpose of the text.

2.5.3. Reading comprehension

2.5.3.1. Reading comprehension: definition

Understanding the meaning of the words in a written text is considered the main goal of reading, involving a number of processes that go beyond simple decoding (Bowyer-Crane & Snowing, 2005). Reading comprehension has been defined as the construction of meaning from what is read (Mellard, Fall, & Woods, 2010). In order to achieve this objective, a reader must decode words and associate them with their meanings. It is a requirement to have an acceptable level of fluency, in order to not lose word meanings while the text is being processed (Curtis & Kruidenier, 2005).

According to the simple view of reading, comprehension can be understood as an interplay between decoding and listening comprehension (Gough & Tunmer, 1986). In other words, readers are required to identify printed words (in a bottom-up process) and, at the same time, be proficient in terms of linguistic analysis about semantic and syntactic relationships among the words in a written text (Cutting & Scarborough, 2006). Both components in combination explain between 65% and 85% of the variance in reading comprehension (Catts, Hogan, & Adolf, 2005).

The simple view of reading, based on bottom-up and top-down processes, allows reading comprehension difficulties to be classified into two types. Problems in the bottom-up information processing transform reading into a weak and effortful task due to the unknown or misunderstood words. When this is the case, cognitive resources are focused on trying to discriminate and understand the words (decoding) instead of focusing on text comprehension (LaBerge & Samuels, 1974; Perfetti, 1985). When problems appear in the top-down skills, the child is able to read accurately all the printed words but is unable to fully understand the meaning of the text because of difficulties with the meaning of the words or with the logical and structural relationships among the words or sentences in the text (Catts, Fey, Zhang, & Tomblin, 1999; Gough & Tunmer, 1986). Wolf and Bowers (1999) have also suggested including speed as a factor when explaining difficulties in poor readers. The inclusion of processing speed tasks like rapid automatic naming (RAN) improves the prediction in reading comprehension models (Joshi & Aaron, 2000).

Despite the adequate explanatory framework that the Simple View of Reading proposes, in the last years, several studies have been conducted in order to revisit the original model. For example, Kendeou, Savage, and van den Broek (2009) instead of confirming the contribution of decoding and listening comprehension on reading comprehension variance, aimed to prove the dissociation of these components. They confirmed the independence of these factors by using two different large datasets from different approaches in English-speaking children. Florit and Cain (2011) in turn, questioned if those findings in English speaking readers can be transferable to other orthographies. In their study, they suggest that the contribution of decoding and listening comprehension on reading comprehension is mediated by the grapheme-phoneme consistency in the language that has been mastered, for example decoding was more influential than linguistic comprehension in the early stages of reading in English-speaking children. Finally, Adlof et al. (2006) conducted a study in order to evaluate whether the simple view of reading model should include a fluency component in the model. Their results did not find an independent effect of fluency on reading comprehension. However, these findings should be taken with caution because half of the children in the sample had language and/or non-verbal cognitive impairments.

2.5.3.2. Reading comprehension: predictors

The DIME (Direct and Inferential Mediation) model (Cromley & Azevedo, 2007) holds five domains as predictors of reading comprehension. These are background knowledge, inferences, strategies, vocabulary, and word reading skills (Carr, Brown, Vavrus, & Evans, 1990). Other models consider six predictors, which are: word recognition, working memory, vocabulary, inferencing and reasoning skills, and background knowledge. It has been suggested that rather than listing a number of predictors, it is better to differentiate them according to lower and higher level thinking processes depending on the reading stage (Cain, Oakhill, & Bryant, 2004; Rapp, van den Broek, McMaster, Kendeou, & Espin, 2007). In the basic level, predictors such as working memory and verbal skills predict early stages of reading comprehension, while in the more advanced stages, the interplay of prior knowledge and the new information provided by the text allow the development of more complex cognitive processes, such as inferencing (Cain et al., 2004). In sum, word recognition, readers' vocabulary knowledge, inferencing, and background knowledge are often recognized as strong predictors of reading comprehension in the early and later stages of reading (Oakhill & Cain, 2012).

Word recognition and readers' vocabulary knowledge have been shown to strongly affect reading comprehension. Word recognition has been considered the best predictor of reading comprehension in the early years (Juel, Griffith, & Gough, 1986). Vocabulary, in turn, has also been considered one of the most robust predictors of reading comprehension (Muter et al., 2004). The reader's vocabulary knowledge is closely related to the perception that the reader has regarding the text's difficulty (Stahl, 2003; Wixson & Lipson, 1996). Other non-phonological language skills, such as syntactic and morphological awareness, have shown to be predictors of reading, particularly in those poor comprehenders (Kirby et al., 2011; Tong, Deacon, & Cain, 2013).

Moreover, it has been found that the ability to make inferences is related to higher scores in reading comprehension tasks (Cain & Oakhill, 1999). An adequate theory of reading comprehension should include the role of generating inferences when readers construct the model about the text´s topic (Graesser et al., 1994). This situation model is a mental representation of people, setting and events that are mentioned implicitly or explicitly in the text (Bowers, 1989). To create this situation model, making inferences becomes crucial. Thus, it has been suggested that moving from basic to more advanced stages of reading is permeated by the use of a range of cognitive skills, particularly the ability to draw inferences (Mellard et al., 2010).

In a wider sense, background knowledge appears to be a central predictor of reading comprehension, although it is rarely included as factor in research studies (Stahl, Hare, Sinatra, & Gregory, 1991). More specifically, it has been hypothesized that background knowledge mediates the extent in which cognitive skills are used in reading comprehension tasks (Cromley & Azevedo, 2007). Fisher and Frey (2009), argue that background knowledge acts both directly and indirectly on reading comprehension. For instance, reading fluency is an important contributor to reading comprehension. Fluency, in turn is strongly affected by the level of readers' background knowledge (Klauda & Guthrie, 2008). Background knowledge also strongly affects the reader's vocabulary knowledge, which is a strong predictor of reading comprehension (Fisher & Frey, 2009). The effect of background on reading comprehension has been shown to increase with age (Evans, Floyd, McGrew, & Leforgee, 2001).

2.5.3.3. Reading comprehension: assessment

There are at least five ways to evaluate reading comprehension: oral reading, sentence comprehension, multiple choice tasks, story retell, and silent reading comprehension. In oral reading, participants are required to read a paragraph or a short text aloud, while the test administrator monitors the process. Once the reading has finished, the tester asks a few questions regarding the passage (Wiederholt & Bryant, 2001). In sentence comprehension tasks, participants are required to read a sentence with a word missing, and then they must decide which word best completes the sentence. Usually, a range of simple, compound, and complex sentences are used (K. Williams, 2001). In the case of multiple-choice tasks, participants read a short story and then they are presented questions with multiple options. Participants are required to select one correct answer from a list. The questions usually refer to summarise the main ideas of the text, and literal/inferencing questions (Defior et al., 2006). In story retell tasks, participants listen to a story and retell its important details and features. In this case, responses are open-ended and a rubric is provided to guide the scoring of responses (Berninger, 2001). Finally, in silent reading comprehension, participants read passages or texts and answer explicit comprehension questions (Flynt & Cooter, 2004).

Although there are multiple tasks to evaluate reading comprehension, researchers rarely give much attention to the choice of task (Cain & Oakhill, 2006; Mellard et al., 2010). There are at least two factors to consider when choosing a comprehension task: the format of the task, and the conceptions about reading. Regarding the format, in those tasks using a bottom-up or top-down format, significant differences have been found in the explained proportion of the variance in reading comprehension. Conceptions about reading also modify the way reading comprehension is evaluated, due to the number and the weight of the factors that are included in the test (Cutting & Scarborough, 2006). Unfortunately, these conceptions of reading comprehension are often not explicit in the tasks. Variables such as the sentence and passage length, word frequencies, syntactic complexity, and the inclusion of academic versus colloquial language forms, correspond to different cognitive and linguistic demands, affecting the reading comprehension performance. Other authors include two additional factors: the reader's skills (e.g. memory, vocabulary, word reading, etc.), and the purpose of reading (e.g. responding questions in a test, pleasure, etc.) (Mancilla-Martinez & Lesaux, 2010).

As the processes involved in reading comprehension are not a dichotomy, but a linear gradient from decoding simple words to the comprehension of a text, the comprehension assessment should include this approach. This is, to evaluate from words and phrases comprehension, responding different kind of questions based on texts from different nature. The current project aimed to include different reading tasks, including several reading skills to consider the complexity in which reading processes take place.

As it has been previously stated, it is crucial to automate the decoding process in order to reach an adequate reading comprehension, and therefore, the battery of tests of reading comprehension should allow to establish the level in the reading gradient in which a child perform.

2.6. Foundational reading skills

The current evidence regarding foundation reading skills shows that there are three variables that consistently predict word reading and spelling ability not only in English but also in other language with different levels of grapheme-phoneme consistency. The triple foundation model proposed by Caravolas and Samara (2015) states that the knowledge of the functional symbol set of the orthography, awareness of the speech units to which orthographic symbols maps, and the efficiency in mapping between the graphemes and phonemes, are crucial in the reading acquisition processes.

In practical terms, the Triple foundational model states that phonological awareness, rapid automatic naming (RAN) and letter knowledge are the most relevant predictors of reading accuracy, fluency and comprehension (Caravolas et al., 2012; Savage & Frederickson, 2005). However, it has been established that the effect of these three factors vary not only regarding the component of reading: accuracy, fluency, and comprehension, but also according the language features such as the grapheme-phoneme consistency (Caravolas & Samara, 2015). In this line, the authors suggest that RAN might play a more important role in highly grapheme-phoneme consistent languages, because in these cases the differences might appear in fluency rather than accuracy.

Given that phonological awareness and RAN make a singular contribution to predict reading outcomes, it has been proposed that they might be part of a single construct; RAN can be considered as one of the phonological awareness tasks (Torgesen, Wagner, Rashotte, Burgess, & Hecht, 1997). Contrary to this idea, Wolf and Bowers (1999) argue that phonological awareness and RAN must be considered different processes. The authors argue that children can face difficulties in phonological awareness but not in RAN, and vice-versa, and therefore, considering both processes as part of the same construct does not seem reasonable. A different hypothesis is that RAN might tap a mechanism that enables the formation of associations in order to integrate orthographic and phonological representations (Caravolas & Samara, 2015).

Although an important cumulus of evidence comes from English context (Share, 2008), in recent years some studies have also been conducted in other languages, including Finnish (e.g., Leppänen, Niemi, Aunola, & Nurmi, 2004; Parrila, Aunola, Leskinen, Nurmi, & Kirby, 2005), Czech (Caravolas, et al 2012), and Spanish (Pallante & Kim, 2013; Strasser & Lissi, 2009). The inclusion of other languages is highly useful since it cannot be assumed that those findings coming from the English context can be directly transferred into more consistent grapheme-phoneme orthographies (Kim & Pallante, 2012; Pallante & Kim, 2013). In the same way that it cannot be assumed that the development of reading is similar in languages with different grapheme-phoneme consistency, it cannot be considered *a priori* that the socio-economic factors, and the reading opportunities are the same in students who share the same language (Ziegler & Goswami, 2005). Therefore, they also should be considered in the reading predictor models.

The grapheme-phoneme consistency in the languages cannot be underestimated. Caravolas and Samara (2015) suggest that in those less transparent languages the rate in which children learn to read is slower than their peers learning in a more transparent language. They provide as an example the study conducted by Defior, et al., (2002) in which two similar languages as Spanish and Portuguese were compared. The authors noted that Portuguese is slightly less consistent than Spanish language. The results show that Portuguese children acquire reading slower than their Spanish peers from the first to fourth grade of primary.

In this line, a logical explanation suggests that in shallow orthographies the relation between grapheme and phone is predictable, while in deep or less consistent orthographies a greater effort is required to convert rules and apply them to the reading processes. This phenomenon is particularly evident when children in less consistent orthographies are required to read unfamiliar words, because in these cases they need to apply or adapt rules that not always are completely established.

Ziegler and Goswami (2005), have proposed the called Grain size theory, which suggests that when a reader must deal with the ambiguity in the reading, the reader must trust on larger sublexical units and print-to-speech correspondences. In contrast, in more consistent languages children can rely on smaller units to reach an adequate level of accurateness in reading.

In the next section, the variables included in the Triple foundational model: Phonological awareness, Rapid automatic naming and Letter knowledge will be presented.

2.6.1. Phonological awareness

2.6.1.1. Definition

Phonological awareness can be understood as a meta-linguistic skill (Bravo, Villalón, & Orellana, 2002; Stahl & Murray, 1994) that enables people to manipulate the sounds within words by segmenting or deleting them (Denton, Hasbrouck, Weaver, &

Riccio, 2000). Phonological awareness includes the awareness of different size units of sound, from small ones (i.e. phonemic awareness) to larger ones (i.e. syllables and rimes). In this sense, the definition of phonological awareness varies depending on the theoretical and empirical perspectives of the researchers, and most definitions refer to the number and kinds of tasks that have to be included (Anthony & Francis, 2005). The impact of phonological awareness on early word reading has been demonstrated in a wide range of languages, such as English, Slovak, Czech (Caravolas et al., 2012; Hulme et al., 2002), and Spanish (Bravo, Villalon, & Orellana, 2003; Denton et al., 2000; Melby-Lervag, Lyster, & Hulme, 2012).

Regarding the development of phonological awareness, two facts become evident. Firstly, while children are growing up, they seem to be increasingly sensitive to smaller parts of sounds in words (i.e., phonemes). Thus, children learn to identify and manipulate syllables before they can play with onsets and rimes (Anthony & Francis, 2005). Second, children can detect similar and dissimilar words before they can play with the sounds within words (Anthony, Lonigan, Driscoll, Phillips, & Burgess, 2003). Ziegler and Goswami (2005) compile evidence to suggest that children in the first instance are likely to master at word-level before they can move to syllable-level. Then, syllable-level skills appear before onset-rime skills, and finally onset-rime-level skills are reached before phoneme-level skills. This progression has been demonstrated by controlling the task complexity (Anthony, Lonigan, Driscoll, Phillips, & Burgess, 2003). Although the pattern from larger to simpler units of sounds can be described as a universal process, the rate at which children move from one stage to another varies from language to language.

The features of each language are determinant in the development of phonological awareness (Anthony & Francis, 2005). In this sense, children who learn to read in a highly consistent language, develop syllable awareness sooner than those who learn to read in a less consistent grapheme-phoneme language (Cossu, Shankweiler, Liberman, Katz, & Tola, 1988). Caravolas and Bruck (1993) compared some phonological awareness tasks in a sample of Czech-speaking (high grapheme-phoneme consistency) children and English-speaking (low grapheme-phoneme consistency) children. The results showed that Czech children had better phonological awareness than their English-speaking peers. The results of this study show that the orthographic consistency in the languages has an impact on the rate and patterns of phonological awareness development, reflecting some oral language input that children receive before the introduction of alphabetic literacy.

2.6.1.2. Phonological awareness and reading

It is widely accepted that phonological awareness makes a crucial contribution to both reading accuracy and fluency (Ehri et al., 2001). When different reading predictors such as phonological awareness, letter knowledge, parents occupation status, and vocabulary are evaluated before children start school, phonological awareness is the strongest predictor for the first stages of reading (Share, Jorm, Maclean, & Matthews, 1984). One of the hypotheses that explain this relationship is based on the alphabetic system. Each written word is, in some ways, consistent with phonemes. Being able to separate and manipulate these sounds and simultaneously relate them to written words are tasks that contribute to the early stages of reading (Ehri et al., 2001), and therefore the combined effect of phonological awareness (particularly phonemic awareness), along letter-sound knowledge strongly influence the development of early stages of reading (Hulme, Bowyer-Crane, Carroll, Duff, & Snowling, 2012).

Castles and Coltheart (2004), question the causal link between phonological awareness and reading. The authors suggest that because most of the evidence based on this relationship is collected in school-settings, the influence of other literacy components can affect the correct interpretation of this effect. Hulme, Snowling, Caravolas, and Carroll (2005) refute this idea by suggesting that there is strong evidence of the causal link, but that this finding should be considered within a broader set of language skills, and therefore phonological awareness should be included in a multicausal system of reading predictors.

It is important to analyse the influence of phonological awareness on reading from a wider perspective, which includes the role of phonological processing. It has been proposed that while a good performance in phonological processing tasks is related to acceptable levels of reading, impaired phonological processing is associated with difficulties in reading, such as dyslexia (Bishop & Snowling, 2004; Kamhi & Catts, 1986). A common way to evaluate phonological processing is through non-word repetition (Conti-Ramsden, Botting, & Faragher, 2001), which will be discussed at the end of this section.

2.6.1.3. Phonological awareness assessment

There are four components of phonological awareness that should be considered: phoneme, onset, rime, and syllable (Hoien, Lundberg, Stanovich, & Bjaalid, 1995). These components are often evaluated according to the age of the participants, reading levels, and the language through participants learn to read, as discussed earlier (Anthony & Francis, 2005). Several tasks can be used to assess phonological awareness, including:

a. **Phoneme isolation,** which requires recognising individual sounds in words, usually the first one. For example, 'could you please tell me what is the first sound in the word 'director''? (Bravo et al., 2003; Bravo et al., 2002).

b. **Phoneme identity**, which requires identifying the common sound in different words for example, 'Tell me the common sound in the words battle, bike and blue' (Denton et al., 2000).

c. **Phoneme categorisation**, which requires identifying the odd sound in a sequence of three/four words. Example, 'Which word does not belong in bus, bun, rug?' (Ehri et al., 2001).

d. **Rhymes,** which requires a matching of vowels and some consonants at the end of words. For example, 'what is the best rhyme for 'dog' from these three words (cat, sum, fog)?' (Denton et al., 2000; Muter et al., 2004).

e. **Phoneme segmentation,** which requires separating a word into sounds by tapping or counting the sounds in the words. For example 'How many sounds are there in the word 'final'' (Álvarez, Carreiras, & de Vega, 2000; Bravo et al., 2002; Denton et al., 2000).

f. **Phoneme blending,** which requires listening to the sounds of a word, and then combining them to create a recognisable single word, e.g. what word can be created with the sounds '/c/ /a/ /t/'? (Bravo, 1995; Caravolas et al., 2012).

g. **Phoneme deletion,** which requires identifying which word remains when a sound is removed. For example, 'what is smile without the /s/?' (Bravo et al., 2002).

Different studies, using a range of methodologies, have been conducted to evaluate the single and multiple contribution of each of the tasks commonly evaluated as part of phonological awareness. Using confirmatory factor analysis in a factorial design, Anthony et al. (2002), found that one single factor characterised phonological awareness in 258 2-to-5-year-old children. This finding was later confirmed with a greater sample size of 1,200 participants (Anthony & Lonigan, 2004). In sum, it has been proposed that despite multiple tasks being involved in the assessment of phonological awareness, it is a single and unified ability which emerges more clearly in the early years and primary education.

2.6.2. Phonological processing: Non-word repetition

Children with poor reading accuracy (i.e. dyslexia) face difficulties in phonological processing, expressed in tasks as non-word repetition (de Bree, Rispens, & Gerrits, 2007). Non-word repetition is considered one of the most basic and important language and phonological processing skills (Gathercole, 2006). Nevertheless, repeating a word immediately after hearing it requires the coordination of different skills, such as speech perception, phonological encoding, phonological short-term memory, and articulation (Coady & Evans, 2008). Repetition, and particularly non-word repetition, is affected by lexical and sublexical properties of the words, such as word-likeness, phonotactic frequency, and syllable and prosodic structure (Coady & Evans, 2008; Marshall & van der Lely, 2009).

Regarding the relationship between non-word repetition and reading, the evidence is contradictory depending of the sample group (Brady, Shankweiler, & Mann, 1983). For example, de Bree, Wijnen, and Gerrits (2010) evaluated the relation between non-word repetition in three groups: typical, children with dyslexia, and children with specific language impairment (SLI). The results showed that children with SLI performed below than the rest of the groups, and that the relationship between non-word repetition and reading was significant only for dyslexic children, but not for the control and SLI group. Gathercole (2006) states that even though the relationship between non-word repetition tend to be stronger with language skills than with reading outcomes, children with substantial language impairments perform poorly on language and reading tasks.

It can be hypothesized that the relationship between non-word repetition and reading is not direct, but mediated by other factors, such as vocabulary knowledge and phonological awareness, which are in turn strong predictors of reading (Lee & Gorman, 2012). In the case of vocabulary, a reciprocal relationship with non-word repetition has been proposed (Gathercole, 1995). Bowey (2001) proposed that children who show a good performance in phonological processing tasks, particularly in the non-word repetition task, are likely to learn novel words more easily than their peers with difficulties in phonological processing. Gathercole (2006) proposes that this effect of vocabulary declines as children get older. Regarding phonological awareness, a direct and positive relationship with non-word repetition has been proposed, with a reciprocal influence between them (Tattersall, Nelson, & Tyler, 2014). Metsala (1999) proposed that phonological awareness mediates the relationship between non-word repetition and vocabulary in typical children from 3 to 7 years-old.

It has been claimed that non-word repetition is not affected by the socioeconomic background of children (Alloway, Gathercole, Willis, & Adams, 2004). However, in at least certain groups of children has been possible to find a relationship between non-word repetition and reading (de Bree et al., 2010). Reading is in turn, affected by SES. In this line, evaluating the effect of non-word repetition on reading outcomes in children from different socioeconomic background will contribute to understanding the mechanisms by which non-word repetition and reading are linked.

2.6.2. Rapid Automatic Naming (RAN)

2.6.2.1. Definition

The second of the traditional foundational reading skills is Rapid Automatic Naming (RAN). RAN is a simple task where participants are required to name a series of familiar items as quickly as possible, usually in a period of 60 seconds (Norton & Wolf, 2012). The original task developed by Denckla and Rudel included four subtasks: objects, colours, numbers, and letters (Denckla & Rudel, 1974). Each of the subtests had 50 randomised items, arranged in 5 rows and 10 items each. Scoring is usually calculated through the total time spent in naming all items.

The RAN tasks began with the work of Norman Geschwind on patients with alexia. He was particularly interested in determining what kind of brain damage was related with several reading difficulties. Geschwind (1965) found that one of the main problems in patients with alexia was related with a disconnection between verbal and visual processes in the brain. For example, one of the patients showed huge difficulties in naming colours, despite the fact that the ability to perceive colours was not affected (Geschwind & Fusillo, 1966). Thus, it was relevant to recognise what kind of processes was involved in colour naming. Martha Denckla (1972a) investigated the relationship between RAN and reading, specifically in a sample of children with difficulties on the RAN task. Denckla found that five children who had dyslexia were particularly slow and inconsistent in this task, despite having typical intelligence and colour vision.

In the last decades, there has been a debate about whether RAN should be considered a subskill of phonological awareness or whether they are two independent processes. It has been argued that both tasks depend on the retrieval of phonological codes (Torgesen et al., 1997). On the other hand, Norton and Wolf (2012) argue that although both factors contribute to later reading achievement this is not a strong argument for considering them to be part of the same construct. In fact, RAN and phonological awareness are only moderately correlated (i.e. r= 0.38) in a range of studies (Swanson, Trainin, Necoechea, & Hammil, 2003). In addition, those studies that include

RAN and phonological awareness as contributing to reading performance show a better statistical fit in the reading prediction model when they are included separately (Cutting & Denckla, 2001; Katzir et al., 2006).

2.6.2.2. Rapid Automatic Naming and reading

RAN has proved to be one of the best predictors of reading accuracy and fluency (Compton, 2003; Compton, Olson, DeFries, & Pennington, 2002; Lervag & Hulme, 2009; Manis, Seidenberg, & Doi, 1999; Wolf & Bowers, 1999; Wolf, Bowers, & Biddle, 2000). Alphanumerical RAN tasks are particularly strong reading predictors, especially in the case of poor readers. One of the hypotheses that explains the relationship between RAN and reading is related to the kind of processes involved, because both reading and RAN tasks require the integration of a number of processes, such as: a) attention to the stimulus; b) bihemispheric visual processes for initial feature detection; c) integration of visual features with stored orthographic representations; d) integration of visual and orthographic information with the stored phonological representations; e) access to phonological labels; f) activation and integration of semantic information and g) motoric activation leading to articulation (Wolf et al., 2000; Wolf & Denckla, 2005).

RAN tasks have been widely administered in a range of languages, such as Arabic, Chinese, Dutch, Finnish, French, German, Greek, and Spanish (Norton & Wolf, 2012). The findings of these studies show that RAN tasks predict both concurrent and longitudinal reading performance, in samples of typical and non-typical readers (Vaessen et al., 2010). Because most of the research about RAN and reading has been conducted in English, it might be relevant to conduct studies with a more grapheme-phoneme consistency languages, to help to understand the mechanisms on which this relationship is based (Georgiou et al., 2006). It has been proposed that orthographic features affect the relative contribution of RAN to reading. Specifically, when children learn to read in a language with a high grapheme-phoneme consistency, the effect of phonological awareness on reading is increasingly replaced by the effect of RAN (Wimmer, 1993).

The way in which RAN tasks are scored affects the degree to which they predict reading. There are at least three ways of scoring RAN tasks: overall RAN scores, time to articulate the items, and length of pauses between items. Overall RAN score is the easiest way to evaluate RAN performance and is strongly related to reading performance (Georgiou et al., 2006). The time to articulate the items, evaluated through the rate between the number of items and the time spent in naming them, does not appear to have a significant effect on reading (Clarke, Hulme, & Snowling, 2005; Cutting & Denckla, 2001). Regarding scoring pauses on RAN tasks, the evidence concerning its effect on reading is contradictory. In Clarke et al. (2005) study, no effects were found. However Georgiou et al. (2006) found that the pauses in RAN tasks, evaluated at the end of kindergarten, were significant predictors of reading accuracy and fluency in the first grade. Reasons for the discrepancy in the results could be related to differences in the sample size in both studies. For example, a smaller sample size in the Clarke et al. (2005) study (30 students), could have affected the statistical power to find the effect of pauses on RAN outcomes, which was found in the Georgiou et al (2006) study in which a larger sample size (233 children) was used, and therefore there was a higher likelihood of detecting this effect.

2.6.2.3. Rapid Automatic Naming assessment

Denckla and Rudel (1976a) developed three versions of the task: using objects, letters and numbers as stimuli. They labelled this task as Rapid automatic naming. Currently, these tasks are known by several names such as rapid serial naming, serial visual naming, continuous rapid naming, rapid naming, and naming speed (Norton & Wolf, 2012). Currently, there are two widely used standardised ways of evaluating RAN: The RAN-RAS test (Rapid Automatized Naming-Rapid Alternating Stimulus) (Wolf & Denckla, 2005), and the Comprehensive Test of Phonological Processing (CTOPP) (Wagner, Torgesen, & Rashotte, 1999).

The RAN-RAS test includes the four classic subtests developed originally by Denckla and Rudel: objects, colours, numbers, and letters. Each of the subtests has 50 randomised items arranged in 5 rows and 10 items each. In the CTOPP rapid-naming subtests, RAN is included as one of the components of phonological awareness (Wagner et al., 1999) and it includes 6 different and randomised items, which are displayed in two pages of 4 rows with 9 items in each of them. There is a total of 72 presented items (Norton & Wolf, 2012).

In some studies, latencies, self-corrections, and types of errors are scored in order to register more qualitative task observations (Norton & Wolf, 2012). An important consideration is that all presented items must be known to the participants. For this purpose, Denckla and Rudel (1976b) promoted starting the RAN tasks with a trial phase, in order to evaluate the level of knowledge of these items. In their studies, Denckla and Rudel found that those tasks where the stimuli had been learned earlier in development were easier than those which had been learned when children entered school (e.g. the subtests of RAN colours and objects are easier than RAN digits and letters) (Denckla, 1972b; Denckla & Rudel, 1976a).

2.6.3. Letter knowledge

2.6.3.1. Definition

The third traditional reading predictor, alongside phonological awareness and rapid automatic naming is letter knowledge. Letter knowledge can be defined as the knowledge of the correspondence between the sounds in speech and the orthography of the written language. It is the matching between phonemes (sounds) with their respective graphemes (Treiman, Tincoff, & Richmond-Welty, 1996), that contributes to promote phonological sensitivity, which is key in the process of transforming graphemes into phonemes (Bowey, 1994).

It has been suggested that the alphabetical order of letters and the occurrence of letter in the child's name, influence how easily they are learned. It has been reported that those letters that appear earlier in the alphabet are more easily remembered than those appearing later (Treiman, Kessler, Zevin, Bick, & Davis, 2006). Children might take advantage of the primacy of these letters appearing earlier in the alphabet, which are in turn those repeated most often, for example, in songs such as the "ABC song" (Justice, Pence, Bowles, & Wiggins, 2006). The studies suggest that children are 1.5 times more likely to recognize letters that appears in their own name than letters that do not. This increases to an 11-fold advantage if it is the first letter of their name (Bloodgood, 1999; Justice et al., 2006). These findings have been reported for a range of languages such as English, Portuguese and Hebrew (Phillips, Piasta, Anthony, Lonigan, & Francis, 2012). The hypothesis is that children have a sense of ownership regarding the letters present in their names. It is not unusual to find statements such as “that letter is mine”, and “I have a b, too”.

2.6.3.2. Letter knowledge and reading

Letter knowledge is one of the best predictors of both reading and spelling acquisition (Bond & Dykstra, 1967; Caravolas et al., 2001; Muter et al., 2004; Share et al., 1984). A study conducted by Share et al. (1984), found that letter knowledge was the best individual predictor of reading among 39 variables evaluated such as, IQ, vocabulary, and socioeconomic status. Knowing letters before they start school has a strong impact on children’s later reading achievement (Foulin, 2005). In addition, children who experience reading difficulties show lower scores in the letter knowledge tasks than their peers of similar ages (Gang & Siegel, 2002; Pennington & Lefly, 2001). Most of these findings come from longitudinal studies, where the letter knowledge and reading performance are assessed in kindergarten and first grade of primary school respectively.

Despite the importance of letter knowledge as a reading predictor, there are relatively few studies on the topic (Diuk & Ferroni, 2011). It has been suggested that this lack of interest is related to the fact that letter knowledge is often associated with an external factor (de Jong & Olson, 2004), and as dependent on school and the home environment (Burgess et al., 2002). Indeed, the influence of SES on letter knowledge is undeniable (Diuk & Moras, 2009). Ferreiro (1986) holds that children acquire the notion that printed words represent spoken words thanks to the experience they have with printed material, such as books, alphabets, magnetic letters, etc. The lack of opportunities for knowing letters affects their acquisition. For example, it has been found that children from low SES families show slower rates in letter naming compared to those children from high SES in Kindergarten and first grade of primary education (Pallante & Kim, 2013).

2.6.3.3. Letter knowledge assessment

The way in which letter knowledge is evaluated has implications for how well it predicts later reading achievement. Usually letter knowledge is treated as a unitary skill, which can be separated into letter sounds and letter names, although both are closely related. The studies in the area suggest that while letter-sound knowledge participates in the basic stages of reading, such as decoding; knowledge of letter-names is involved in more complex reading tasks, as those involving reading comprehension (Caravolas et al., 2001; Wagner, Torgesen, & Rashotte, 1994). Another hypothesis is that letter-name knowledge does not intervene directly in reading processes, but it does indirectly through its influence on other reading predictors, such as phonological awareness (Foulin, 2005).

In addition to considering letter-sounds and letter-names as part of the letter knowledge assessment, it has also been suggested that the way of presenting the stimuli can affect the results. Particularly, the use of lower and upper-case can affect performance. Most of the studies have typically used upper-case letters, despite the fact that lower-case letters are more frequently used in texts (Jones & Mewhort, 2004). Regarding lower-case letters, it has been proposed that similarities in the shape of letters can lead to children's difficulties when discriminating them, particularly in some letters such as "b" and "d", or "p" and "q" (Goikoetxea, 2006; Treiman & Kessler, 2006).

Usually, in the letter knowledge assessment tasks, children are presented a list of letters (for example, using cards). The tester asks to participants to name the letter-sounds and/or letter-names of the letters, which can be exhibited in upper or lower-case format (Caravolas et al., 2013). In more basic stages, for example before entering school, children are required to discriminate between letters and other symbols (Woodcock, McGrew, & Mather, 2001). There are two typical batteries for assessing letter knowledge: the 'Dynamic Indicators of Basic Early Literacy Skills (DIBELS)' (Good & Kaminski, 2007) and the ‘Early Reading Diagnostic Assessment (ERDA)’ (The Psychological Corporation, 2003). In the DIBELS, the task is called the Letter Naming Fluency (LNF) and children are required to name as many letters they can in one minute. The letters are presented in an upper-and lower-case, and are arranged randomly on page (Good & Kaminski, 2007). In the ERDA, the task is called “letter recognition”, and in the first item, the examiner presents a lower-case letter (e.g., *p*) in a flip-book, and then after 1 second, the tester displays a new page with three letters (e.g., *d, p, e*) and asks the children to point to the letter that is the same as the one that appeared on the previous page. The next pages show the rest of the alphabet letters (in blocks of 9 letters) and children are required to name them. This task is untimed (The Psychological Corporation, 2003).

2.7. Early language predictors

Having explored the three main predictors of reading: phonological awareness, rapid automatic naming, and letter knowledge, this section presents the predictors that can be placed under the label of 'early language predictors'. Even though these skills do not fully explain the variation in all reading tasks, their failures affect later reading achievement. In this section, grammar knowledge, receptive vocabulary and lexical search and retrieval are presented.

2.7.1. Grammar knowledge

2.7.1.1. Definition

Grammar knowledge is an important component of language proficiency (Rimmer, 2006) and it can be defined as the understanding of the set of structural rules that guide any language, including the composition of clauses and phrases. These rules are associated in fields such as morphology, and syntax (Stovall, 2008).

2.7.1.2. Grammar knowledge and reading

Grammar knowledge is a strong predictor of reading comprehension (Mecartty, 2000), real and pseudoword reading (Deacon, 2012). Knowledge about grammatical categories such as nouns, verbs, adjectives, and adverbs is linked with reading comprehension (Guarino & Perkins, 1986). In particular, grammar knowledge plays a crucial role in terms of coherence building (Givón, 1995), by establishing the word integration that allows the meaning of the text to be understood (Fender, 2001). On the contrary, failures in grammar knowledge are associated with reading difficulties (Bowey, 1986).

It has been suggested that grammar knowledge is closely related to vocabulary, and both predict the reading comprehension outcomes. This relationship has been found thanks to the use of structural equation modeling. These models have found latent variables which represent latent structures, in this case that there is a structure compound of vocabulary and grammar knowledge, that is a factor to explain later reading outcomes (Zhang, 2012).

2.7.1.3. Grammar knowledge assessment

There are at least two ways of evaluating grammar, depending on whether participants are or are not able to write/read. Once children can read, the grammar tasks can be divided in two sub-categories: Production and recognition. In the case of production, a number of grammar components can be evaluated by gap filling, paraphrasing, transforming items, among others (Defior et al., 2006). Recognition tasks include multiple choices, error recognition items, true/false, pairing and matching items, cloze, among others. These tasks are often used in a large-scale sample, and can be used for diagnosis or to establish a baseline of grammar proficiency (Defior et al., 2006; Woodcock et al., 2001).

When participants are not able to read, one of the ways to evaluate grammar is through sentence repetition tasks (Ahmadian & Tavakoli, 2010; Ebbels, Dockrell, & van der Lely, 2012). In these tasks, participants are asked to repeat a sentence after listening to it. Accurate sentence repetition requires the role of memory and vocabulary knowledge (Gathercole, 2006). In any case, there is robust evidence showing that children with specific language impairment (SLI) repeat sentences less accurately than their peers

(Chiat & Roy, 2007; Conti-Ramsden et al., 2001; Marcel, Ridgeway, Sewell, & Whelan, 1995).

2.7.2. Vocabulary knowledge

2.7.2.1. Definition

Words have been characterised as the building blocks of language (Pruden, Hirsh-Pasek, Golinkoff, & Hennon, 2006), because they allow people to communicate ideas and feelings, and to represent the world. However, learning new words is a complex process through which a child is able to map meanings between word and world (Woodward, Markman, & Fitzsimmons, 1994). The definition of vocabulary knowledge is not simple (Moghadam et al., 2012), since the multidimensionality of the construct suggests that knowing a word should include a range of linguistic knowledge, such as pronunciation, spelling, and morphology (Haastr & Henriksen, 2000). In addition, semantic relationships, including knowledge of antonym, synonymy, hyponym, and collocational meanings, should be included in the definition of vocabulary knowledge (Henriksen, 1999).

Acquiring a word is different to other learning processes. Commonly, learning can be categorised as an associative process, which means that learning is achieved by the temporal contiguity and repetition (Pruden et al., 2006). However, in the case of vocabulary knowledge, associativity is not a sufficient condition. It is also required to establish a lexical representation, which includes a phonological representation of the word, a semantic map to link the new word with a referent, and the formulation of an internal semantic representation (Dockrell & Messer, 2004). This process is also affected by the information provided in the social context (Hollich et al., 2000).

In this line, the number of learned words and the rate at which children's vocabulary develops during early childhood vary widely (Rowe et al., 2012). Variability in the amount, quality, and rate of vocabulary acquisition depends to a significant extent on children's exposure to oral and written language (Hart & Risley, 1995; Hoff & Naigles, 2002). This factor includes not only the family environment, but also the opportunities that children get at school, and because children's experiences are so different prior to entering school, it is not surprising that vocabulary size shows great variability at the start of formal education (Loftus, Coyne, McCoach, Zipoli, & Pullen, 2010). These early differences in vocabulary size increase over time, widening the gap between the students with rich and poor vocabulary (A. Fernald et al., 2013; Kieffer, 2011).

The opportunities for acquiring new words are not provided in the same way to all children. It has been suggested that socioeconomic status is one of the most important factors for explaining differences in vocabulary knowledge, because there is an association between SES and the opportunities to acquire and support vocabulary (A. Fernald et al., 2013). It has been established that families from higher SES backgrounds know and use a larger range of words than those families from low SES backgrounds (Hoff, 2003); and that children whose parents are more talkative are in turn more likely to receive a larger variety of words and also more complex syntactic structures (Hoff & Naigles, 2002). The relationship between SES and vocabulary is strong. In fact, even when only families from low socioeconomic environments are compared, it is possible to find differences in vocabulary by using just family income as a proxy for SES (L. Fernald, Weber, Galasso, & Ratsifandrihamanana, 2011).

2.7.2.2. Vocabulary knowledge and reading

Vocabulary knowledge is associated with the ability to decode words, recognize words, and comprehend texts (Ouellette, 2006; Stahl, 2003). People who know more word meanings comprehend text better than those who know fewer words (Graves, 1986). Correlations between vocabulary and reading comprehension in some cases can reach 0.9 (Stahl, 2003). The effect of vocabulary is not exclusive to reading comprehension, but it permeates different areas such as oral and written communication (Bates, Bretherton, & Snyder, 1988), and it is a predictor of lexical and grammatical development, and later academic success (Stahl & Fairbanks, 1986).

The study of how vocabulary knowledge is related to reading comprehension started one century ago (E. L. Thorndike, 1917). However, despite the large number of studies conducted since then to investigate the relation between vocabulary and reading comprehension, there is no consensus regarding the mechanisms on which this relation is based (Stahl, 2003). From a very simple view, vocabulary is related to comprehension in the way that whether the reader do not know the words in a paragraph, will be unable to understand the meaning of the text (Wagner & Meros, 2010). However, the relation is not so simple, because the reciprocal influences between reading and comprehension, and the influence of other mediator variables, such as phonological awareness and decoding (Metsala, 1999; Wagner & Meros, 2010; Wagner, Muse, & Tannenbaum, 2007). Anderson and Freebody (1981) suggest two additional hypotheses about the relationship between vocabulary and reading comprehension. They propose that children with larger vocabulary possess in turn better cognitive skills, which facilitate the text comprehension. The second hypothesis is that children with larger vocabulary have been exposed to more learning opportunities, and therefore have a better conceptual knowledge. Thus, the hypothesis is that conceptual knowledge is related with comprehension via vocabulary performance.

2.7.2.3. Vocabulary knowledge assessment

There are different ways to evaluate vocabulary, and the most important distinction is between vocabulary breadth and vocabulary depth (Anderson & Freebody, 1981). Vocabulary breadth is a measure of the number of words that participants know, and it is usually evaluated through standardised multiple-choice tests. Vocabulary depth refers to how well the words are known, and its assessment usually requires participants to provide the definition of a word, which is later examined in terms of how superficially or deeply the word is known. Another way is presenting a word and asking directly the level of knowledge that students have about it (Schmitt, 2014). Another distinction in vocabulary assessment is between receptive and productive vocabulary. Receptive vocabulary is related to the understanding of the spoken words, for example, asking children to point to a picture after the tester has named it. On the other hand, expressive vocabulary refers to the ability to produce a word, and it is usually assessed by the tester showing a picture and asking the child to name it (Stahl & Bravo, 2010).

In terms of vocabulary knowledge assessment, it is required not only to know how many words a child knows, but also how these words are searched and retrieved. In the current study, vocabulary will be measured using receptive vocabulary through the picture-word matching paradigm, and lexical search and retrieval will be evaluated through the semantic and phonological fluency tasks. The inclusion of these two measures of vocabulary responds to the fact that a reader can exhibit an adequate level of vocabulary size, but at the same time face difficulties in the search and access to the words presented in a text (Altemeier et al., 2006; Shao, Janse, Visser, & Meyer, 2014).

2.7.3. Lexical search and retrieval

In order to understand what lexical search and retrieval are, it is important to explain the model in which the concepts are based on. Lexicon refers to the way vocabulary is organised and stored in the mind, as individual lexical entries (Lezak, 1995). It is important to highlight the fact that words are not stored as a simple list of items, but they are part of a complex net of relations between them, activating or facilitating the search and retrieval of other related words (Hollich et al., 2000; Thornbury, 2002).

One of the ways to evaluate lexical search and access is through semantic and phonological fluency tests (Oria, Costa, Lima, Patrick, & Guerrant, 2009), due to their easy and fast administration (Ostrosky-Solis, Gutierrez, Flores, & Ardila, 2007). Semantic and phonological fluency tests require that participants produce as many words as possible in a short and fixed amount of time (Fossati, Guillaume, Ergis, & Allilairea, 2003). In the case of semantic fluency, participants are required to name items from a given category such as animals or vegetables. In phonological fluency, participants are required to name words starting with particular sounds or letters, for example /F/, /A/, /S/.

Semantic and phonological fluency tasks measure the lexical search and retrieval, alongside the ability to respond to a novel task (Ostrosky-Solis et al., 2007). These tasks are not exclusively related to vocabulary components, but also include some cognitive skills such as attention (Altemeier et al., 2006), and a number of skills of the central executive, such as initiation and strategic retrieval (Fossati et al., 2003).

Regarding the influence of lexical search and retrieval on reading outcomes, there are not to date specific studies comparing them in typically developing children. However, Frith, Landerl, and Frith (1995) compared the performance in semantic and phonological fluency tasks in groups of typical and dyslexic children. The results showed that children in the dyslexia group produce fewer words in the phonological version, but they were unable to find significant differences between groups in the semantic fluency test. This finding was taken as evidence that dyslexia is an impairment related to phonological processing rather than to a semantic impairment. The effect of semantic and phonological fluency on reading is indirect via both vocabulary knowledge (Ostrosky-Solis et al., 2007) and cognitive skills (Kosmidis et al., 2005).

2.8. Cognitive skills

Cognitive skills are involved both in language development and in reading processes. These skills include general cognitive ability, analogical reasoning, causal reasoning, categorisation, and executive functions. Including cognitive skills as predictor of reading, it allows a more complete understanding of the complex set of relationships between different language, cognitive skills and reading (Cutting et al., 2002). The hypothesis is that cognitive skills underlie reading indirectly, via affecting other reading predictors such as phonological awareness, rapid automatic naming, letter knowledge, and vocabulary (Altemeier et al., 2008; L. Bradley & Bryant, 1983).

2.8.1. General cognitive ability

2.8.1.1. Definition

General cognitive ability can be defined as the ability required to solve a range of tasks such as following patterns, spatial visualization, and memory, among others. Historically, general cognitive ability has been known as intelligence, mental abilities, or the 'g' factor (Harlaar et al., 2005). General cognitive ability is a construct characterised by positive correlations among different cognitive tasks, which are in turn transferrable to other domains (Spearman, 1920). Usually, people's scores in the cognitive abilities tasks are presented in terms of Intelligence Quotation (IQ) scores, which shows a standardisation of the IQ scores compared to the rest of the population (Harlaar et al., 2005).

Spearman (1920) was the first author to promote the idea of a single factor which underlies different cognitive tasks, particularly those based on the problem-solving task. Spearman proposed that this ability is related to a cognitive factor, which he labelled the 'g' factor. Later, Cattell proposed that the 'g' factor had two underlying components: fluid and crystallized intelligence (Cattell, 1943). Fluid intelligence can be understood as the ability to solve problems using different cognitive resources, whereas crystallized intelligence refers to the use of prior experience and knowledge to solve problems (McDaniel & Banks, 2010).

Studies in the area usually evaluate general cognitive abilities using verbal rather than non-verbal tasks. However, at age 3-4 the children's language in some cases is not accurate enough to express some ideas, and this issue could affect interpretation of the outcomes (Szpunar & McDermott, 2008). In addition, children from low SES usually show lower scores in vocabulary tests which in turn can affect the correct interpretation of those verbal cognitive tasks. It has been suggested that the use of non-verbal tasks to evaluate general cognitive abilities, can be considered a purer way of measuring cognitive processing without the confound of language ability (DeThorne & Schaefer, 2004).

2.8.1.2. General cognitive ability and reading

The correlations between general cognitive ability and reading show, on average, effects from moderate to large (r= 0.30 to r= 0.70) (Naglieri, 2001). The strongest correlations appear between general cognitive ability and reading comprehension. Unfortunately, the mechanisms that explain the relationship between both elements have been poorly understood to date (Harlaar et al., 2005). One of the evidences in the area indicates that poor readers exhibit problems in a range of cognitive tasks. These problems appear for children with low or normal IQ (Share & Stanovich, 1995).

The relationship between cognitive abilities and comprehension raises the question regarding which ability is influencing which, because a group of readers have been identified who are able to read both accurately and fluently, but who have a poor understanding of what they read (Nation, Clarke, & Snowling, 2002). This group has been labelled as “poor comprehenders” and represent an estimated of 10% of the population (Yuill & Oakhill, 1991).

Studying the specific role of general cognitive ability on reading could help to determine whether some reading difficulties have a language processing or a cognitive-related cause. To determine these differences, it has been proposed that general cognitive ability should be assessed through non-verbal tasks, because the use of verbal tasks could lead to wrong conclusions, by overlapping reading and language skills (Nation et al., 2002).

2.8.1.3. General cognitive ability assessment

There are different ways to evaluate general cognitive abilities, including standardised tests and ecological measures (S. Ortiz, Lella, & Canter, 2010). Standardised and norm-referenced tests are the most common and historical way to evaluate the intellectual ability of people. The batteries are compound of several different problem-solving tasks, which are later scored, estimating an average performance of 100 points, with a standard deviation of 15 points (Botting, Powls, Cooke, & Marlow, 2008). These tests are usually administered to a large group of individuals. Examples of these batteries for evaluating general cognitive abilities are: the Wechsler Preschool and Primary Scale of Intelligence (WPPSI) (Wechsler, 2002), Wechsler Intelligence for Children (WISC) (Wechsler, 2003), Woodcock–Johnson Tests of Cognitive Abilities (WJ) (Woodcock et al., 2001), the Stanford–Binet Intelligence Scale (SB) (Roid, 2003; R. Thorndike, Hagen, & Sattler, 1986), and the Kaufman Assessment Battery for Children (KABC) (Kaufman & Kaufman, 1983).

An alternative but complementary way to evaluate general cognitive ability is an ecological assessment (Armour-Thomas & Gopaul-McNicol, 1997). This approach includes to collect some information about student’s environment and the review of educational records, observation of the child in different learning spaces, interviews with parents, and teachers, and other professionals related to the student. This way to evaluate cognitive abilities helps to reduce some misinterpretation in the intelligence scores. For example, the traditional way of evaluating cognitive abilities does not consider imperfections in the test itself, or any involuntary error of the participant (S. Ortiz et al., 2010).

In order to get a purer cognitive skill performance, the use of non-verbal task seem to be plausible to reach this goal, because it diminishes the effect that linguistic competence has on the performance of cognitive tasks. The most widely used non-verbal tasks are block design and object assembly (Stothard & Hulme, 1992). Both tasks require skilled-motor movements and spatial skills.

Spatial skill is the ability to reason through the manipulation and transformation of mental pictures (Casey et al., 2008). Working on spatial skills offers children the opportunity to develop other cognitive skills, such as classifying, measuring, counting (Stannard, Wolfgang, Jones, & Phelps, 2001), thereby promoting the development of problem-solving skills and logical thinking processes (Hanline, Milton, & Phelps, 2010). An example of measuring spatial skills is the block building task (Wolfgang, Stannard, & Jones, 2001). A systematic use of tasks related to block building has shown to be an effective way to measure intelligence (Stannard et al., 2001) and a good predictor of academic achievement (Casey et al., 2008; Stannard et al., 2001; Wolfgang et al., 2001; Wolfgang, Stannard, & Jones, 2003).

2.8.2. Analogical reasoning

2.8.2.1. Definition

Analogical reasoning is one of the most important components of children's higher cognitive development (Goswami, 1991; Richland, Morrison, & Holyoak, 2006; Thibaut, French, & Vezneva, 2010). Analogical reasoning is defined as a conceptual strategy that allows children to select relevant information and make inferences about new phenomena while transferring previous knowledge to new knowledge (Richland et al., 2006; Tunteler & Resing, 2002). It could be conceived as a vehicle for assessing different interactions among multiple demands of the executive control, such as working memory and inhibitory control (Cho, Holyoak, & Cannon, 2007; Richland, Chan, Morrison, & Au, 2010; Thibaut et al., 2010).

There are at least three different hypotheses that explain the development of analogical reasoning during childhood related to: the amount of knowledge, the relational shift, and the influence of other executive resources such as working memory or inhibitory control (Richland et al., 2006). The first hypothesis states that young children are not able to solve analogical reasoning tasks because they do not have sufficient knowledge of the names, and/or functions of certain objects, and therefore are not able to understand the links between them (Goswami, 1991; Richland et al., 2010; Thibaut et al., 2010). The hypothesis based on relational shifts argues that in their early years, children can understand the link between objects based only on feature similarities. Later, at a certain point in development, children make a relational shift, understanding that the link among objects is not only based in terms of perceptual features, but is also related to functional aspects (Ratteman & Genter, 1998). The third hypothesis suggests that failures in detecting analogical reasoning in young children are associated with difficulties managing different sources of information simultaneously. For this, children not only have to be able to name objects but also to retain these names, and to think about a link between them (Richland et al., 2010).

2.8.2.2. Analogical reasoning and reading

Analogical reasoning is an important skill both for decoding and for reading comprehension (Goswami, 1999). In terms of decoding, it has been proposed that as children grow up, they learn to use the relation between the spelling and the sound of a word as a basis for reading new words, generating analogies between them (Savage, Deault, Daki, & Aouad, 2011; Ziegler & Goswami, 2005). The use of analogies in English has been considered a suitable strategy for reading (P. D. Walton et al., 2001). Regarding reading comprehension, children use a range of analogies, particularly when they face understanding a difficult text (Goswami, 1991). For example, children found it easy to understand a text when analogies were used in the paragraphs (Hayes & Tierney, 1982).

Similarly, Vosniadou and Ortony (1983) found that children understood more easily a text about infections when the ideas of invasion and enemy appeared in the text.

Another hypothesis regarding the relationship between analogical reasoning and reading is via phonological awareness, particularly though creating or recognising rhymes (De Cara & Goswami, 2002). It has been suggested that in the case of rhymes, children are required to find a kind of relational similarity among words, and that for this purpose, children must be able to organise words into rhyming categories (e.g. light, night and fight) (Goswami, 1999). The use of analogy for finding rhymes have been found both for orthographic and phonemic cases (Savage et al., 2011). The ability to make analogies allows children to improve their rhyme awareness, which in turn, have a direct effect on reading and spelling acquisition, and at the same time, the improvement of phoneme awareness (L. Bradley & Bryant, 1983; Goswami, 1999).

Grapheme-phoneme consistency affects the relation between analogical reasoning and reading. Goswami (1991) proposed that the orthographic consistency across languages can affect the use of analogies and their effect on reading. Children learning to read in English must deal with the inconsistency between letters and sounds. For example, the rhyme in ‘light’ is inconsistent with respect to the correspondences between individual letters and sounds, but “ight” has a common pronunciation in many words, such as “night”, “fight”, etc. and so at the unit of the rhyme its spelling is regular. Therefore, making analogies between these different words at the level of the rhyme will enable the words to be read correctly.

2.8.2.3. Analogical reasoning assessment

In the past decades, different tasks have been used for evaluating analogical reasoning (Thibaut et al., 2010): Duncker’s tasks (Duncker, 1945), the Genie task (Holyoak, Junn, & Billman, 1984) and the A:B::C:D task (Benítez & García, 2010; Goswami, 1991). Duncker developed several problem-solving tasks such as the “candle problem”, “an electromagnet as a pendulum”, “a branch of a tree as a tool” etc.; these tasks were administered to evaluate the analogical reasoning in different contexts (Gick & Holyoak, 1980). The Genie task has different formats, but in general requires that participants help the Genie to transfer several jewels from one to another bottle, following certain principles. Currently, the most used task is based on the A:B::C:D paradigm (Benítez & García, 2010; Thibaut et al., 2010).

The A:B::C:D paradigm is a set of relations between 4 terms. A is related to B, in the same way that C is related to D. The relation between A and B provides insight into the relation between C and D (Goswami, 1991; Thibaut et al., 2010). Based on this paradigm, different tests have been developed where D is omitted, and children must choose an appropriate object, usually among three available possibilities. For instance Door:House::Branch:?, in this case, children have three options: a) A tree; b) A branch with a Nest; c) An umbrella; in this case, based on a part-whole analogy, the correct answer is a) A tree (Martínez, Herrera, Valle, & Vásquez, 2002).

2.8.3. Causal reasoning

2.8.3.1. Definition

Causal reasoning is an important human capacity useful for explaining, learning, predicting, and controlling the actions (Spellman & Mandel, 2003). It can be defined as the process of identifying causality, that is, the relation between a cause and its effect, for this purpose people need to make inferences. Causal reasoning in reading comprehension becomes crucial in helping the reader to form a coherent representation of a narrative (Sullivan, Oakhill, Arfé, & Boureux, 2014).

In the early years, the way children develop inferences related to cause and effect depends to their knowledge about objects and their causes and properties. However, as the first-hand experience is limited at that time, the linguistic information provided by parents and teachers plays a crucial role in guiding or constraining the cause-effect rules (Gelman, Star, & Flukes, 2002).

2.8.3.2. Causal reasoning and reading

To ensure the success in reading, a child must be able to decode individual words and be able to comprehend a text. Although both components are highly correlated, good reading does not necessarily ensure good comprehension (Oakhill & Cain, 2007). Reading comprehension is in a way, a mental representation model of people's feelings, emotions, and actions, and causal reasoning, are key to this construction (Graesser et al., 1994). Advanced readers understand the cause-effect rules, and intuitively make predictions about the events in a text. Later, they can test if these predictions are confirmed in the story (Strong, Sulver, Perini, & Tuculescu, 2002). In other words, if children identify and understand the cause-effect principles in real life, they will be more likely to transfer this rules in the text, and therefore infer some not explicit ideas that appear in the texts (Oakhill & Cain, 2007). The relationship between causal reasoning and reading can be expressed in at least two ways: as predicting future facts, and inferring actions although they are not explicit in the text (Magliano, Trabasso, & Graesser, 1999).

Studies about causal reasoning show that the understanding of the rules in which cause-effect is based on, play an important role in determine what sections of a story are more important than others, and therefore to improve the reading efficacy (van den Broek, 1989). The hypothesis is that causal reasoning is involved in reading via other cognitive skills such as problem-solving and short-term memory. Both components play a crucial role in how the texts are understood and remembered, although the way in which the story is presented can affect these results (C. Fletcher & Bloom, 1988).

2.8.3.3. Causal reasoning assessment

Causal reasoning is closely related to people´s prior knowledge about objects and actions. However, this relationship leads to problems when measuring it, since causal reasoning and prior knowledge overlap (Sobel, Yoachim, Gopnik, Meltzoff, & Blumenthal, 2007). To deal with this issue, it has been necessary to develop mechanisms that control children's prior knowledge through the amount of verbal information given about the objects in the tasks (Gopnik & Sobel, 2000; Schulz & Gopnik, 2004).

Gopnik and Sobel (2000) developed a non-verbal task to evaluate the elaboration of inferences, particularly those related to causal reasoning, with minimal verbal instruction. They created a machine that requires no prior knowledge about its operation, called the blicket detector. The blicket detector lights up and at the same time plays music whenever certain objects are placed on it. The child's job is to try to understand which objects are blickets, i.e. which objects activate the machine (Schulz & Gopnik, 2004). At least two different conditions are used: one/two causes and forward/backward. In each task, object A and object B are presented while children are asked if each one is a blicket (or not) and why the blicket makes the machine produce noise (Gopnik & Sobel, 2000; McCormack, Butterfill, Hoerl, & Burns, 2009).

2.8.3. Categorisation – Categorical flexibility

2.8.3.1. Definition

Categorisation is one of the most fundamental cognitive tools, which allows us to make order from chaos (Blaye, Bernard-Peyron, Paour, & Bonthoux, 2006). It is the process through which people group equivalent objects and exclude others (Reznick, 2000). The most basic categorisation process is generalisation, which involves applying the distinctive feature of an object to a group (Opfer & Bulloch, 2007). Categorisation is not only generalising but also discriminating objects that belong to a group or category from those that do not (Ricciuti, Thomas, & Ricciuti, 2006).

Some of the factors that affect categorisation processes are: age, vocabulary, and cognitive flexibility. In terms of age, it has been proposed that by the 3 or 4 months children start categorising using simple criteria (Mareschal & Quinn, 2001; Quinn & Eimas, 2000; Westermann & Mareschal, 2012). The process becomes more complex in the early years (Ramsey, Langlois, & Marti, 2005). In addition, categorisation processes have proved to be strongly related to vocabulary growth. The hypothesis is that developing categorisation leads to vocabulary growth and hence, children who know more words might achieve more complex categorisation processes and vice versa (Ricciuti et al., 2006). Finally, the flexibility in the use of the criteria for sorting objects is also related with the categorisation processes. This flexibility, called categorical flexibility, helps to create a more efficient cognitive system (Blaye et al., 2006).

Categorical flexibility is a high order cognitive process that emerges between ages 4-5 (Blaye et al., 2006; Kloo, Perner, Kerschhuber, Dabernig, & Aichhorn, 2008), and the studies in this area show two types of categories: thematic and taxonomic. Thematic categories are those in which objects that share a similar common theme are sorted. For example, a rabbit, a hat, and a wand are similar in the way that they can be sorted in the group of objects used by a magician. In a taxonomic category instead, the objects are sorted by using shared characteristics between them. For example, dog, cat, elephant, and rabbit can be placed in the group of animals because they share common features such as, having sense organs and nervous system, are able to respond to stimuli. It is possible to group the same object, for example rabbit, in two different categories: thematic ('objects used by magicians') and taxonomic ('animals'). (Neuberg & Newsom, 1993) propose that this flexibility can be conceived as a strategy to understand the surrounding world around.

2.8.3.2. Categorisation and reading

One of the first approaches to investigating the relationship between categorisation and reading was proposed by Serafica and Sigel (1970). They proposed that the categorisation processes facilitate the reading process. Advanced readers are required to focus their attention on the elements of a story, discriminating those important actions from those less important ones, sorting, and organising the elements according to the requirement of the narrative. Santostefano, Rutledge, and Randall (1965) hold that these categorization-related abilities are needed for achieving reading comprehension.

It has been proposed that an indirect relation between categorisation and reading comprehension is mediated by vocabulary; in the way that categorisation affects vocabulary size, which in turn, affects reading comprehension. The hypothesis is that names encode basic-level categories, and as children grow up, and they have a wider access to words, the categorisation criteria and patterns become more complex (Gopnik & Meltzoff, 1992).

2.8.3.3. Categorical flexibility assessment

Several methods have been used to evaluate categorical flexibility in children. One of the most frequently used tasks is the Dimensional Change Card Sort (DCCS) task (Zelazo, Muller, Frye, & Marcovitch, 2003). In this task, children receive two cards that vary along two dimensions (e.g. colour and shape). Participants are asked to match a series of bivalent pictures (e.g. yellow balls, blue trucks) to the target pictures. In the first step, children are required to match the cards on one of the criteria, e.g. shape. Then, they are required to change the criteria e.g. colour. Thus, cognitive flexibility is required to respond to the task. However, the main critique is that DCCS seems to be more of an executive function task than an evaluation of categorical flexibility in children (Deák, Ray, & Pick, 2004).

Another task for assessing categorical flexibility is the taxonomic and thematic tasks developed by Blaye et al. (2006). Children receive a set of cards with different people, animals, and objects, and then they are asked to sort the images using the criteria that they want. Once they sort the images, the tester asks, "are you able to group them in a different way?" The images can be sorted thematically (e.g. beach, circus and farm) or taxonomically (people, animals, and vehicles). Unlike other tests, the taxonomic and thematic tasks are not interested in how well (or poorly) the images fit the expected criteria, but they focus on assessing the child's ability to put the same object into different categories.

2.8.4. Executive functions

2.8.4.1. Definition

Executive functions are a group of cognitive processes that regulate and self-direct behaviour toward a goal (Altemeier et al., 2006; Lyon & Krasnegor, 1996). They involve a range of subskills that can work in isolation or in combination. These components of executive functions can be sorted into six different skills: inhibition (related to self-control and resisting acting impulsively), interference control (including selective attention and cognitive inhibition), working memory, and cognitive flexibility (Diamond, 2013). It has been also proposed that the components of executive functions can be sorted in two major groups: 'cold' and 'hot' factors. 'Cold' factors group are those cognitive skills related to cognition such as attention, and planning. 'Hot' factors group include those controlling emotional behaviours (Zelazo & Müller, 2002).

2.8.4.2. Executive functions and reading

Executive functions are responsible for the integration of visual and linguistic information and the automatic retrieval of information from memory while reading. Altemeier et al. (2008) hold that subskills from executive functions are integrated at the same time in the reading processes. For example, retrieval of phonological codes for letters is affected by the ability to supress irrelevant codes.

It has been established that some writing tasks could improve reading comprehension through executive functions. In a study conducted by Slotte and Lanka (1999), it was found that taking notes during a class improves the performance in reading comprehension tasks. This circle between executive functions ,writing and reading, has also been confirmed in a sample of children in the 3rd and 5th grade, showing that executive functions contribute to the development of writing, which in turn, promotes the reading processes (Altemeier et al., 2006).

Executive functions seem to play an active role in explaining some differences in reading outcomes, for example between typical and dyslexic readers. In the case of children with dyslexia, executive functions explain less variance in literacy outcomes compared with typical children (Altemeier et al., 2008). It has been established that children with dyslexia are not only poor in RAN colours and word reading but also show a significant number of errors in inhibition tasks (Reiter, Tucha, & Lange, 2005). However, not all of the executive functions tasks predict reading comprehension, for example in the Christopher et al. (2012) study, they found that working memory and general processing speed, but not inhibition or the speeded naming of non-alphanumeric stimuli, were predictors of both word reading and comprehension

2.8.4.3. Executive functions assessment

Because executive functions include different cognitive processes, there are different tasks for assessing them. Likewise, one task can evaluate different components of executive functions, at the same time (Chan, Shum, Toulopoulou, & Chen, 2008). For example, planning and working memory are two components evaluated through the Tower of Hanoi (Humes, 1997). Although most of the tasks use simulated games (Robertson, Manly, Andrade, Baddeley, & Yiend, 1997), other tasks are based on the daily life, such as the Naturalistic action test, in which participants are required to complete actions of the daily life (Schwartz, Segal, Veramonti, Ferraro, & Buxbaum, 2002).

Non-verbal tasks, such as the Tower of Hanoi, have showed a significant correlation with not only other executive functions tasks such as inhibition, but also with reading outcomes (Morere & Koo, 2012). Poor comprehenders performed below their peers in tasks such as Stroop task, and Distracter tasks, suggesting that both working memory and inhibitory behavior account for reading variance (Borella, Carretti, & Pelegrina, 2010).

2.9. Context of the current study

In the previous pages, the role of several predictors of reading has been established. Variables related to foundational literacy skills, language development, and cognitive skills are known to participate directly or indirectly in explaining reading accuracy, fluency, and comprehension. These skills are in turn, affected by the influence of the environment, which could explain why children from different socioeconomic environment show significant differences in reading tasks.

To date, few studies have been conducted to evaluate reading outcomes and the influence of reading predictors in children from different socioeconomic status (Bravo, 1995; Guardia, 2010). PISA (Programme for International Student Assessment) suggests that children studying in countries with the most unequal income distributions are most affected by the socioeconomic environment (OECD, 2010). Studying the effect of socioeconomic environment in countries with an unequal income distribution could allow a better estimation of the real effect of the socioeconomic status on reading and its predictors, and Chile is an example of this unequal income distribution (Castillo, Miranda, & Carrasco, 2012). In Chile, two studies have investigated the effect of some predictors of reading on later reading achievement from a longitudinal approach. Guardia (2010) studied the effect of linguistic, phonetic and lexical factors on reading acquisition in typical children from kindergarten and first year of primary school (5 to 6 years-old); while Bravo (1995) studied the effect of cognitive and language variables on reading difficulties, in a sample of typical and specific language impairment children from low SES between 7 to 10 years-old. However, this study did not include participants' socioeconomic status as a factor, since the focus was to discover the main predictors of reading in a Spanish-monolingual sample.

The current study has two aims. The first is to evaluate whether there are SES differences both in reading and in a number of predictors (foundational, language, and cognitive) and if so, to estimate the magnitude of these differences. The second aim is to evaluate the contribution of these predictors in explaining the variance in reading outcomes. In the next pages, the context of the Chilean education system is presented.

2.9.1. Reading results in Chilean students from low and high SES

Chile has been categorised as the second most economically segregated country in comparison to the rest of the OECD countries, and is the country in which socioeconomic variables are most closely related to students' achievement (OECD, 2010). In Chile, given the huge social stratification of the country (Posner, 2012), only those students from higher backgrounds have access to high quality education provision; students from low SES families, who cannot pay for education receive a low quality of teaching in their schools (Castillo, 2011).

In general terms, Chilean students show poor results in reading both in national (MINEDUC, 2007, 2013, 2014) and international tests (OECD, 2007, 2010, 2013). When all OECD countries are compared according to the PISA outcomes, Chilean students perform significantly lower than the mean (OECD, 2010). It has been suggested that those educational systems where children from different backgrounds study together allow better opportunities and outcomes (OECD, 2013). However, the Chilean case is exactly the opposite; students tend to study with their peers from a similar socioeconomic background (Aguirre, 2009; Mizala & Torche, 2012).

2.9.2. The Chilean educational system

Under dictatorship (1973-1990), Chile transformed its economic model from one where the state played a strong role in education to a neoliberal system. This change reduced the state apparatus and most of the public sector moved to a private one, starting a system where the achievement gap between children from rich and poor environments have increased over time (Aguirre, 2009). Based on the effective principle of neoliberalism, the Ministry of Education decentralised the administration, and granted autonomy of management to the schools in each municipality (council) (Oliva, 2010; Schneider, Elacqua, & Buckley, 2006). Nowadays, the Ministry of Education oversees curriculum matters only, and it monitors students' attendance, but it has no authority to directly improve the learning processes in Chilean schools. Due to the transformation of the Chilean educational system from State to a neo-liberal model, and high stratification of schools, Chile is known in the international education literature as 'the Chilean experiment' (Cornejo, 2006), or 'the Chilean case' (Torche, 2005).

Another feature of the Chilean model of education is the use of vouchers and the inclusion of private businesses in education (Mizala & Torche, 2012). Thus, the State grants a subsidy for each student's attendance, and the voucher is paid to the schools (Mizala, Romaguera, & Urquiola, 2007; Schneider et al., 2006). Alongside the introduction of the voucher system, the Chilean state allowed private organisations to participate in the establishment of schools. Since then, Chile has been administering three types of schools: public, which receive the state voucher only; public and private combined, which receive the same state voucher plus an amount of money charged to parents (Mizala & Torche, 2012); and private, which are funded by parents only. The idea behind this system was to increase the level of competition among schools and also to enhance strong motivation in order to generate quality education (Cornejo, 2006).

To accomplish the idea of including a comparison among schools, students are yearly evaluated in a test called Sistema de Medición de la Calidad de la Educación – SIMCE (*Education Quality Measurement System Test*) (I. Ortiz, 2012). Thus, the underlying idea is that those schools that show better outcomes would probably attract a greater number of students each year and would therefore receive a higher amount of money. However, the school choice in Chile is not based on the SIMCE outcomes, but it responds to other factors, such as discipline, order, family-school relationship, infrastructure, and availability of school equipment. The learning processes appear as a factor, but it is far from being considered the most important one (Hernández & Raczynski, 2015).

The most important difference in management between public and other schools is the selection process. Public/private and private schools can select students themselves, whereas public schools are not allowed to do this. Therefore public schools, in most cases, are the only option for those children who were not selected in private or public/private schools (Rambla, Valiente, & Frías, 2011). Obviously, none of the comparisons are fair when some schools can select students based on their skills and knowledge.

The trend over the years shows that parents transfer their children from public to private/public schools due to several reasons, which include conducive academic environment, school location, high moral values, and quality safety standards (Schneider et al., 2006). Between 2000 and 2006 or public schools reduced their enrolment by 186,000 students (13%), meanwhile the public/private schools (those who receive voucher plus a parent fee) increased their enrolment by 386,000 students (38%) (Paredes & Pinto, 2009). All of these processes and changes are impoverishing public education and enriching school owners, and it is resulting in high educational stratification (Oliva, 2010; Rambla et al., 2011). Currently, this is the main cause that increases the gap by socioeconomic status, allowing a better education only to those who can pay more for it (Mizala & Torche, 2012). This high segregation in the Chilean education system has been considered a risk-factor for achieving same learning opportunities among students (OECD, 2013). The high stratification and the profiting-making in education have led to the largest protests in Chile since the democracy era, in the so-called 'penguin revolution' or 'the march of the penguins'[1] (Rambla et al., 2011).

2.9.3. Features of Chilean educational system

The educational system in Chile serves approximately 3,574,419 students in 11,555 schools (Meckes & Carrasco, 2010). The system comprises four educational levels: preschool, primary, secondary, and higher, in which primary and secondary are part of compulsory education.

Preschool

On 21st of May of 2013, the former Chilean President Sebastián Piñera announced that preschool level would become compulsory within the next few years. The preschool system serves the population of children from 0:6 to 6:0 years old. In Chile, there are two main institutions that provide education at this level:

1. Junta Nacional de Jardines Infantiles – JUNJI *(National Kindergarten Board)* is a state foundation created in 1970. In 2015, 193,477 young children were attended JUNJI schools (Junta Nacional de Jardines Infantiles [National Nurseries' Board], 2015), and
2. Fundación Integra *(Integra Foundation),* which is a private, non-profit institution created in 1990. In 2015, Integra Foundation was attended by around 77,948 young children in 1067 locations (Fundación Integra [Integra foundation], 2016) .

[1] The name 'penguins' is given to the Chilean students, due to their black and white uniforms.

In Chile, 85% of children begin their formal education at the age of 5 (MINEDUC, 2013). These children are educated in institutions such as: JUNJI, INTEGRA, or any public or private/public or private schools that include preschool levels as part of their curriculum.

Primary

Primary education is a compulsory level and takes eight years to complete. 97.0% of children in the ages 6 to 13 attend school regularly. The dropout rate at this level is around 1.3% (Espínola, Balladares, Claro, & Valencia, 2011). The Ministry of Education provides the guidelines through a National Curriculum for each subject. However, each school or group of schools may develop their own curriculum, with the approval of Ministry.

Secondary

Secondary education has been a compulsory level only since 2003, and it takes 4 years (from ages 13 to 17). The dropout rate at this level is around 7.2% (Espínola et al., 2011). The secondary level includes three different types of schools: Scientific-humanities, Technical-Professional, and Artistic (from 2006). In the first two years, students follow a core plan and then choose one of those three options for their last two years.

In 2006, a total of 3,589,061 students were attending primary and secondary schools in Chile. 1,698,639 (47.3%) students attended public schools; 1,642,413 (45.8%) attended public/private schools, and 248,000 (6.9%) attended private schools (Paredes & Pinto, 2009).

Further and Higher Education

In further education, there are three types of establishments: Technical Training Centres (CFT) and Professional Institutes (IP), and colleges or Universities. CFT and IP usually offer short-term programmes, while colleges or universities offer long-term programmes providing undergraduate and postgraduate degrees. The 25 most important colleges in Chile belong to the Consejo de Rectores de Chile - *Council of Chancellor of*

Colleges of Chile (CRUCH). They have developed a test called PSU – Prueba de Selección Universitaria (*College Selection Test*), which is the selection process to enter college or universities. The content of the test is based on the high school curriculum. Both PSU and SIMCE tests are strongly associated with the socioeconomic status of the students, demonstrating once again Chile's strong social and educational stratification.

Socioeconomic status and reading in Chilean educational system

In the PISA reading test (2006) Chilean students reached an average score of 442, while the mean of OECD countries was 492, and this represents a score of 0.5 standard deviations below the average of OECD countries (MINEDUC, 2007; OECD, 2007). In all OECD countries, it is possible to find a significant relation between the reading test and socioeconomic status (OECD, 2007). This situation is accentuated in countries where the population has a less homogeneous distribution. A commonly used tool to estimate inequality levels among countries is the Gini index, which ranges from 0 (perfect income homogeneity) to 1 (perfect heterogeneity). According to this indicator, Chile has a score of 0.52, which places it among the most unequal countries in the world (Aguirre, 2009).

This stratification has a strong impact on language and literacy attainment. SIMCE, the national test that evaluates some components of literacy, shows that 69% of children from high SES at age 7 can be labelled as advanced readers, while only 20% of children from low SES are placed in this level (MINEDUC, 2007). This gap is significant in the later years (MINEDUC, 2013, 2014).

To reduce the literacy gaps that may be due to SES, a program labelled 'Chile Grows with You' has been implemented in recent years. This programme is a part of the public policies that aim to reduce the reproduction of poverty and equalize the opportunity for children from low SES, through the provision of learning and developmental services by public bodies at a community level (Consejo Asesor Presidencial para la Reforma de las políticas de infancia [Presidential Advisory Council about Reform Policies for Children], 2006). Despite this effort, improving the early identification of language difficulties, along the design of appropriated interventions are still required in order to improve the conditions of early young children coming from low SES (Nag & Snowling, 2012). In Chile, it is rather unfortunate that there is little research related to language development and reading in children from deprived contexts (Strasser et al., 2009).

Undoubtedly, developing studies in early childhood and particularly in poverty contexts would help to improve policies. Equally, such research would help to achieve the goals of reducing the educational gap by socioeconomic level ([NICHD], 2000). According to Strasser and Lissi (2009), young Chilean children in poverty contexts are attaining poor results and therefore important reforms are urgently needed. The aim of this study, therefore, is to further our understanding of how reading develops among Chilean children from high and low SES backgrounds, with the aim of decreasing the gap between them.

2.10. Summary

Learning to read is a complex process. Several skills are involved, and some of them act coordinately to allow a fluent, accurate, and comprehensive reading. Studies on reading predictors in a range of languages have shown that three skills can be considered key when predicting later reading achievement (Caravolas et al., 2013; Guardia, 2003, 2010; Hulme, Caravolas, et al., 2005; Muter et al., 2004). These factors are phonological awareness (the ability to use and manipulate the sounds of oral language) (Mann, 1986; Nation & Cocksey, 2009; Wagner & Torgesen, 1987; P. Walton & Walton, 2002), letter knowledge (Pallante & Kim, 2013) and rapid automatic naming (the ability to retrieve well-known words quickly) (Jong & Vrielink, 2004; Savage & Frederickson, 2005). In addition to these foundational reading abilities, the role of some language components, along cognitive skills seem to play an indirect role when explaining the variability in reading results. The hypothesis is that these factors are in turn, influenced by the environment in which a child grows up, this is: the socioeconomic status.

The current study aims to evaluate several reading predictors in a sample of children from low and high SES groups. Children were evaluated twice, first at age 5, where they attended pre-kindergarten, and then at age 7, when they attended the first grade of primary. Two main goals of the study have been considered. Firstly, the study aims to evaluate whether there are SES differences in a wide number of reading predictors (foundational, language and cognitive) and if so, to estimate the magnitude of these differences. Secondly, it aims to identify the contribution of those less studied predictors of reading in Spanish, which include cognitive skills, certain early language skills, and the influence of the home literacy environment.

The results of this study will contribute to a better understanding of the influence of Home Literacy environment on a wide range of reading predictors (foundational, language and cognitive) in a non-English context, namely Spanish. With respect to educational practice, the results will contribute to the development of more effective policies, studies, and interventions to decrease the reading gap by SES, benefiting particularly those children from deprived groups.

Chapter 3: Methodology

This chapter details the research method used in this study. The primary objective of this study was to identify the effect of foundational reading, early language and cognitive skills on reading outcomes, and to evaluate whether these factors differ between children from low and high socioeconomic groups. Chapter 3 presents information related to the objectives, research design, sampling, participants, instruments and procedures, ethical issues, and data analysis of this study.

3.1. Objectives of the Study

Chile, the country where this study was conducted, shows vast differences in the academic performance among students. A significant proportion of these differences is explained by the students' socioeconomic background. For instance, in the Chilean National test (SIMCE), children from low and high SES show significant differences when the reading outcomes are compared (MINEDUC, 2014). To date, there are no longitudinal studies in Chile that evaluate the processes that underlie reading, considering children from low and high SES. The current study can help us to understand individual differences in how children learn to read.

The objectives that guide this study can be summarised as:

a. Regarding literacy outcomes at age 7, what is the contribution of foundational literacy skills (phonological awareness, rapid automatic naming and letter knowledge), early language skills (grammar, vocabulary knowledge, and lexical search and retrieval), and cognitive skills (general cognitive ability, analogical reasoning, causal reasoning, inferencing, categorization, and executive functions) in a Spanish-speaking sample? And if so, what is the contribution of Home literacy environment to the development of these predictors?
b. Do these predictors differ when children are compared according low and high socioeconomic backgrounds at two different time points (ages 5 and 7)?

3.2. Research design

This study follows a longitudinal approach, which allows the evaluation of changes and continuities over time. The current study is based on a two-wave panel design, where the same group of children was evaluated at two different time points (ages 5 and 7). A significant number of studies have shown that children from lower SES perform significantly lower than their peers from higher SES and that these differences increase over time (Hart & Risley, 1995; Hoff & Naigles, 2002). The use of longitudinal studies allows a more precise estimation of when and where the differences occur between groups.

3.3. Sampling

The current study uses a disproportionate stratified sampling to divide the population into two groups of interest. In a proportionate stratified sampling, the composition of each of the strata is proportional to the number of the strata in the population, while in a disproportionate stratified sample, the sample size can be similar in the groups. The interest of this research was to compare two groups with similar characteristics (i.e. same course, similar age, similar proportion of boys and girls, etc.) but differing only in terms of their socioeconomic status. Thus, the disproportionate stratified sampling used in this study attempted to maintain similar sample sizes in both groups, to ensure an adequate number of participants at both times and likewise to enable fairer comparisons between them at each time point.

This study took place in Linares, a city in southern Chile. Linares county has a population of 107,311 inhabitants according to last census in 2012, although the number of people resident in Linares city is 87,661 (Instituto Nacional de Estadísticas / *National Statistics Institute*, 2013); 81.95% of this population lives in the urban area of the city.

Since the design of this research is longitudinal, it was important to find a place where children were likely stay in the same schools over a period of two years. In a Chilean study about student migration, the authors found that in Santiago, the capital of Chile, students change schools more frequently than their peers from other counties (Espínola et al., 2011). Thus, Linares in this respect seemed to be a suitable place for this kind of study. From a practical point of view, because Linares is a province and not the capital of the country, and neither a region capital, few educational studies have been conducted there. Therefore, children are less over-tested than their peers from Santiago, the capital of Chile.

In Linares city, there are 30 schools, and several criteria were considered for the choice of schools in this study. These criteria included:

a. Only schools - and not nurseries - were considered. This criterion was included to ensure the participation of students at both time points.
b. The schools had to have Preschool levels (Prekindergarten and Kindergarten).
c. Prekindergarten and Kindergarten had to be in different levels. In other words, the students in each level had to be in different and separate courses, classrooms and with different teachers.
d. More than 65% of the students in each school had to belong to a higher or lower SES, according to the IVE - Índice de vulnerabilidad del establecimiento (School vulnerability index).

From these 30 schools, only 12 matched the criteria and were invited to participate. Five of them signed the agreement; three of these schools had a high proportion of students from low SES, while two schools had a high proportion of students from high SES.

In Chile, the schools start preschool with Prekindergarten (around the age of 4) and then continue with Kindergarten (at the age of 5). The next level of Kindergarten is the primary education. As explained in section 2.9.2., the Chilean educational system uses school vouchers, whereby the government provides a monthly payment to schools depending on the attendance of each student. Thus, Chile has three different types of schools: those that receive just the monthly voucher (public schools), those that receive the voucher plus a fee applied to parents (public/private schools), and those that just receive the parents' fees (private schools).

The use of voucher and some neoliberal policies implemented in education have configured a highly-segregated system, with children from low-income families attending public schools and children from high-income families attending private schools. In this study, children from one public/private and two public schools (where parents do not have to pay fees) were allocated to the group of low SES. Children from one public/private and one private school (where parents must pay fees) were allocated to the group of high SES. In the next section, a sample description at both time points is presented.

3.3.1. Participants at time 1

One hundred and thirty-three Spanish-speaking Chilean children (58 girls and 68 boys) aged 3:10 to 6:3 (mean age 5:6) participated. 68 children were allocated to the low SES group, and 65 children to the high SES group. The mean age of the overall sample was 5 years and 6 months (5:6), with a range between 3:10 to 6:3. The mean age of children in the low SES group was 4:11 (59.2 months, SD = 5.3), with a range of 3:10 to 6:3. The high SES group had a mean age of 5:2 (61.8 months, SD = 4.0), with a range of 4:8 to 5:9. These two groups differ significantly in age, $t_{124} = 3.15$, $p = 0.002$. All of participants were monolingual Spanish-speakers. Regarding previous education, 74.2% of the total sample attended nursery school before starting Pre-kindergarten. However, this proportion varies according to groups, for example only 56.9% of children from the low SES group attended nurseries, while 93.2% of children in the high SES had done so.

Family Environment Survey

In order to have a better characterisation of each participant's background, the Encuesta Sobre Ambiente Familiar Preescolar – EAF-P (*Family Environment Survey - Preschooler*) (Romero-Contreras, 2006) was administered. This survey was designed for parents of young Latin American children. It considers different proxies for measuring socioeconomic status and home literacy environment. Surveys were collected in parent meetings in each of the schools. This survey was not compulsory and took between 40 and 50 minutes to complete. The response rate was 73%, although not all respondents were willing to provide information about their family income or educational level. Tables 1, 2, and 3 present data regarding families' monthly income, parental education, and parental occupation as proxies for the families' SES.

Table 1 shows the ranges of family income collected in the parent survey, expressed by SES group. Both high and low SES groups were previously defined according to the school's vulnerability index (IVE). School vulnerability was calculated through the proportion of students needs in the school. These needs include: number of children with medical needs, deficit of weight for age, family income, etc. The index is expressed as a percentage from 0 to 100% where 100% is the maximum level of vulnerability of a school. In this study, schools from low SES were classified as those with an IVE value of more than 65%, while high SES was defined as an IVE value lower than 35%. The IVE calculated in 2013 shows that those schools from low SES in this study had a mean of 84.6% students in a vulnerable situation, while the schools from high SES had only 33.1% of students in vulnerability (own elaboration based on IVE Report, 2013).

Table 1. Family monthly income

Ranges of monthly income	Socioeconomic Status	
	Low (%) n=48	High (%) n=44
0 to £215	46.2	0
£216 to £411	26.2	0
£412 to £616	0	0
£617 to £1644	0	36.1
More than £1645	0	32.8
Missing	27.6	31.1
Total	100	100

In Chile, the minimum wage is £274 (375,75 USD). As can be seen in Table 1 the income of all the families in the low SES group is less than £411. In contrast, the revenue of all the households in the high SES group is above £617 (844.3 USD). It is important to highlight that although the groups were separated according to features of the school they attended, the family income is consistent with this allocation, this is, schools reflect the social inequities in family incomes among Chilean families. Children in low SES group have lower family income compared to their peers from the high SES group.

Table 2. Parents' occupation according SES

		Mother´s occupation				Father's occupation			
		Low SES		High SES		Low SES		High SES	
	Income	n	%	n	%	n	%	n	%
Stay-at-home parent	N/A	18	42.9	6	13.3	1	3.6	0	0
Student	N/A	3	7.1	1	2.2	1	3.6	0	0
Non-professional occupations	£241 to £644	19	45.2	5	11.1	20	71.4	5	12.8
Professional	From £430	0	0	32	71.1	0	0	27	69.2
Other	N/A	2	4.8	1	2.2	6	21.4	7	17.9
Total		42	100	45	100	28	100	39	100

Table 2 presents data on the occupation of children's parents, by SES group. Non-professional occupations included those in the farming, retail, cleaning, construction, and service industries, whereas professional occupations included those in education, medicine, management, and law.

Table 3. Parents' educational attainment

Attainment level (or some years of)	Mother				Father			
	Low SES		High SES		Low SES		High SES	
	n	%	n	%	n	%	n	%
Primary	15	34.1	0	0	13	41.9	0	0
Secondary	21	47.7	4	8.7	15	48.4	6	14
Tertiary education (Technical)	7	15.9	9	19.6	3	9.7	7	16.3
Under/Postgraduate	1	2.3	33	71.7	0	0	30	69.8
Total	44	100	46	100	31	100	43	100
Missing	21		15		34		18	
Total	65		61		65		61	

Finally, in Table 3 data on parents' highest educational level is presented. Strikingly, while more than two-thirds of mothers and fathers in the high SES group had been educated at an undergraduate or postgraduate level, only one mother in the low SES group reached undergraduate studies (although she did not finish her degree).

3.3.2. Participants at time 2

At time 2, 106 children participated (52 from the low SES group and 54 from the high SES group), which is almost 80% of the original sample. 27 students did not participate at time 2 for reasons of changing schools, or for not having been promoted to the first year of primary. Table 4 shows the number of girls and boys both at time 1 and 2.

Table 4. Sample distribution at times 1 and 2

	Time 1			Time 2		
	Girls	Boys	Total	Girls	Boys	Total
Low SES	34	34	68	24	28	52
High SES	29	36	65	24	30	54
Total	63	70	133	48	58	106

3.4. Instruments

Table 5 summarises the tests and tasks administered at both times of this research. Subsequently, the characteristics of each test are described.

Table 5. Summary of tests and tasks at times 1 and 2

Area	Skills	Instruments	T1	T2
Reading	Accuracy	Word reading		✓
		Non-word Reading		✓
	Fluency	One-minute reading		✓
		Picture-word matching		✓
	Comprehension	Word/phrase comprehension		✓
		Text comprehension		✓
Foundational reading skills	Phonological awareness	Syllable segmentation	✓	
		Phoneme isolation - vowels	✓	
		Phoneme isolation – consonants	✓	
		Phoneme isolation – initial		✓
		Phoneme isolation – final		✓
		Phoneme blending		✓
		Phonological processing: Non-word repetition	✓	
	Rapid Automatic Naming	Colours	✓	
		Objects	✓	
		Letters		✓
		Digits		✓
	Letter knowledge	Woodcock Muñoz scale	✓	
		Letters sounds (from alphabet)		✓
		Letters names (from alphabet)		✓
Early language predictors	Grammar knowledge	Sentence repetition	✓	
	Receptive vocabulary	Peabody picture vocabulary test	✓	✓
	Lexical search and retrieval	Semantic fluency test (animals)	✓	✓
		Phonological fluency test (F/A/S)		✓
Cognitive skills	General cognitive ability	Block building	✓	
	Analogical reasoning	Verbal	✓	✓
		Non verbal	✓	✓
	Inferences and causal reasoning	Blicket detector task (one condition)	✓	
		Blicket detector task (two conditions)	✓	
	Categorisation	Categorical flexibility	✓	
	Executive functions	Tower of Hanoi		✓

3.4.1. Reading

Three components were considered in the evaluation of reading: accuracy, fluency, and comprehension. Accuracy was evaluated by word and non-word reading tasks from the Enhancing Literacy Development in European Languages - ELDEL project (Caravolas et al., 2012). Fluency tasks were taken from the same battery - One-minute reading and Picture-word matching tasks. Reading Comprehension data was collected using word/phrase and comprehension texts, from the Test de Lectura y Escritura en Español [LEE] (Test for Reading and writing) (Defior et al., 2006). LEE is a battery used by professionals and researchers interested in reading processes. It is usually administered from first to fourth year of primary and allows identifying risks in processes such as word knowledge, fluency, reading comprehension and writing (Defior et al., 2006).

3.4.1.1. Accuracy

The accuracy scale includes two tasks from the LEE battery, word and non-word reading.

a) Word reading

The aim of this task was to evaluate the lexical and sub-lexical processes involved in reading. Children were required to read a list of 42 words. These words considered criteria such as frequency, length and orthographic complexity. The time children needed in order to read the whole list was recorded. Each word was analysed regarding how children pronounced it (syllabic, hesitant, or fluent). Syllabic pronunciations occurred when children took pauses between the segments of a word. Hesitations were coded when a child stopped more than the expected time on a letter, even when he/she was finally able to read it. Self-corrections were also considered as hesitations. When a child was able to read with no pauses and proper intonation contour was scored with 2 points. Those words pronounced as syllables or hesitantly received 1 point. A score of 0 was awarded when children were not able to read the word or reading contained mistakes. Possible scores range from 0 to 84 points.

b) Non-word reading

The aim of this task was to evaluate sublexical reading processes without the support of word knowledge. As in word reading, children were required to read a list of 42 items. Non-words were matched in length and complexity to items in the real word reading task. The list of 42 non-real words can be divided into three groups: 26 complex words, 8 simple words and 8 with consonant clusters [from CCVC (cral) to CVC-CV-CV-CCV (disnutible)]. Scoring followed the same principles as the word reading task.

3.4.1.2. Fluency

To evaluate fluency, one-minute reading and picture-word matching were included.

a) One-minute reading

In the **One-minute reading** task, children were asked to read aloud a list of 140 high-frequency words of 1 to 5 syllables, as quickly as possible. The list began with very simple one-syllable words and grew up with more complex 2 to 5 syllable-words, as presented in table 6. The list started with one-syllable words such as Y (*And*) ending with more complex five-syllable words as Rápidamente (*Quickly*). The score was calculated with one point for each word correctly produced (Caravolas et al., 2012).

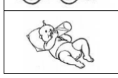
Table 6. Distribution of One-Minute reading according to syllable number

Number of syllables	Number of words
One	14
Two	37
Three	49
Four	31
Five	9

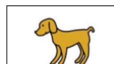
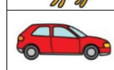
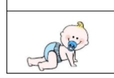
b) Picture-word matching

The picture-word matching task is a paper-and-pencil task where children are asked to tick the box which matches a given picture. Each item contains one image and four possible options: the correct word, a distractor with a similar spelling, a distractor with a similar meaning and an unrelated distractor. The task includes 52 items, and children were given 3 minutes to complete as many items as possible. The task starts with one demonstration item and two practice items. One point was awarded for each correct match. The images were coloured and improved to avoid confusions in some target pictures.

Original items

	hierro ☐	perro ☐	hueso ☐	arroz ☐
	rueda ☐	noche ☐	mundo ☐	coche ☐
	mago ☐	bebé ☐	besé ☐	mamá ☐

Modified items

	hierro ☐	perro ☐	hueso ☐	arroz ☐
	rueda ☐	cauto ☐	mundo ☐	auto ☐
	mago ☐	bebé ☐	besé ☐	mamá ☐

3.4.1.3. Comprehension

Comprehension was evaluated using two tasks from LEE battery: word/phrase and text comprehension.

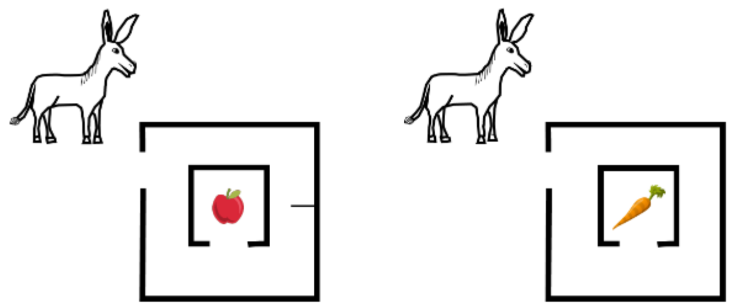
a) Word/phrase comprehension

The aim of this task was to assess the morphosyntactic processes involved in text comprehension. It included three subtasks: phrase comprehension, word family, and phrase completion. These three subtasks were collapsed in the analysis.

Phrase comprehension: the task included three simple activities to encourage children to solve the rest of the tasks. The scale has two sections. In the first part, children were asked to respond two very simple questions, the first of them in the active voice and the second one in the passive voice. Then, children were given a picture, and were asked to draw or match with a line according to the instructions. Each task was scored with 1 point when children responded the questions adequately and followed the instructions. The maximum possible score in phrase comprehension was 5 points.

E.g. Draw the path that the donkey must take to reach the carrot

Completa el camino que debe recorrer el burro para llegar a la zanahoria



Word family: The aim was to evaluate morphological knowledge and word comprehension. Children were presented a target word and seven different related and distractor words. Participants were asked to circle those words that might be related to the target word. Scoring was calculated with one point for each correct answer. A correct answer included both those correctly circled and properly noncircled words. The maximum score for each family was 7 points, and the total score was 28 points.

E.g. Word families [2]

Phrase completion: The aim was to evaluate morphosyntax. The task consisted of four sentences. Each of the sentences was incomplete, and children were asked to match the first part of the sentence with one of the three option phrases. Each phrase had to be

[2] Target word: To wrap up. 1. Disaster 2. Wrapped up 3. Open 4. Little coat 5. To button 6. Clothes off 7. Coat

matched according to the criteria of coherence and cohesion. 1 point was given for each correctly matched phrase. The total score for this task was 4 points.

E.g. Phrase completion

b) Text comprehension. In the text comprehension section, children were shown three texts from LEE battery, which they had to read and understand. After each text, some questions were asked. Texts in this study included two narratives and one expositive story. The text complexity was determined by considering a) number of words, b) proportion of frequent and infrequent words, c) number of anaphora (i.e., the use of a word to replace a word used earlier in a sentence to avoid repetition) d) number of subordinated sentences.

To evaluate comprehension, three literal questions, and three inferential questions were included in each of the texts. Children were allowed to read the text again, after the questions had been asked. Some multiple-choice questions were also included about selecting an appropriate title for the text and summarising its content. The score for each text could vary from 0 to 16 points. The maximum score was 48 points.

3.4.2. Foundational reading skills

Foundational reading skills in this study were phonological awareness, rapid automatic naming, and letter knowledge.

3.4.2.1. Phonological awareness

Regarding phonological awareness, different tasks were used at both time points. These tasks were selected considering the participants' age. At time 1, three different subtasks were administered: syllable segmentation, initial phoneme isolation in words starting with a vowel and initial phoneme isolation in words starting with a consonant. These subtasks were taken from 2 different tests. Syllable segmentation was taken from the Test de Habilidades Metalinguisticas – THM (*Metalinguistic Skill Test*) developed by Gómez, Valero, Buades and Rosario and Pérez (1995) and phoneme isolation (consonants) from Prueba de Predicción Lectora (*Test of Reading Prediction*) developed by (Bravo, 1997). At time 2, three tasks from the Spanish version of ELDEL (Enhancing Literacy Development in European Languages) were used. These tasks evaluate different components of phonological awareness: phoneme blending and phoneme isolation, both initial and final.

a) Time 1.

Syllable segmentation

Syllable segmentation is a short subtask taken from the Test de Habilidades Metalingüísticas – THM (*Metalinguistic Skill Test*) (Gómez, Valero, Buades, & Pérez, 1995). Children are asked to count the number of syllables that several words have. In this subtask, the examiner starts by saying "Let's play with the words. I am going to name a word and we will try to cut this word into several parts while we are clapping. We are going to clap for each part of the word. Mano is Ma - no (the examiner claps for each of the syllables), how many parts does the word Mano (*Hand*) have?" The subtask includes 20 different words with 2 initial training examples: Mano (*Hand*) as an example of a 2-syllable word and Zapato (*Shoe*) as an example of a 3-syllable word. The items contain from monosyllables to four-syllable words. Specifically, 2 monosyllable words (i.e. Pan / *Bread*), 7 two-syllable words (i.e. Cama / *Bed*), 7 three-syllable words (i.e. Chaqueta / *Jacket*) and 4 four-syllable words (i.e. Escalera / *Stairs*). Each word correctly divided into syllables was scored with 1 point. The maximum score for this subtask was 20.

Phoneme isolation - consonants

To evaluate phoneme isolation in words starting with a consonant, a task from Prueba de Predicción Lectora (*Test of Reading Prediction*) developed by (Bravo, 1997) was used.

Phoneme isolation (consonant) requires children to identify the first sound of several words that start with a consonant. The examiner starts by saying "Let's play with these words. I am going to name a word and we need to try to identify the first letter of this word. For example, the word Pato/Duck (the examiner stresses the first phoneme /p/) starts with which letter?" The subtask includes 8 common words with 2 initial training examples: **P**ato (*Duck*) and **C**osa (*Thing*) (see table 7).

Table 7. List of words for phoneme isolation (consonants)

Spanish	English	Correct response
Sapo	Frog	S
Mesa	Table	M
Rosa	Rose	R
Foca	Seal	F
Gato	Cat	G
Limón	Lemon	L
Pala	Shovel	P
Tuna	Prickly Pear	T

2 points were given when a child responded by indicating the name of the letter, 1 point was given when the response included only the sound and not the name of the letter, and 0 points when the response was incorrect. The maximum score for this subtask is 16.

Phoneme isolation - vowels

The Language Guidelines for Prekindergarten level emphasize teaching of vowels based on how children should be able to manipulate and identify the vowels in a word

(Ministry of Education, 2008). Following these guidelines, a phoneme isolation task was included in the time 1 of this study. The task is included in the Prueba de Predicción Lectora (*Test of Reading Prediction*) (Bravo, 1997).

Phoneme isolation (vowels) is a task where children are asked to identify the first sound of different words that start with a vowel. The examiner says "Let's play with these words. I am going to name a word and we need to try to identify the first letter of this word. For example, the word **A**rco/Arch (the examiner stresses the first phoneme /a/) starts with which letter?" It included 8 typical words with 2 initial training examples: **A**rco (*Arch*) and **E**lla (*She*) (see table 8). Each correctly identified vowel was awarded 1 point. The maximum score was 8.

Table 8. List of words for phoneme isolation (vowels)

Spanish	English	Responses
Auto	Car	A
Olla	Pot	O
Isla	Island	I
Edad	Age	E
Uvas	Grapes	U
Amor	Love	A
Imán	Magnet	I
Osos	Bears	O

Time 2.

At time 2, three subtasks were administered: phoneme isolation for initial sound, phoneme isolation for final sound, and phoneme blending.

Phoneme isolation – initial

To evaluate the awareness of the first sound of words, the phoneme isolation sub-test from ELDEL battery scale was used. This sub-test included only non-real words and this was the reason for including it in this study, instead of the Prueba de Predicción

Lectora (*Test of Reading Prediction)* (Bravo, 1997) used at time 1. The test starts with 2 items where the examiner models the task features. The examiner says "Let's play by guessing the first sound of these non-real words that I have invented. Repeat after me "Sol/*Sun*" (child repeats the word "Sol") and please pay attention and tell me what the first sound of the word "Sol" is? Yes, it is /s/. The task continues with two practice non-word items, one with a CCVC pattern (i.e. FLOS) and the second with a CVC pattern (i.e. CIR). Children received one point for each correct response. The task consists of two sections: CVC and CCVC patterns, each with 8 items. The maximum score in this task is 16 points.

Phoneme isolation – final

This scale follows the same principles as the previous task and was taken from the ELDEL battery. It starts with two items where the examiner models the task features. The examiner says "Let's play by guessing the last sound of these non-words that I have invented. Repeat after me "Pez/*Fish*", (the child repeats the word "Pez"). Please pay attention and tell me: what is the last sound of the word "Pez"? Yes, it is /z/. Then, the task continues with two non-real words practice items, one with a CVC pattern (i.e. RAL), and the second with a CCVC pattern (i.e. PLAS).

The children received one point for each of the correct responses. The task considers two sections: CVC and CCVC patterns, each with eight items. Thus, the maximum score in this task is 16 points.

Phoneme blending

The task begins by presenting an image, in this case, the picture of a "Río" (*River*). The examiner says "Let's play by guessing words. I will say the sounds of a secret word, and you have to put together these sounds and guess what the word is. I will give you an example. What is this? (Showing the picture of a Río/*River*). The sounds of Río are R-í-o". After another example with the word "two" (Dos), the task continues with practice items, which do not include pictures as reference.

Children were asked to blend each of the presented phonemes to produce a word. The task contained 24 words with 2 to 4 sounds. 4 of these words had 2 letters, 7 words had 3 letters, and 13 words had 4 letters. Children received one point for each correct response. The maximum score was 24. The task ended once a child had completed the 24 words or when he or she had made 6 consecutive errors in the words.

Phonological processing

This study included a measure of phonological processing through a non-word repetition task, translated and adapted from The Grammar and Phonology Screening (GAPS) test (Gardner, Froud, McClelland, & van der Lely, 2006). The 8 bisyllabic and trisyllabic non-words, were translated according to the phonotactic patterns of Chilean Spanish and contained a variety of stress patterns (final, penultimate and antepenultimate stress), with different syllable structures (CV, CVC and CCV). A non-word that was repeated entirely correctly was awarded one point. Segmental, syllabic and prosodic errors led to a score of 0. Table 9 presents the items of the non-word task.

Table 9. Non-word tasks adapted from GAPS test

Non-words (stress is underlined)
1. Cuton
2. Malte
3. Gobla
4. Triduta
5. Siberol
6. Glumita
7. Mofrelo
8. Purramo

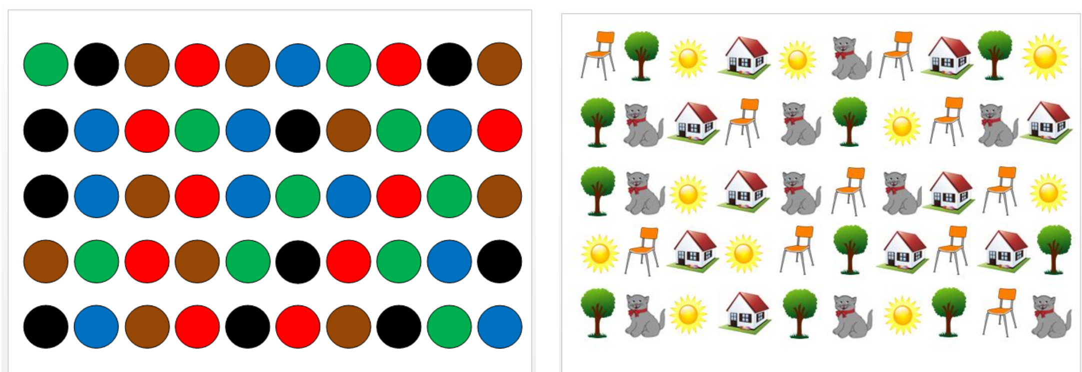
3.4.2.2. Rapid automatic naming

In this study, Rapid Automatic Naming (RAN) task developed by Wolf and Denckla (2005) was administered. RAN is a task that measures naming speed for letters, digits, pictures or colours (Caravolas et al., 2012; Savage & Frederickson, 2005; Wolf et al., 2000). The original test includes four different versions: colours, objects, letters, and digits. In this study, colours and objects were administered at time 1 while letters and digits were administered at time 2 only. At time 1, children are more likely to work in their classrooms recognising colours and naming objects rather than manipulating letters or digits. For this reason, colours and objects were included at time 1, while letters and digits were included at time 2, when children attended to the first year of primary, and where letters and digits are more common tasks.

Each of the RAN subtests has 50 items in 5 rows of 10 items each. Children were asked to name each element, following a sequence from left to right, as quickly as possible. At the end of the first row, children were prompted to continue to the first element of the second row from left to right. At times 1 and 2, tasks started with a training phase to ensure that all participants knew the elements of this task [colours (green, black, brown, red and blue), objects (chair, tree, sun, house and cat), letters (A, O, L, M, P), and digits (2, 3, 5, 6 and 7)] (see figure 3).

Figure 3. RAN at times 1 and 2

Time 1 (colours and objects)



Time 2 (digits and letters)

2 7 3 5 6 3 6 2 5 7	A M P L O P O A L M
6 3 7 5 2 6 7 5 3 2	O P M L A O M L P A
5 6 2 3 7 5 2 6 3 7	L O A P M L A O P M
2 7 3 5 6 2 3 7 5 6	A M P L O A P M L O
3 6 2 5 6 7 5 3 2 7	P O A L O M L P A M

3.4.2.3. Letter knowledge

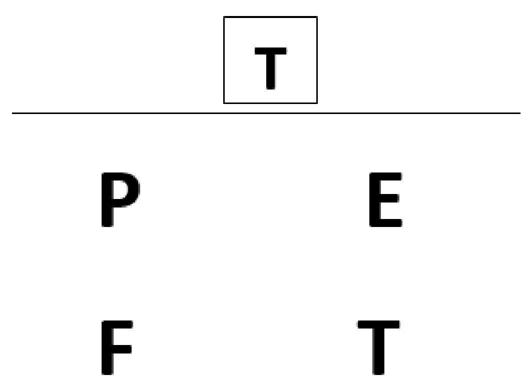
Time 1

Letter knowledge from Woodcock Muñoz scale

In order to evaluate children's knowledge of letters, the Letter-Word identification task from the Woodcock-Muñoz Language Survey-Revised was administered (Woodcock et al., 2001). Several cognitive and language processes are involved in this task, including the access and retrieval of both letters and words from mental lexicon, and the activation of representations of sounds from a visual form. The task has different requirements that children have to comply with. These tasks are presented in degrees of increasing complexity. Thus, in the first items, children are required to point to a letter (i.e. M) considering three distractors (banana, dog, and sport shoe). The examiner says, "This is the letter "T". Could you find this letter "T" below?" Then, the children have to point to the letter "T" from a set of letters such as P, F, E and T. The rest of the tasks involve the identification of upper and lowercase letters from a set of distractors, and the selection of a target word from 4 different words (see figure 4). The most difficult section is the one where children are asked to read words that are 4 and 5 syllables long. After six consecutive errors, the task is terminated. Children received 1 point for each correct response.

Figure 4. Example of an item from Letter identification scale

This is the letter "T". Could you point to the letter "T" below?



Time 2

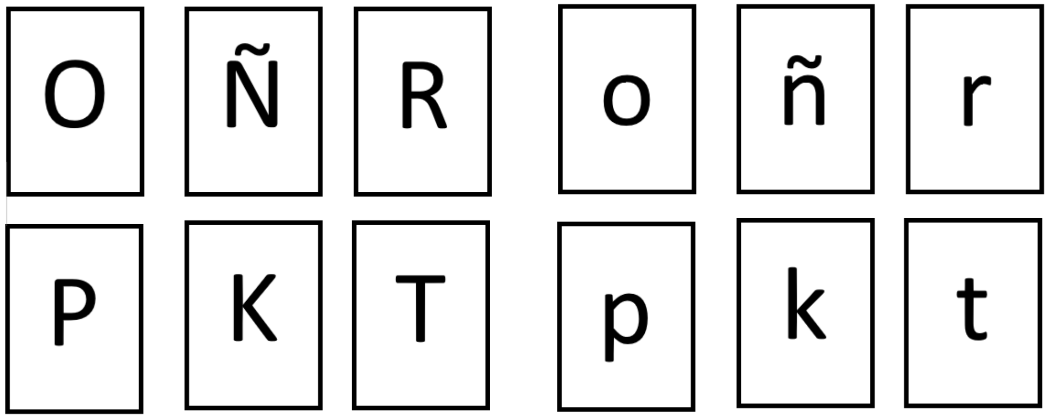
Letter knowledge from ELDEL project

At time 2, as children attended the first year of primary school and therefore all the letters had to be known, a new Letter knowledge scale was administered. This new scale is a direct evaluation of the names and sounds of each of the letters. The scale is part of the ELDEL project. With a series of cards, children are asked to pronounce the sounds and names of each letter of the Spanish alphabet. Letters are presented separately both in upper and lower case. Children must choose which option they prefer.

In the Spanish language, there are five vowels and twenty-three consonants that were asked. The letters were not presented in alphabetic order, but randomized, starting with vowels and the consonants. At the beginning, children are asked to choose an upper or lower case set of letters. Then just one of them is presented. Each of the letters of the Spanish alphabet was printed in a card. Participants were presented a deck of cards and each card was presented once (see figure 5). The task ends when participants have made 4 consecutive mistakes in the same column. The score was calculated with 0, 1 and 2 points. 2 points were given when a child was able to provide both name and sound of a letter, 1 point just the name or the sound and 0 when sound and name were incorrect. The maximum score was 53, which was calculated considering the number of the consonants of the Spanish alphabet (24) multiplied by 2 (correct name and sound), plus 5 points of the sounds of the vowels [(24 x 2) + 5]. Vowels in Spanish language have just sounds and not "names".

The task starts by presenting the first letter of both the first name and surname of each participant. For instance, if the name of a participant were "Juan Torres" the examiner would say, "Look at this letter (showing the letter "J" for Juan). Do you know what letter this is?" After that, the examiner repeats the question without showing the letter "T" for Torres.

Figure 5. Example of an item from Letter knowledge (upper and lowercase letters)



3.4.3. Early language predictors

This section includes the description of some tasks collected at times 1 and 2 related to early language predictors. The early language predictors in this study were grammar knowledge, receptive vocabulary and lexical search and retrieval.

3.4.3.1. Grammar knowledge

Sentence repetition

The Grammar and Phonology Screening (GAPS) test was translated and adapted from English to Spanish (Gardner et al., 2006). This task contains 11 sentences, with a variety of syntactic and morphological structures. Each sentence was accompanied by a picture that reflects the situation expressed in the utterance. Scoring was calculated at the whole item level. A sentence that was repeated correctly was awarded one point. Lexical, morphological and syntactic errors resulted in a score of 0. Table 10 presents the stimuli for this Spanish version of the GAPS sentence repetition task.

Table 10. Sentence and non-word stimuli for the Spanish adaptation of the GAPS test

Sentences	
1. El gato con el lazo es gris.	*(The cat with the bow is grey.)*
2. Los gatos se han comido al pez.	*(The cats have eaten the fish.)*
3. La leche es arrastrada por el perro.	*(The milk is pulled by the dog.)*
4. ¿Qué ha bebido el perro?	*(What has the dog drunk?)*
5. El perro que los gatos empujan es azul.	*(The dog that the cats push is blue.)*
6. El gato lo lava.	*(The cat washes it.)*
7. Los gatos beben la leche.	*(The cats drink the milk.)*
8. El gato se lava.	*(The cat washes himself.)*
9. El perro es tocado por el gato.	*(The dog is touched by the cat.)*
10. El perro rojo le da la leche.	*(The red dog gives him the milk.)*
11. ¿A quién están lavando los gatos?	*(Who are the cats washing?)*

Lexical search and retrieval

This ability was assessed through the Controlled oral word association test (COWA or COWAT), which it measures spontaneous production of words belonging to the same category or beginning with some designated sound (Benton, Hamsher, & Sivan, 1994). This study considered both semantic and phonological subtasks. At time 1 and 2, semantic fluency tasks were administered, while at time 2 the phonological fluency task was also included.

Semantic fluency task requires the child to name as many words as possible from a given category in 60 seconds (Ardila, 2013; Matute, Rosselli, Ardila, & Morales, 2004; Ostrosky-Solis et al., 2007). In this study, the category "animals" was used because it is one of the most commonly used semantic categories in studies in the area. The score was calculated with one point for each of the correct animals produced. Animals included fish, birds and mammals. This scoring also included some imaginary or mythology animals such as unicorns, Pegasus, etc. However, those responses that included the name of pets or the name of characters in cartoons were scored with 0 points. Repetitions were not considered as valid responses, and singular and plurals of a same word were considered as just one correct response (e.g. cat, cats).

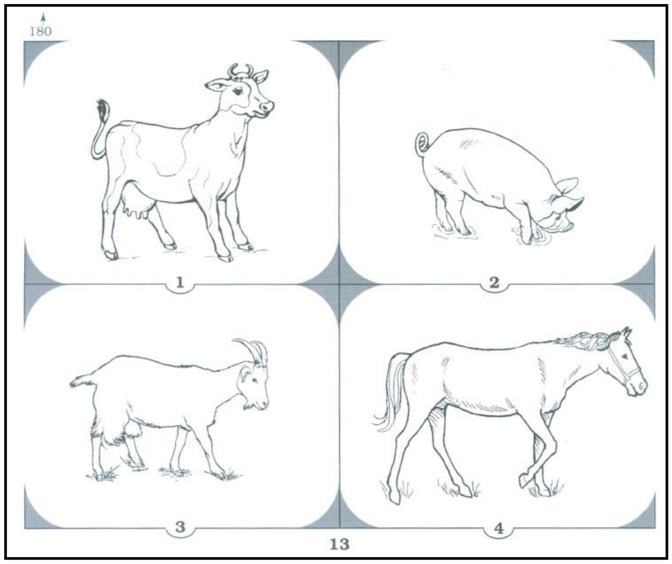
In the phonological version, children were required to name as many words starting with the sounds "F", "A" and "S" in 60 seconds. Children were instructed to avoid repeating words or using the plural and singular of the same word. One point was scored for each correct word. The score was calculated with one point for each of the correct words starting with the sounds F, A, and S.

Receptive vocabulary at times 1 and 2

For receptive vocabulary, the Spanish version of the Test de Vocabulario en Imágenes Peabody - Peabody Picture Vocabulary Test - PPVT was administered (Dunn & Dunn, 1981) at times 1 and 2. The Peabody Test is straightforward to administer. One of its main advantages is that children are merely required to indicate the picture that matches the spoken word (Nettelbeck & Wilson, 2004). The test is graded according to more to less known words and has different starting points according to the examinee's age. The test ends when participants make eight mistakes within a block of 12 words. Usually, this test takes between 10 and 15 minutes. Peabody test has been standardised to Latin American population with a sample of 1219 monolingual children and teenagers from Mexico and 1488 children from Puerto Rico (Dunn, Padilla, Lugo, & Dunn, 1986). The internal consistency (split-half) was 0.93. The concurrent validity was evaluated using the Spanish version of the Kaufman scale - ABC, a cognitive development test. This analysis showed an adequate validity (Gómez-Palacio, Rangel, & Padilla, 1985). Although Peabody test is not normed for the Chilean population, it has been included in previous studies in Chile with no problems in the administration or scoring (Strasser, Larraín, López de Lérida, & Lissi, 2010).

Figure 6 shows an example of one of the Spanish Peabody test items. The target word is VACA (*Cow*). The image shows 4 different animals (the target and three distracters): 1. Vaca (*Cow*), 2. Cerdo (*Pig*), 3. Chivo (*Kid*) and 4. Caballo (*Horse*).

Figure 6. Example of an item from the Spanish Peabody test



3.4.4. Cognitive skills

Five different tasks were included in the cognitive section of the battery. These tasks tapped general cognitive abilities, analogical reasoning, inferences and causal reasoning, categorisation, and executive functions.

General cognitive ability. Block building. Time 1

The block building from the British Scales Abilities (BAS) was administered at time 1 as a measure of general cognitive performance. This task has shown to be an effective way to measure intelligence (Stannard et al., 2001), and it has been considered a good predictor of later academic achievement (Casey et al., 2008; Wolfgang et al., 2003). Furthermore, block building is one of the most common activities of children at preschool age (Casey et al., 2008; Wolfgang et al., 2001). Therefore, children from both low and high socioeconomic backgrounds are likely to find this activity familiar at this age (Kamii, Miyakawa, & Kato, 2004). The task taps different skills such as problem-solving, visual perceptual matching, hand-eye coordination, and spatial orientation by considering visual cues. It has been designed for an age range from 3:6 to 7:11.

The task requires the child to copy various models built by the examiner (see figure 7). These models should be made with 3 or 4 cubes, except the first one, where children must use all the 8 available cubes to make a tower. The task has two sections depending on age: Usual Age Range (2:6-3:5), and the Extended Age Range (3:6-7:11). Block building task contains 16 graded designs. Children must complete each design in less than 30 seconds. For each design correctly constructed, children receive a score of 1. Scoring for this task followed the protocol suggested by the British Abilities Scale II, in terms of the accuracy in building the model.

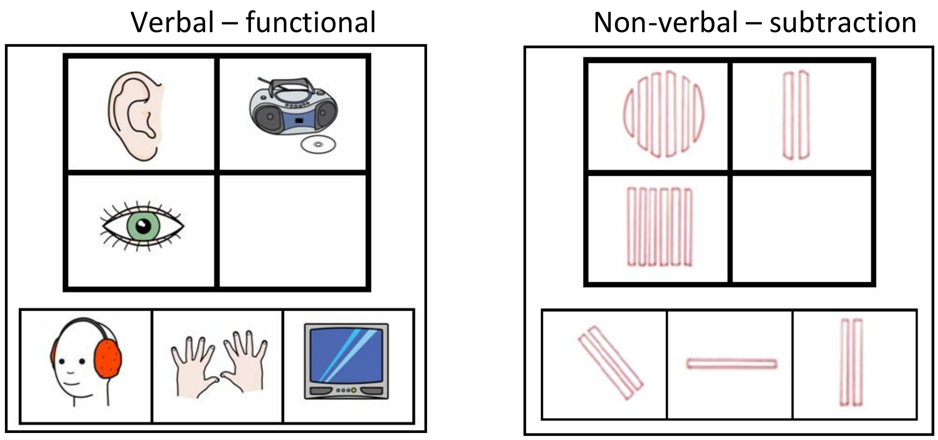
Figure 7. Cubes from block building scale

Analogical reasoning. Times 1 and 2

In order to evaluate analogical reasoning, a task based on the A:B::C:D paradigm was administered (Benítez & García, 2010; Thibaut et al., 2010). The A:B::C:D is a kind of analogy about the relation between 4 terms, in which the way in that A is related to B, influences the way in that C is related to D. In other words, the relation between A and B provides a clue about the relation between C and D (Goswami, 1991; Thibaut et al., 2010). Based on this paradigm, different tests have been developed, where D is omitted. Usually children are required to choose an appropriate object, among different options. For instance Wing:To fly::Legs: ?; in this case, children have three options: a) To walk; b) A T-shirt; c) A knee; thus, based on a functional analogy, the correct answer is a) To walk (Martínez et al., 2002).

A Chilean adapted test designed by Martínez et al. (2002) following the A:B::C:D paradigm (Benítez & García, 2010; Goswami, 1991) was used (see figure 8). In this task, children are asked to understand the relationship between A and B. After that, they see C, and are asked to choose one of the 3 available options in order to complete the sequence A:B::C:D. Children of 4 years old show an acceptable performance in this task (Martínez et al., 2002; Tunteler & Resing, 2002).

Figure 8. Examples of verbal and non-verbal – Analogical reasoning test



This task contains 40 pictures in two different sections: verbal (20 pictures) and non-verbal (20 pictures). The verbal scale included five different dimensions: hyponymy, functional, attributive, metonymy, and antonymy. Each of these dimensions appeared four times in the scale. Hyponymy included those elements which belong to a group (i.e., apple as part of fruit groups). Functional refers to the purpose of an object (i.e., legs for running). Attributive refers to a feature of an object (i.e., green for a tree). Metonymy is a concept which is not called by its own name but by the name of something related (i.e., keys for piano), and finally Antonymy, where an opposite association is presented (i.e., full and empty). Non-verbal scale includes four scales: equality, subtraction, addition, and permutation. Each of these dimensions appeared five times. Equality items showed two pictures exactly equals. Addition consists of two similar drawings, but the second image includes some new elements. Subtraction images were the opposite of Addition, this is, the second drawings include fewer features than the first. Permutation includes drawings where the order of the image is altered (i.e., left to right or up to down). Each group started with a training phase. Correct responses were awarded with 1 point; thus, the maximum score was 40 (20 in each scale).

Inferences and causal reasoning. Blicket detector task. Time 1

To evaluate the child's inferences and causal reasoning, the Blicket Detector task was administered in this study. This task was created by Gopnik and Sobel (2000) and it has been widely used because of its ease of use and quick administration. The Blicket detector is a machine that lights up and at the same time plays music when different objects are placed on it. Children must draw inferences to know which objects are those that light up the machine ("Blickets") and why they are Blickets (what is/are the reason/s). The device is activated by the researcher with a switch hidden from the children's sight.

At time 1 the one/two cause condition in a forward procedure was administered. Forward procedure implies that children must place one object on the machine at a time. In the forward procedure, the machine is activated when objects are placed on it. In the reverse procedure, all objects are placed on the machine and the blicket detector is activated when one or more items are removed. Table 11 summarises the administered conditions.

Table 11. Blicket detector conditions

	Objects		**Question**	**Answer**
	Object A	**Object B**		
One Cause Condition	Activates	Doesn't activate	What is the blicket?	Object A
	Doesn't activate	Activates	What is the blicket?	Object B
	Activates	Activates	What is the blicket?	Both
	Doesn't activate	Doesn't activate	What is the blicket?	Neither one

	Objects			Question	Answer
	Object A		**Object B**		
Two-causes condition	Activates	Doesn't activate	Don't activate	What is the blicket?	Just A
	Doesn't activate	Activates	Don't activate	What is the blicket?	Just B
	Activates	Activates	Activate	What is the blicket?	A and B
	Don't activate	Doesn't activate	Activate	What is the blicket?	Both, but they have to be placed together.
	Activates	Activates	Don't activate	What is the blicket?	Both, but together they repel each other (or similar response)

Responses for each trial could be awarded either 2, 1 or 0 points. 2 points were given when the responses showed some level of hypotheses regarding the operation of the machine (*e.g. Both are blickets. Blickets must be different to activate the machine. When both objects are similar, the machine does not turn on / Both are blickets, because it seems that the machine is activated when the objects are heavier, thus when two objects are placed close together they are heavier*). 1 point was given when the response was correct, but the explanation was simple (*e.g. Both are blickets. When you put one it does not make a sound, but if you put both together the machine makes a sound*) and 0 point when the explanation was insufficient or incorrect (*e.g. I do not know / the machine is activated because it is turned on*).

Categorisation. Categorical flexibility. Time 1

The process through which a child can change the criteria to group the same set of objects has been called categorical flexibility. This process has been described to start in the preschool years. At this age, children seem to be able to group and switch their criteria for sorting objects (Kloo et al., 2008).

To evaluate categorisation abilities, an adaptation of the Categorical flexibility task was administered at time 1. In the original task, the authors used thematic and taxonomic categories. In Blaye et al. (2006) study, children received a set of objects that can be sorted by a thematic or taxonomic category. The original set of objects include pictures such as a farmer, a farmer woman, a farmer boy, a cow, a sheep, a chicken, a cattle dray, a tractor, a hay dray, a girl in a swimming costume, a woman in a swimming costume, a diver, a crab, a dolphin, a fish, a boat, a canoe, and a windsurf. These objects can be grouped both thematically [e.g. Beach (girl in a swimming costume, woman in a swimming costume, diver, crab, dolphin, fish, boat, canoe, and windsurf) or Farm (farmer, farmer woman, farmer boy, cow, sheep, chicken, cattle dray, tractor, and hay dray)] or taxonomically [e.g. People (girl in a swimming costume, woman in a swimming costume, diver, farmer, woman farmer, and boy farmer), animals (crab, dolphin, fish, cow, sheep, and chicken) and vehicles (boat, canoe, windsurf, cattle dray, tractor, and hay dray)]. In addition, a mix between thematic and taxonomic categories could be sorted, such as Animals in a beach (crab, dolphin, and fish). Children were asked to sort (and switch) as many groups as possible from thematic and/or taxonomic choices.

Since the aim of this work was to understand the mechanisms through which children sort objects, rather than knowing whether they know words, this test was adapted. The adaptation consisted of fundamentally eliminating those word-related figures (e.g. crab), and replacing them by objects, shapes, and colours. The purpose of the adaptation was to minimize the effect of vocabulary knowledge in this cognitive task. Children with less exposure to test's figures could perform below than their peers with more vocabulary knowledge.

The task used in this study, included a set of 18 cut-out triangles, squares, and circles of three different colours: red, yellow, and blue. Each of these pictures appeared twice in big and small sizes. Scoring was coded through the number of criterion used (i.e. 1 criteria = 1 point). Table 12 summarises the presented items.

Table 12. Summary of items in Categorical flexibility task. Time 1

		Shapes		
		Triangle	**Square**	**Circle**
Sizes	**Big**	Red	Red	Red
		Yellow	Yellow	Yellow
		Blue	Blue	Blue
	Small	Red	Red	Red
		Yellow	Yellow	Yellow
		Blue	Blue	Blue

Executive functions. Tower of Hanoi. Time 2

In order to evaluate one of the components of the Executive functions, the Tower of Hanoi task was included. The Tower of Hanoi is a puzzle compound of three pegs and different size discs that are stacked. Participants are required to move these discs from one peg to another, considering a series of constraints. Usually, there are three of these constraints:

a. Only one disc can be moved at a time.

b. Any disc that is not being moved must remain on one of the pegs.

c. A larger disc cannot be placed on a smaller disc.

The moves made by the participants were recorded in two different ways: number of moves, and number of errors. The first score allowed the calculation of efficiency in the task, in other words, what is the number of moves needed to reach the proposed goal. The number of errors was calculated through the number of norm violations during the task.

3.5. Procedure

This is a longitudinal study, this means that children were evaluated at two different time points: when they were five years old, and they were attending Pre-Kindergarten (October to December 2013), and then, when they were seven years old and were attending the first grade of primary school (September to November 2015). This study took place in Linares, Chile. The academic year in Chile starts in March and ends in mid-December. The gap between the first and second time points was almost two years.

In October of 2013, meetings were held to discuss the aims of the study with the schools who had agreed to participate. In these meetings the researcher, head teacher, and Pre-Kindergarten teachers participated. Head teachers and teachers signed a consent form to confirm the participation in this research. Once the meetings were held, each of the Prekindergarten teachers received a copy of a Consent form for the participants' parents. The consent form included a brief sheet of Questions and Answers in order to show the objectives of the study and what the benefits of participating in this study would be. The consent form also included a contact section, where a parent could communicate their queries about the study directly to the researcher. Only children whose parents signed the Consent form took part in the study.

Schools provided a place for the test administration and an assistant that helped the primary researcher. In addition, children were asked to agree or not to participate in this study, and only those who confirmed their participation verbally were evaluated. At both time points children were evaluated individually in two separate sessions, with 2 weeks of difference. In the first session of time 1, children participated in 10 different tasks, while in the second session 4 tasks related to phonological awareness and letter knowledge were administered. In the first session of time 2, 14 tasks were administered, while those 4 tasks, mainly those related to reading, were administered in the second session. At the end of the second session, each child received a small gift for their participation. At time 1 they received a London pencil and at time 2 they received a London wrist band. The order of presentation and an estimation of the administration times are presented, in table 13.

Table 13. Tasks and times in each of the times

Times	Session	Order	Tasks	Time (min) approx.
Time 1	First	1	Block building	10
		2	Semantic fluency test (animals)	1
		3	Sentence repetition	4
		4	Non-word repetition	3
		5	Analogical reasoning – Verbal	6
		6	Analogical reasoning – Non Verbal	6
		7	Rapid automatic naming – colours	2
		8	Rapid automatic naming – objects	2
		9	Categorical flexibility	6
		10	Blicket detector task – One/two conditions	10
		11	Receptive vocabulary	15
	Second	1	Syllable segmentation	3
		2	Phoneme isolation – vowels	2
		3	Phoneme isolation – consonants	2
		4	Letter knowledge	5
Time 2	First	1	Semantic fluency test (animals)	2
		2	Phonological fluency test (F/A/S)	4
		3	Analogical reasoning – Verbal	4
		4	Analogical reasoning – Non Verbal	4
		5	Phoneme isolation (initial)	3
		6	Receptive vocabulary	10
		7	Tower of Hanoi	7
		8	Picture-word matching	3
		9	One-minute reading	1
		10	Letter knowledge	5

	11	Phoneme isolation (final)	3
	12	Phoneme blending	6
	13	Rapid automatic naming – digits	1
	14	Rapid automatic naming – letters	1
Second	15	Word reading	4
	16	Non-words reading	4
	17	Word/phrase comprehension	15
	18	Text comprehension	20

3.5.1 Ethical issues

Ethical approval was given by the Department of Psychology and Human Development of the UCL Institute of Education. This study followed the principles of the Code of Ethics of the College of Psychologists of Chile. This study has been conducted based on the principles of willingness, anonymity, non-discrimination, and child protection. All tasks were designed and adapted to ensure that nobody, at any time, was adversely physically or psychologically affected. All children who took part in the study were tested in a room at their school. They were informed that in case of experiencing discomfort, they could return to a safe place, for instance, their classrooms. Children were informed that they could leave the room at any time without providing information about this action. Children could take breaks when they felt tired.

One of the concerns about the test administration with children of this age, especially those coming from low SES backgrounds, was that they might not fully understand the tasks. To avoid this problem, most of the tests were designed in a non-verbal format task, or with very limited verbal interactions. In terms of child protection, the researcher was assisted by one member of the staff in each of the schools. The room where the tests were administered was always open, in order not to frighten the children, and to give transparency regarding the way in which tests were administered. Once data was collected, the names of students, parents, teachers, and schools were replaced by codes in order to keep the whole process anonymous.

Regarding the ethical issues related to the data analysis, only the primary researcher and his supervisors shared the information of this study. In the database, children's names were replaced by codes; therefore, it is not possible to associate the results of any task with a given participant.

3.6. Data analysis

Due to the nature of the research questions, this study is framed in a quantitative model, based on a longitudinal approach. The interest is attempting to understand the processes and trajectories that two groups of children (from low and high SES) exhibit when starting to read. In the first stage (prekindergarten), the interest was to assess traditional and non-traditional reading predictors, while in the second stage, the interest was to determine the reading performance in both groups.

The data was analysed at three different levels: descriptive, comparative, and predictive. Descriptive analyses included some typical tools such as those from measures of central tendency like Mean, Median, and Mode. Comparative analyses included the t-test, ANOVA and regression tools. The p-value was established as 0.05 for rejecting null hypothesis. Predictive analyses included some simple and multiple linear regressions and considered students' performance at both test times.

In addition to the test batteries that were administered, a parental survey of the family environment was also included. The results of this survey are presented in descriptive and comparative terms mainly.

Chapter 4: Results of home literacy environment survey

In this chapter, some descriptive and comparative data from the Encuesta Sobre Ambiente Familiar Preescolar (*Family Environment Survey - Preschooler*) (Romero-Contreras, 2006) are presented. This survey aimed to investigate how the home experiences of children from low and high SES might differ, particularly in those aspects that are relevant to reading acquisition. The survey was originally designed to evaluate some language- and literacy-related characteristics of Mexican families with children attending Kindergarten. This scale has been called Encuesta sobre Ambiente familiar – EAF (*Family Environment Survey)*.

This current version of EAF was previously administered to two hundred and forty-seven families living in San Jose, Costa Rica. The results showed that families from different socio-economic status exhibited a range of behaviors and features in the four section of the survey: socio-cultural characteristics of the families, parental support for language, direct and indirect literacy and schooling, and parents' aspiration and expectations for their children.

The survey had been administered in the Chilean context for the Un buen comienzo (*A good start*) project. This intervention designed by the School of Education, of Harvard University and administered by the Fundacion Oportunidad (*Opportunity foundation*). The survey administered on that project shows adequate levels of validity and consistency, as it has been stated in the study conducted by Rivadeneira (2011). The author, however, highlights two challenges in the use of EAF survey: difficulty in responding questions, length of the survey, and social desirability. Rivadeneira (2011) states that the questions of this survey, as other similar ones evaluating Home Literacy Environment, are often difficult to understand, or they do not always express accurately the occurrence of behaviors. In addition, the author states that EAF takes long time to be responded, which could affect the accurateness of the results. Finally, social desirability biases could affect the results in terms of underestimating and overestimating some of the evaluated aspects included in the survey. However, these self-reports, at the same time allow the researcher to gather information from a range of language and literacy beliefs and behaviors (Sénéchal et al., 1998).

In this study, the survey was piloted with five families. This pilot section showed that some expressions must be adapted to the Chilean context, particularly to the features of the people living in Linares, the city in which the study took place. These changes were included in the final version of the survey. Nutritional and sleep patterns were also included at the end of the instrument administered in the current study.

In the Chilean context, parents often attend once per month to a parent meeting at schools. These meetings are conducted by the head teacher, and who report some learning-and-teaching aspects, and some practical issues inside the classroom. The main researcher attended to these parents' meeting, and parents were invited to fill out the survey. 97 parents out of 133 families filled out the survey (73.0%). The rest of parents did not attend the meeting, or they were not likely to respond the survey. Six parents (from low SES group) were illiterate adults. In these cases, both the teacher and the researcher helped to these parents to fill the survey. The surveys were completed at time 1 of the study, this is, in the month of November of 2013.

The internal consistency of the survey was calculated by using the Cronbach alpha and it was estimated for the total number of items. The EAF survey shows a high level of internal consistency, with a Cronbach alpha value of 0.77. The Cronbach alpha for the subscales are: socio-cultural characteristics of the families (i.e. number of items at home, parent educational attainment, number of people living at home, etc). (0.44), parental support for language (0.74), direct and indirect literacy and schooling (0.88), and parents' aspiration and expectations for their children (0.65). Parental support, and direct and indirect literacy and schooling scales show adequate levels of internal consistency. Parent's aspiration and expectations for their children appear to be close to the expected value.

4.1. General background

This section includes some general aspects regarding the number of people living at home and the number of home appliances. The section also includes some features related to parents' educational attainment, family income, and parent's occupation.

4.1.1. People living with the student

Table 14 summarises the data related to the number of siblings that each student has.

Table 14. Number of siblings

	How many siblings does the student have?
Mean (SD)	1.7 (1.6)
N	88
Minimum	0
Maximum	9
Low SES. Mean (SD)	2.2 (2.1)
High SES. Mean (SD)	1.2 (1.0)
N Low SES / N High SES	41/47
p-value	0.004

The number of siblings who belongs to this sample shows a significant difference when comparing children from low and high SES (t_{86}= 2.926; p= 0.004). The results also show that, on average, children from low SES have 1.2 brothers and 1.0 sister, while children from high SES have 0.66 brothers and 0.55 sisters.

The survey also asked about the responsible adult(s) that the students live with. The results are summarised in Table 15.

Table 15. Caregivers the students live with

	Overall n=97 (%)	Low SES n=48 (%)	High SES n=49 (%)
Both parents	77.3	62.4	91.8
Only with mother	17.5	29.2	6.2
Only with father	1.0	2.1	0.0
Another family member	4.2	6.3	2.0

Regarding the question "With whom the student lives", the results show that most students live with both parents (77.3%). While 62.4% of the students from low SES live with both parents, the number is higher in the case of high SES students, of whom 92% live with both parents.

In the case of children who do not live with both parents, most of them live with their mother (17.5%). The proportion of children who live with just their mothers in the low SES group (29.2%) is almost five times the group of high SES (6.2%).

4.1.2. Home appliances

The survey also asked about the presence or absence of 10 home appliances. These were: TV, shower, fridge, washing machine, boiler, microwave, car, cable TV, Computer/laptop, Internet/Wi-Fi. The presence or absence of these articles is summarised in Table 16.

Table 16. Home appliances

	Overall n=96 (%)	Low SES n=48 (%)	High SES n=48 (%)
TV	97.0	94.0	100.0
Shower	97.9	96.0	100.0
Fridge	97.0	94.0	96.0
Washing machine	98.0	96.0	100.0

Boiler	61.1	29.2	94.0
Microwave	80.0	60.4	98.0
Car	65.3	38.0	94.0
Cable TV	76.0	56.3	96.0
Computer/laptop	74.0	54.2	94.0
Internet/Wi-Fi	55.0	23.0	87.2

Each article was coded with 0 and 1 to indicate its presence or absence. The numbers were then summed and compared according SES (see Table 17).

Table 17. Home appliances – Mean and comparison

	Home appliances
Mean (SD)	7.9 (2.3)
N	96
Minimum	1
Maximum	10
Low SES. Mean (SD)	6.4 (1.8)
High SES. Mean (SD)	9.4 (1.6)
N Low SES / N High SES	48/48
p-value	< 0.001

The results of this scale show significant difference when comparing low and high SES groups (t_{94}= 8.837; p< 0.001). This difference is in favor of the high SES group. They reached a mean total of score of 9.4 out of 10, while the low SES group just reached 6.4 out of 10.

4.1.3. Parents' occupation

Parents were asked about their occupations. The results of this question are presented when comparing low and high SES groups in the table 18.

Table 18. Parents´ occupation according to SES

	Mother´s occupation		Father's occupation	
	Low SES (%) n=42	High SES (%) n=45	Low SES (%) n=27	High SES (%) n=40
Stay-at-home parent	43.0	13.3	3.8	0
Student	7.1	2.2	0.0	2.5
Non-professional occupations	45.1	11.1	74.0	12.5
Professional	0	71.2	0	67.5
Other	4.8	2.2	22.2	17.5
Total	100	100	100	100

Non-professional occupations included those in the farming, retail, cleaning, construction, and service industries, whereas professional occupations included those in education, medicine, management, and law. More mothers in the low SES group worked at home, when compared to the high SES group, while none of the mothers or fathers from the low SES group were employed in professional occupations.

4.1.4. Parents' educational attainment

The data collected from the survey shows disparities in terms of educational attainment when comparing families from low and high SES (see table 19).

Table 19. Parents’ educational attainment

Attainment level (or some years of)	Mother´s educational attainment		Father´s educational attainment	
	Low SES n=44 (%)	High SES n=46 (%)	Low SES n=30 (%)	High SES n=44 (%)
Primary	34.1	0.0	43.3	0.0
Secondary	45.4	10.9	50.0	13.7
Tertiary education	15.9	19.6	6.7	13.7
Under/Postgraduate	4.6	69.5	0.0	72.6
Total	100	100	100	100

In Table 7, data on the parents’ highest educational level is presented. Strikingly, while more than two-thirds of the mothers and fathers in the high SES group had been educated at an undergraduate or postgraduate level, only one mother in the low SES group reached undergraduate studies (although she did not finish her degree).

4.2. Family-school relationship

4.2.1. Expectations

Several questions were asked about how families relate to their child’s school. Two of the questions were related to the expectations in terms of the educational attainment that they would *like* for their child and the educational attainment that they *expect* for their child. These questions included five possible options from primary to higher education. The results presented in Table 20, did not show significant differences when low and high SES are compared in the question regarding the maximum educational attainment that parents would *like* their children to reach (t_{93}: 1.936, p= 0.056). However, there is a significant difference regarding the level of educational attainment that parents actually *expect* their children to be able to reach (Low SES $\bar{x}$=: 4.3; High SES $\bar{x}$=: 5.0; t_{90}: 4.081, p< 0.001). In other words, low SES parents expect a lower level of education from their children than the one they would like them to achieve (see table 20).

Table 20. Expectations about maximum educational attainment

		Values (1= Primary; 5= Undergraduate)
Maximum educational attainment that parents *would like* their children to reach	Overall (n=95)	4.9
	Low SES (n=46)	4.8
	High SES (n=49)	5.0
Maximum educational attainment that parents *expect* their children to reach *	Overall (n=92)	4.6
	Low SES (n=45)	4.3
	High SES (n=47)	5.0

* $p < 0.05$. Significant differences based on t-test.

4.2.2. Beliefs and attitudes of parents regarding school

One of the questions asked whether the parents had attended a meeting with the teacher during the school year. 95.8% of them had done so. The survey presented parents six possible topics which they might have discussed with the teacher. They were asked to tick all the options that apply. These options were "how their child is doing in school", "nonattendances", "discipline at school", "discipline at home", "how to provide learning support for their child at home" and "materials required for the child“. The results presented in Table 21, show that two of these aspects are related with SES [χ^2 (1, N = 95) = 9.856, p = 0.002]. A larger proportion of parents from low SES families (85.0%) report being asked more often about discipline at school in comparison to families from high SES (55.1%). The second aspect refers to those questions related to the kind of materials that are required for the child at school, in which SES is associated with this aspect [χ^2 (1, N = 95) = 4.522, p = 0.027]. Low SES families talk about these topics more often than high SES families (54.3% versus 33.0%)

Table 21. Conversation topics between teacher and parents

	Overall % (n=95)	Low SES % (n=46)	High SES % (n=49)
How their child is doing in school	86.3	89.1	84.0
Nonattendances	26.3	33.0	20.4
Discipline at home *	70.0	85.0	55.1
Discipline at school	44.2	50.0	39.0
How to provide learning support	59.0	57.0	61.2
Materials required for the child *	43.2	54.3	33.0
Other	13.2	4.4	22.0

* $p < 0.05$. Significant associations based on Chi squared and Fisher exact tests

4.2.3. Who is responsible for teaching skills: school or home?

Several questions presented in a Likert scale of five points, were given in order to evaluate parents' views about certain skills, abilities and knowledge that children should acquire in their early childhood (e.g. Who do you think is responsible for encouraging the students to help the environment?). The Likert scale presented a range between 1 to 5, where 1 means "School responsibility" and 5 "Home responsibility". Only one of the eleven questions showed a significant difference when comparing children from low and high SES (see Table 22). The question was "Who do you think is responsible for the students' ability to learn how to express themselves clearly? The results show that low SES families believe that this is a skill that should be taught at home, while high SES families believe that this skill should be taught at school.

Table 22. Conversation topics between teacher and parents

Who do you think is responsible for the students' (1= home; 5 school)	Overall (n=95)	Low SES (n=46)	High SES (n=49)
ability to learn how to express themselves clearly	2.0	1.8	2.3
learn to relate to others	2.3	2.2	2.4
learn to be disciplined	2.0	1.8	2.1
learn to organise themselves	2.0	1.8	2.1
learn to respect the environment	2.5	2.5	2.5
interest in what happens around	2.4	2.5	2.4
achieve knowledge and information	3.6	3.6	3.6
interest about reading and writing	2.9	2.8	3.1
learn to read and write	3.4	3.4	3.4
interest in math	3.5	3.6	3.4
learn basic operations in math	3.6	3.7	3.6

4.2.4. When should skills be taught?

Parents were asked about when certain skills should be taught. Four options were presented (Prekindergarten, Kindergarten, first year of primary, and "do not know"). Table 23 summarises the results of this scale.

Table 23. When should students learn these activities?

	Pre-K (%)	Kinder (%)	1st year (%)	Don't know (%)
Identifying left and right				
Total SES (n=96)	93.8	6.3	-	-
Low SES (n=47)	89.4	10.6	-	-
High SES (n=49)	98.0	2.0	-	-
Appreciating books and stories				
Total SES (n=94)	72.3	19.1	8.5	-
Low SES (n=47)	61.7	25.5	12.8	-
High SES (n=47)	83.0	12.8	4.3	-

Knowing letters and their sounds				
Total SES (n=93)	81.7	18.3	-	-
Low SES (n=44)	90.9	9.1	-	-
High SES (n=49)	73.5	26.5	-	-
How words are written				
Total SES (n=93)	37.6	46.2	16.1	-
Low SES (n=46)	56.5	37.1	4.3	-
High SES (n=47)	19.1	53.2	27.7	-
Reading words and phrases				
Total SES (n=95)	14.7	50.5	32.6	2.1
Low SES (n=47)	23.4	59.6	12.8	4.3
High SES (n=48)	6.3	41.7	52.1	-
Writing short messages				
Total SES (n=91)	12.1	36.3	49.5	2.2
Low SES (n=43)	20.9	32.6	44.2	4.3
High SES (n=48)	14.6	22.9	60.4	-
Numbers and simple operations with numbers				
Total SES (n=93)	28.0	29.0	41.9	1.1
Low SES (n=45)	35.6	20.0	42.2	2.2
High SES (n=48)	20.8	37.5	41.7	-
Reading and understanding shorts readings				
Total SES (n=94)	24.5	26.6	45.7	3.2
Low SES (n=46)	28.3	23.9	43.5	4.3
High SES (n=48)	20.8	29.2	47.9	2.1
Writing words and short messages				
Total SES (n=91)	17.6	27.5	52.7	2.2
Low SES (n=43)	18.6	41.9	37.2	2.3
High SES (n=48)	6.3	31.3	60.4	2.1
Respecting the rules of games				
Total SES (n=94)	84.0	9.6	5.3	1.1
Low SES (n=46)	76.1	10.9	10.9	2.2
High SES (n=48)	91.7	8.3	-	-
Sorting sequences in a story				
Total SES (n=92)	71.7	14.1	13.0	1.1
Low SES (n=44)	61.4	25.5	12.8	2.3
High SES (n=48)	81.3	12.8	4.3	-

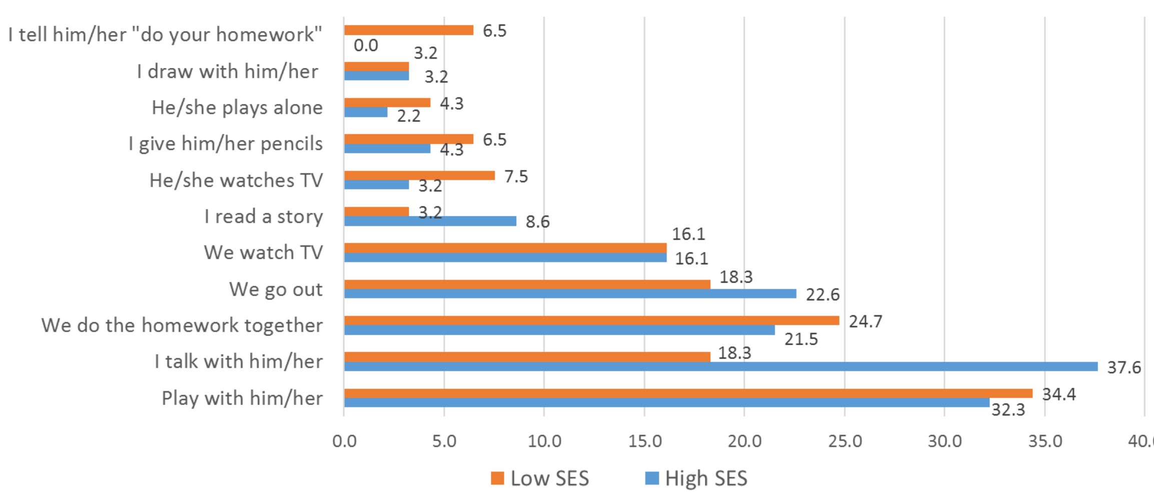
The results show that a larger proportion of parents believe that identifying left and right, appreciating books and stories, knowing letters and their sounds, respecting the rules of the games and sorting sequences in a story, should be taught in Prekindergarten.

Parents believe that in the case of those activities related with basic reading and writing, such as promoting how words are written, and writing and reading words and phrases, should be taught in Kindergarten. They also believe that those more advanced tasks related to writing and reading comprehension should be taught in the first year of primary. These activities include writing words and short messages, reading and understanding short texts, and knowing numbers and simple operations.

4.3. Home literacy environment

Several questions were asked to evaluate different components about the relation between parents and children regarding literacy activities. One of the questions dealt with the frequent activities that parents do when they have at least 20 minutes to spend with their children. Parents were asked to select the three most frequent options from a list of twelve possible alternatives. Graph 1 summarises the options distributed into SES groups. The analysis show similar values between low and high SES groups.

Graph 1. When you have 20 minutes to share with your child



The next question deals with the frequency with which parents helped their children write letters and numbers, reading and identifying letters and numbers, and finally the frequency with which they talk about some special event with their children (see table 24).

Table 24. Frequency of literacy and numeracy activities done by parents and children

		Never or almost never (%)	1 or 2 times per month (%)	1 or 2 times per week (%)	3 or more times per week (%)
Writing letters and numbers	Overall (n=94)	1.1	8.5	45.7	44.7
	Low SES (n=45)	0.0	6.7	42.2	51.1
	High SES (n=49)	2.0	10.2	49.0	38.8
Identifying letters and numbers	Overall (n=94)	2.1	2.1	42.6	53.2
	Low SES (n=45)	2.2	2.2	40.0	55.6
	High SES (n=49)	2.0	2.0	44.9	51.0
Talking about a special event in the past	Overall (n=94)	5.3	8.5	23.4	62.8
	Low SES (n=45)	8.9	13.3	22.2	55.6
	High SES (n=49)	2.0	4.1	24.5	69.4

The results of this question show that there were not significant associations in terms of frequency when comparing low and high SES regarding writing letters and numbers (t_{92}=1.427, p= 0.157), nor regarding identifying letters and numbers (t_{92}= 0.295, p= 0.768). High SES parents report talking more often about a special event than low SES families, and this difference is significant (t_{92}=2.104, p= 0.038).

Parents were also asked about their children's playing preferences. These preferences were listed in a Likert scale, and for each of them, parents were asked to indicate the option that best represents the student's preference. The scale had five options, where 1 meant "do not like" and 5 meant "like". The results of this scale are summarised in the table 25.

Table 25. What option represents the preferences of your daughter/son

	Overall (n=91)	Low SES (n=43)	High SES (n=48)
Puzzle	4.3 (1.2)	4.3 (1.3)	4.3 (1.2)
Blocks to assemble	4.3 (1.1)	4.4 (1.2)	4.3 (1.0)
Crayons	4.4 (1.0)	4.6 (0.9)	4.3 (1.0)
Bicycles, balls	4.3 (1.0)	4.5 (1.0)	4.2 (1.1)
Home role play toys: dishes, spoons	3.4 (1.7)	3.7 (1.7)	3.2 (1.6)
Pencils for writing	4.1 (1.2)	4.1 (1.2)	4.0 (1.2)
Action toys	3.8 (1.3)	4.0 (1.3)	3.7 (1.3)
Radio, DVD for music	3.5 (1.5)	3.6 (1.5)	3.4 (1.5)
Computer games *	3.6 (1.6)	3.1 (1.8)	4.1 (1.3)
Words for rhyming *	3.1 (1.5)	2.6 (1.6)	3.5 (1.2)
Mobile phone / ipad / iphone *	3.6 (1.6)	3.2 (1.7)	3.9 (1.4)
Notebook / Computer *	3.5 (1.6)	3.1 (1.8)	3.8 (1.3)

* $p < 0.05$. Significant differences based on t-test.

Parents reported that the preferred activities for their children were to draw with pencils, puzzles, blocks to assemble, and use bicycles and balls, were the preferred activities, while home role play and words for rhyming were their least preferred activities. There were significant differences by SES in the preferences for making rhymes in favour of high SES group (t_{86}= 3.233, p= 0.002). The rest of the differences seem to be related with the use of technological appliances at home. Children from high SES families seem to be likely to enjoy these activities in a higher proportion than children from low SES families, although these differences could be explained by the availability of these appliances at home. Differences appeared in the items of computer games (t_{83}= 2.892, p= 0.005), using mobile phone/Ipad/Iphone (t_{81}= 2.024, p= 0.046) and using notebook/computer (t_{81}= 2.179, p= 0.032).

4.3.1. Verbal interactions

Parents were asked about the frequency of verbal interactions that the children hold with adults and their peers. The question also included the person who started the interactions. The results of these questions are summarised in Table 26.

Table 26. Verbal interactions

		Never (%)	Sometimes (%)	Always (%)
Adults talk with other adults	Overall (n=91)	1.1	24.2	74.7
	Low SES (n=44)	2.3	36.4	61.4
	High SES n=47	0.0	12.8	87.2
Adults talk with children	Overall (n=94)	0.0	20.2	79.8
	Low SES (n=45)	0.0	31.1	68.9
	High SES (n=49)	0.0	10.2	89.8
Children talk with other children	Overall (n=89)	2.2	23.6	74.2
	Low SES(n=43)	2.3	34.9	62.8
	High SES (n=46)	2.2	13.0	84.8
Children look for adults to talk	Overall (n=88)	3.4	26.1	70.5
	Low SES (n=41)	4.9	36.6	58.5
	High SES (n=47)	2.1	17.0	80.9
Adults tell stories to children	Overall (n=90)	5.6	35.6	58.9
	Low SES (n=43)	11.6	44.2	44.2
	High SES (n=47)	0.0	27.7	72.3
Adults tell stories to other adults	Overall (n=87)	9.2	27.6	63.2
	Low SES (n=40)	17.5	27.5	55.5
	High SES (n=47)	2.1	27.7	70.2

The results of these questions show that in four out of six evaluated aspects a larger proportion of high SES families choose the category ‘always’ compared to their peers from low SES. These statements are: “Adults talk with other adults”, “Adults talk with children”, “Adults tell stories to children”, “Adults tell stories to other adults”.

4.3.2. Family activities

One of the questions evaluated the frequency of activities that both adults and children do together. The list of activities was presented in separated columns: one for adults and one for children. Each activity was evaluated in terms of frequency, eliciting three options a) Never, b) Sometimes and c) Always. The summary of the results is presented in the Table 27.

Table 27. Activities that families do together

		Adults			Children		
		Never (%)	Some times (%)	Always (%)	Never (%)	Some times (%)	Always (%)
Write shopping lists	Overall (n=94)	26.6	33.0	40.4	70.7	25.3	4.0
	Low SES (n=45)	37.8	35.6	26.7	77.1	17.1	5.7
	High SES (n=49)	16.3	30.6	53.1	65.0	32.5	2.5
Fill diaries with addresses and phone numbers	Overall (n=93)	47.3	11.8	40.9	84.5	12.7	2.8
	Low SES (n=45)	57.8	15.6	26.7	88.2	5.9	5.9
	High SES (n=48)	37.5	8.3	54.2	81.1	18.9	0.0
Read newspapers /magazines	Overall (n=94)	21.3	50.0	28.7	44.0	41.3	14.7
	Low SES (n=45)	40.0	48.9	11.1	4.1	51.0	44.9
	High SES (n=49)	4.1	51.0	44.9	48.6	42.9	8.6
Read books suggested by school	Overall (n=88)	5.7	54.5	39.8	11.8	47.4	40.8
	Low SES (n=39)	10.3	69.2	20.5	16.7	61.1	22.2
	High SES (n=49)	2.0	42.9	55.1	7.5	35.0	57.5
Read novels or stories	Overall (n=92)	13.0	60.9	26.1	18.1	44.4	37.5
	Low SES (n=43)	20.9	65.1	14.0	25.0	46.9	28.1
	High SES (n=49)	6.1	57.1	36.7	12.5	42.5	45.0
Consult dictionaries and encyclopedia	Overall (n=91)	35.2	48.4	16.5	60.5	27.6	11.8
	Low SES (n=43)	53.5	32.6	14.0	72.2	16.7	11.1
	High SES (n=48)	18.8	62.5	18.8	50.0	37.5	12.5
Write letters and/or cards	Overall (n=92)	45.7	43.5	10.9	59.5	25.7	14.9
	Low SES (n=44)	61.4	27.3	11.4	61.1	25.0	13.9
	High SES (n=48)	31.3	58.3	10.4	57.9	26.3	15.8
Check bills or documents	Overall (n=91)	19.8	26.4	53.8	86.3	9.6	4.1
	Low SES (n=42)	61.4	27.3	11.4	61.1	25.0	13.9
	High SES (n=49)	31.3	58.3	10.4	57.9	26.3	15.8
Check budget	Overall (n=94)	29.8	24.5	45.7	94.3	1.4	4.3
	Low SES (n=45)	23.8	31.0	45.2	80.0	11.4	8.6

	High SES (n=49)	16.3	22.4	61.2	92.1	7.9	0.0
Use computer / Notebook	Overall (n=92)	27.2	18.5	54.3	35.5	35.5	28.9
	Low SES (n=43)	35.6	26.7	37.8	88.2	2.9	8.8
	High SES (n=49)	24.5	22.4	53.1	100	0.0	0.0

In eight out of ten proposed activities that families do together, particularly at the adult level, high SES families report doing these proposed activities more frequently in comparison with their peers from low SES, in the category 'always'. These activities include "Writing shopping lists" [Adults: 53.1% (high SES) versus 26.7% (low SES)], "Filling diaries with addresses and phone numbers" [Adults: 54.2% (high SES) versus 26.7% (low SES)], "Reading newspapers and magazines" [Adults: 44.9% (high SES) versus 11.1% (low SES)], "Reading books suggested by school" [Adults: 55.1% (high SES) versus 20.5% (low SES)], "Reading novels or stories" [Adults: 36.7% (high SES) versus 14.0% (low SES)], "Consulting dictionaries and encyclopedias" [Adults: 18.8% (high SES) versus 14.0% (low SES)], "Checking bills or documents" [Adults: 10.4% (high SES) versus 11.4% (low SES)], and "Using computer/netbook" [Adults: 53.1% (high SES) versus 37.8% (low SES)]. At children level, the items responses should be taken with caution. At a first glance, it seems that social desirability, in at least two points: firstly, this survey was administered when children attended preschool (5 years old), and they were unable to read. However, in the statement "Read newspapers /magazines", families from low SES reported that almost a half of the sample 'always' read newspapers or magazines (44.9%), when none of them actually was able to read. Therefore, the statements in the children category do not seem to be trusty.

4.3.3. Attitudes towards literacy

The survey also included one question related to attitudes towards literacy. Specifically, parents were asked about their levels of agreement regarding several statements of reading, writing and basic math operations. The summary of the results is shown in table 28. Each item included a Likert scale from 1= Strongly agree to 5= Strongly disagree.

Table 28. To what extent do you agree or disagree with each of the following statements?

	Overall	Low SES	High SES
Reading novels is one of my favourite hobbies	3.2 (1.5)	3.7 (1.6)	2.8 (1.2)
Writing letters is one of my favourite hobbies	3.7 (1.4)	3.7 (1.5)	3.8 (1.3)
I read just when is compulsory to do it	3.1 (1.6)	2.6 (1.7)	3.5 (1.4)
Learn to read and write was difficult to me	3.6 (1.6)	3.2 (1.7)	4.0 (1.5)
If I had more time, I would read more often	2.3 (1.5)	2.5 (1.5)	2.0 (1.4)
When I read, I find lot of incomprehensible words	3.5 (1.5)	3.1 (1.6)	3.9 (1.3)
I would like to buy more books, but they are expensive	2.6 (1.6)	2.3 (1.6)	2.9 (1.6)
My job requires that I read frequently	3.0 (1.7)	3.6 (1.7)	2.5 (1.5)
My job requires that I write frequently	2.8 (1.7)	3.2 (1.9)	2.4 (1.5)
My job requires that I add and subtract frequently	2.9 (1.7)	3.4 (1.6)	2.5 (1.6)
I would like my child to be a fan of reading	2.0 (1.4)	2.0 (1.4)	2.0 (1.3)
I would like my child to write stories or poems	2.0 (1.3)	1.8 (1.2)	2.2 (1.3)
Writers are people with special talent	2.1 (1.4)	2.1 (1.4)	2.2 (1.4)

The results show large differences in seven out of thirteen statements. These differences are around one point. These statements are “Reading novels is one of my favorite hobbies” (Low SES= 3.7, High SES= 2.8), “I read only when it is compulsory to do it” (Low SES= 2.6, High SES= 3.5), “Learn to read and write was difficult to me” (Low SES= 3.2, High SES= 4.0), “When I read, I find lot of incomprehensible words” (Low SES= 3.1, High SES= 3.9), “My job requires that I read frequently” (Low SES= 3.6, High SES= 2.5), “My job requires that I write frequently” (Low SES= 3.2, High SES= 2.4), and “My job requires that I add and subtract frequently” (Low SES= 3.4, High SES= 2.5).

4.3.4. Frequency of shared reading

4.3.4.1. Book reading

In the question that dealt with the frequency with which parents read books with their children, four options were presented 1) Never, or almost never, 2) 1 or 2 times per month, 3) 1 or 2 times per week 4) 3 or more times per week. The results show significant differences between families from low and high SES. While low SES families reported a mean of 2.3 (1.0), high SES families reported a score of 2.9 (0.9).

4.3.4.2. Other literacy activities

The use of house elements as part of literacy activities was also surveyed. The questions included for instance, "how often do you name objects from newspapers or magazines with your child?". Each of the statements was coded with five different values 1) Never, 2) Almost never, 3) Sometimes, 4) Often 5) Always. The results of this scale are presented in Table 29. Each item included a Likert scale with five options (1= Never, 2= Almost never, 3= Sometimes, 4= Often, and 5= Always).

Table 29. You or other adult in your family participate in activities such as:

	Overall (n=95)	Low SES (n=47)	High SES (n=48)
Using plastic or magnetic letters	2.2 (1.2)	2.0 (1.2)	2.4 (1.2)
Reading letters from packages (e.g. sugar, coffee) *	3.7 (0.9)	3.5 (0.9)	3.9 (0.9)
Writing the name of the child	4.2 (1.0)	4.2 (0.9)	4.3 (1.1)
Writing the alphabet letters	3.2 (1.1)	3.0 (1.1)	3.4 (1.2)
Drawing lines and circles	4.0 (1.0)	3.8 (1.0)	4.1 (1.0)
Drawing or painting	4.4 (0.8)	4.2 (0.8)	4.5 (0.7)
Naming objects from newspapers or magazines *	4.0 (1.0)	3.6 (1.2)	4.3 (0.7)

In only one of these seven activities large difference was found in favor of the high SES group. The activity is "Naming objects from newspapers or magazines" (Low SES= 3.6, High SES= 4.3).

4.3.4.2. Literacy materials at home

Parents were asked about some literacy products that they had acquired in the last month. The question was coded with four different values (none, 1 to 5, 6 to 10, and 11 or more). The results are presented in Table 30.

Table 30. In the last month, did you acquire anything for your home?

		None (%)	1 to 5 (%)	6 to 10 (%)	11 or more (%)
Books **	Overall (n=73)	52.1	41.1	2.7	4.1
	Low SES (n=32)	75.0	15.6	6.3	3.1
	High SES (n=41)	34.1	61.0	0.0	4.9
Magazines **	Overall (n=76)	39.5	51.3	5.3	3.9
	Low SES (n=36)	52.8	38.9	2.8	5.6
	High SES (n=40)	27.5	62.5	7.5	2.5
Newspapers	Overall (n=75)	36.0	46.7	9.3	8.0
	Low SES (n=34)	64.7	26.5	5.9	2.9
	High SES (n=41)	12.2	63.4	12.2	12.2
Copybooks	Overall (n=70)	47.1	44.3	4.3	4.3
	Low SES (n=32)	56.3	34.4	3.1	6.3
	High SES (n=38)	39.5	52.6	5.3	2.6
Pencils or pens	Overall (n=81)	25.6	54.9	11.0	8.5
	Low SES (n=39)	30.8	53.8	10.3	5.1
	High SES (n=42)	20.9	55.8	11.6	11.6
Crayons *	Overall (n=81)	24.7	55.6	8.6	11.1
	Low SES (n=37)	40.5	37.8	10.8	10.8
	High SES (n=44)	11.4	70.5	6.8	11.4

* $p < 0.05$ ** $p < 0.01$. Significant associations based on Chi squared and Fisher exact tests

These results show an association between SES and the number of books, newspapers, and crayons acquired in the last month for the families. In the case of books, three quarters of the respondents from low SES families indicated that they had not purchased books in the last month, while only 34.1% of the high SES families were in the same situation. It was possible to find an association between the number of purchased books and SES [χ^2 (3, N=73) =17.454, $p < 0.001$]. Newspapers also show differences when comparing families from low and high SES. 64.7% of low SES families did not purchase a newspaper in the last month. This proportion is five times less in the case of high SES families (12.2%). This association is significant [χ^2 (3, N=75) =22.456, $p < 0.001$]. Finally, in the case of crayons, the situation is the same with 40.5% of low SES families that did not purchase these types of pencils, while only 11.4% of high SES families did not purchase them. There is a relation between the amount of pencils purchased in the last month and the families' SES [χ^2 (3, N=81) =11.155, p = 0.011].

4.3.4.3. Books at home

The two last questions about home literacy environment included the number of books that they have at home. The question was divided into adults' books or classic books, such as, novels, fictions, etc. and children's books such as comics, children stories, etc. The summary of both questions is presented in the table 31.

Table 31. How many books do you have at home?

		No books (%)	1 to 5 (%)	6 to 10 (%)	11 to 15 (%)	16 to 30 (%)	31 to 50 (%)	More than 50 (%)
Adults' books **	Overall	13.8	19.1	16.0	10.6	10.6	11.7	18.1
	Low SES	25.5	31.9	14.9	4.3	14.9	4.3	4.3
	High SES	2.1	6.4	17.0	17.0	6.4	19.1	31.9
Children's books **	Overall	7.4	19.1	23.4	14.9	19.1	6.4	9.6
	Low SES	15.2	34.8	28.3	13.0	4.3	4.3	0.0
	High SES	0.0	4.2	18.8	16.7	33.3	8.3	18.8

**$p < 0.01$. Significant associations based on Chi squared and Fisher exact tests

In terms of adults' books, there is a significant difference when comparing families from low and high SES [χ^2 (6, N=94) =36.970, $p < 0.001$]. While more than 72.0% of the low SES families have fewer than 10 books at home, this proportion is significantly lower in the case of high SES families (25.5%).

In the case of children's books, a significant difference also appeared when comparing families from low and high SES [χ^2 (6, N=94) =39.433, $p < 0.001$]. 78.3% of the low SES families have fewer than 10 children's books at home, while the percentage in the case of high SES families is just 23.0%.

4.4. Nutritional and sleeping patterns

4.4.1. Nutritional patterns

Several questions were asked to evaluate the children's eating and sleeping habits. Regarding eating, parents were asked about what times children eat at home. The question had three possible options: a) Children eat at the same time every single day b) Children have a fixed schedule but just for some foods and c) Children do not have a fixed schedule for eating. The question showed an association with SES [χ^2 (2, N=91) =15.135, p< 0.001]. No high SES families versus 23.3% of low SES families reported that their children did not have a fixed schedule for eating.

Regarding nutritional status, parents were asked to report their children's current status. The question included five different options a) Malnutrition b) Risk of malnutrition c) Normal weight d) Overweight e) Obesity f) Do not know. Descriptive results are presented in table 32.

Table 32. Nutritional status (Percentages)

	Mal-Nutrition	Risk of malnutrition	Normal weight	Overweight	Obesity	Do not know
Overall (n=94)	0.0	4.3	73.4	13.8	7.4	1.1
Low SES (n=46)	0.0	6.5	69.6	8.7	15.2	0.0
High SES (n=48)	0.0	2.1	77.1	18.8	0.0	2.1

This question also showed an association with SES [χ^2 (4, N=94) =11.248, p= 0.024].

4.4.2. Sleeping patterns

The first question was related with the children's sleep habits in the first year of life. The question offered three options: a) Normal sleep pattern, b) Abnormal sleep pattern c) Variable sleep pattern (periods with normal and abnormal sleeping patterns). The results of this item are presented in the table 33.

Table 33. Sleep pattern in the first year of life

	Normal pattern (%)	Abnormal pattern (%)	Variable sleep pattern (%)
Overall (n=91)	69.2	11.0	19.8
Low SES (n=43)	65.1	16.3	18.6
High SES (n=48)	72.9	6.3	20.8

When low and high SES families are compared, no significant association with the sleeping patterns in the first year of life is found [χ^2 (2, N=91) =2.332, p= 0.312]. The next question asked specifically about the current sleeping pattern of children, and results are presented in the table 34.

Table 34. Current sleep pattern

	Most of the time he/she uses to go to bed at similar time every single day (%)	He/She sometimes goes to bed at the same time each day (%)	He/She sleeps at different time each day (%)
Overall (n=90)	78.9	16.7	4.4
Low SES (n=42)	64.3	26.2	9.5
High SES (n=48)	91.7	8.3	0.0

The results showed that almost 80% of children usually go to bed at the same time every single day (78.9%). The responses for this question showed an association with SES [χ^2 (2, N=90) =10.986, p= 0.004].

4.5. Summary of the chapter

The analyses of the survey show that parents from low and high SES show in some cases different values in the statements included in this survey. Firstly, there are differences in terms of the environment where children grow up. For example, regarding to children´s families, in the low SES group was reported that they have 2.2 siblings in average, while families from high SES have 1.2 high SES. 91.8% of high SES children, but only 64.2% of low SES children, live with both parents. These differences in favour of the high SES group also appear in the number of home appliances, family income, parents´ occupation and parents' educational attainment. While these articles are not directly related to reading outcomes, the lack of learning opportunities from practical things such as having a place at home to study, or interactional such as less educated parents, can affect the opportunities to develop literacy.

Secondly, low SES families believe that most of the literacy skills should be promoted earlier than the high SES families think. These skills include to know letters and their sounds, how words should be written and to read words and phrases. Finally, in terms of the questions related to home literacy environment, there are significant differences when comparing low and high SES groups, all these differences are in favor of the latter group. High SES families talk, make rhymes, and tell stories to children and other adults more frequently than families from low SES. In addition, these high SES families participate in literacy tasks such as writing shopping lists and letters and reading books more often than low SES families. In these homes, it is possible to find more books and magazines. As it has previously established, while all these factors are not the cause of having lower outcomes in reading tasks, it is important to highlight that access and the usage of literacy materials is related with better reading performances. In the case of Chile, this link is particularly accented.

In sum, high SES families seem to have a more literacy-rich environment, where speaking, reading and writing are important and common family activities. They also have more materials that facilitate language and literacy opportunities which probably will have an impact on these processes at school. The process of learning to read is strongly related with the features in which children grow up, but they are not exclusively the factors that explain later reading achievement. In other words, this survey should be considered as an attempt to screen the home literacy environment of the children's families, but other factors, in addition to SES, should not be underestimated, because they also may contribute to the specifically lower verbal abilities, and they were not included in this study.

These factors include for example time management in preschool, teacher's and parents' expectations, the family's system of values, to name a few.

Regarding time management, Strasser, Lissi, and Silva (2009), examined how the time was distributed among the different activities in Kindergarten. To this purpose they collect data from 33 observation from 12 different classroom. Strasser, et al (2009) found that more than a half of the journey was devoted to non-instructional activities, such as eating, break time, and instructions about rules and behaviors. Regarding the instructional time, the results show that it was not related with the emphasis described in the literature. These findings were quite similar ones, in schools from different SES groups.

Another study regarding examined who is the responsible to promote instruction in the Latin American context. The results showed that parents consider that teachers should supervise academic instruction, while themselves as parents should teach moral and social development. In the case of teachers, they expect that parents can engage with their children in academic activities at home (Valdes, 1996).

In the school settings, the time spent in literacy instruction, the type and quality of resources to promote literacy, the pedagogical approach to introduce reading, the evaluation tools to evaluate the progress in reading and its predictors, are relevant factors to explain later variance in reading performance, and they also should be integrated in future reading models. While this study considers several aspects of HLE, it does not pretend to underestimate the influence that other factors may have to explain the differences in reading when comparing different SES groups. For methodological reasons, this study did not include these variables that could improve the prediction of the predictors, in a more complex model on the link between SES and reading performance. Chapter 5 presents the analysis of each of reading tasks comparing low and high SES group.

Chapter 5: Results – Reading tasks

5.1. Reading tasks

In this chapter, the results from different reading tasks are presented. Reading tasks include three dimensions: accuracy, fluency, and comprehension. Each of them is a scale compound of two other different tasks. In the case of Accuracy scale, words and non-words tasks have been included. Fluency scale is compound of One-minute reading and Picture-word matching. Comprehension is compound of Word/Phrase and text comprehension tasks. These scales are expressed in interval data. The results are presented in descriptive terms, including mean, standard deviation, sample size, and the range of values (minimum - maximum). In order to express the score distribution several histograms are also presented. These histograms consider the raw scores taken from the tasks and the scales, which in turn, were compound as an average of them. Histograms are presented twice for all participants and for low and high SES groups.

In order to compare the scores by SES, several t-test values have been included. To estimate the effect size between groups two statistical tools have been included: eta-squared to evaluate the effect of SES to explaining the variability of results, and Cohen's d value to express the distance between groups in standard deviation.

It is important to devote a couple of lines to the scores distribution that will be presented not only in the Chapter 5, but also in the Chapters 6, and 7. As it has been previously stated, this study aims to evaluate the effect of HLE on several predictors of reading. In the first section the variables will be compared between low and high SES group. This type of comparative analysis may be considered innovative in this kind of studies; nevertheless, it may be also problematic in terms of how the variables scores are distributed. This study did not include a mid-SES group, and therefore, it is highly likely that the assumption of normal distribution cannot be reached in the evaluated variables, because both groups represent different population and therefore it is highly likely that bi-modal distributions appear in several tasks.

Regarding the latter, it is important to mention that the mean comparisons in this study will be mainly based on the t-test statistical tool. One of the t-test assumptions is that the distribution is normally distributed. However, in the practice this assumption rarely happens. For example, in a study conducted by Micceri (1989) it was found that from 440 large datasets from different areas such as psychology, and education, in evaluating student's performance or psychological measures (i.e. anxiety, satisfaction, etc.), no normal distribution was found. Distribution often were skewed, with different modes and heavily tailed. Micceri (1989) suggests a re-evaluation of these assumptions, considering the real features of the studies. In this line, Erceg-Hurn and Mirosevich (2008) suggest that this case is also found in other of the t-test assumption, and it refers to the equal variances that different groups should have. This is also known as homoscedasticy.

Despite the t-test is robust enough to tolerate non-normal distribution (Field, 2009), it has been suggested that in these cases it is important to ensure that the sample sizes are equal and, that they are large enough (more than 30 or 40 cases), which is the case of this study. T-test is robust to the error type II (which refers to failing to reject a false null hypothesis) under non-normal distribution (Sawilowsky and Clifford, 1992).

In this study the evaluation of normal distribution will be analysed not only for all participants, but also by each SES group (Low and High). This decision will allow to examine whether the lack of normal distribution is associated to some issues related to the nature of the tests and tasks (i.e. *floor and ceiling effect*), or instead can be related to the internal distribution in each group (low and high SES). An alternative solution to the cases in which non-normal distribution emerges from the scores, it is transforming the data to then analyse them through non-parametric statistical tools. However, it has been stated that by using this technique the predictive power decreases dramatically, underestimating the effects when they really occur (Wilcox, 1998).

5.1.1. Accuracy

The results of word and non-words tasks from the LEE battery are summarised in Table 35.

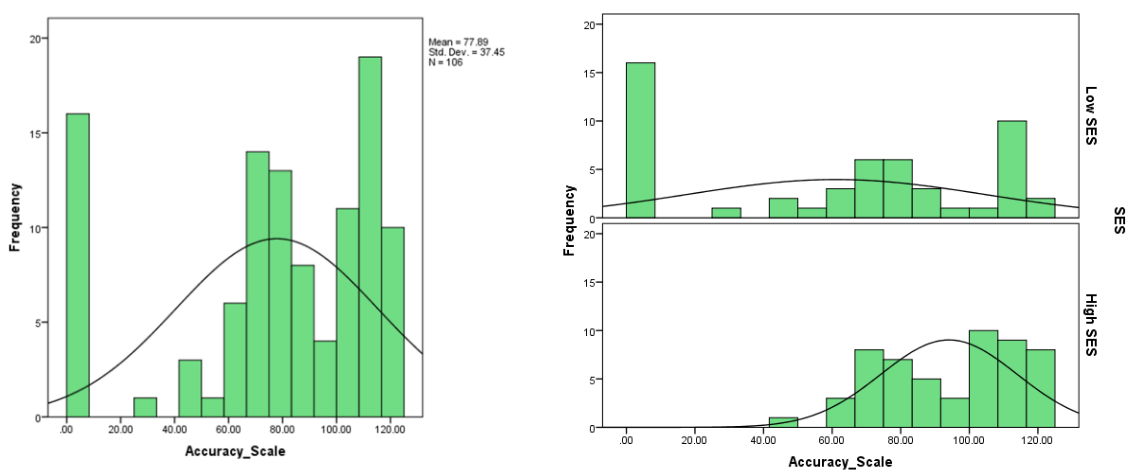
Table 35. Descriptive results – Accuracy word and non-word reading

	Words	Non-words
Mean (SD)	80.1 (38.6)	75.7 (36.7)
N	106	106
Minimum	2	2
Maximum	128	123

Both tasks are highly correlated (r= 0.98; p< 0.001) and have been collapsed into a variable called Accuracy. The descriptive values for this scale are a mean of 77.9 (37.4SD), with a range from 2 to 124.

The variable does not show a normal distribution according to the Kolmogorov-Smirnov, althoug it is quite close to the critical value (p= 0.019). Considering all participants, the histogram shows a simple bimodal distribution (see Graph 2). When the distribution is separated into low and high SES groups, the Kolmogorov-Smirnov Test shows a normal distribution for the high SES group (p = 0.348), but a non-normal distribution for the low SES group, although close to the critical point (p= 0.022). This disparity in the distribution between low and high SES can explain the lack of normal distribution for all participants. In the particular case of low SES, the lack of normal distribution can be explained for an important proportion of children with poor performance in the tasks that this scale considered.

Graph 2. Histogram – Reading accuracy. All participants and SES groups



5.1.2. Fluency

Fluency was evaluated through 2 tasks: One-minute reading task and Picture-Word matching. Table 36 summarises the results of both one-minute reading and picture-word matching tasks.

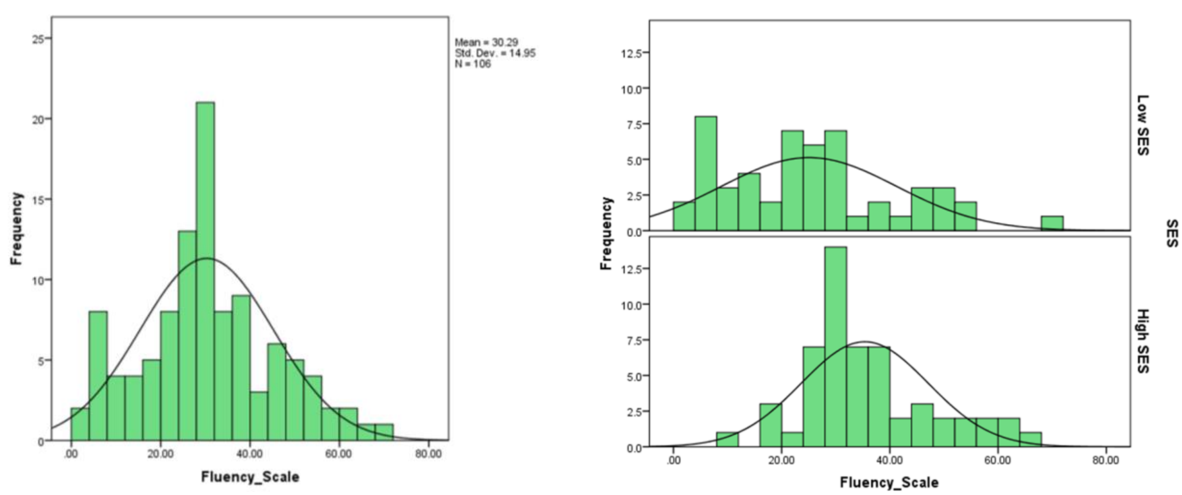
Table 36. Fluency descriptive results - Fluency

	One-minute reading task (number of words read in one minutes)	Picture-word matching (number of pictures and words matched in 3 minutes)
Mean (SD)	39.1 (21.3)	21.5 (9.3)
N	106	106
Minimum	1	1
Maximum	100	45

Both tasks are highly correlated (r= 0.905; p< 0.001) and have been collapsed into a variable called Fluency. The descriptive values for this scale are a mean of 30.3 (15.0SD), with a range from 1 to 70.5T.

The scale Fluency shows a normal distribution according to the Kolmogorov-Smirnov (p= 0.49). When the distribution is separated into low and high SES groups, the Kolmogorov-Smirnov Test shows a normal distribution for both the low SES group (p = 0.597), and for the high SES group (p = 0.328), as it can be seen in graph 3.

Graph 3. Histogram – Reading fluency. All participants and SES groups



5.1.3. Comprehension

This dimension was evaluated using two tasks: Word/phrase and text comprehension. Word/phrase comprehension considered four components: phrases (syntax and semantic processes), family of words (morphology and semantic processes), questions (syntax and semantic processes) and complete sentences (syntax and semantic processes). In the case of text comprehension, children were asked to read three short stories: two stories and one narrative text. These texts evaluate textual and inference elaboration, identification, and summary of the main ideas and comprehension of the text structure.

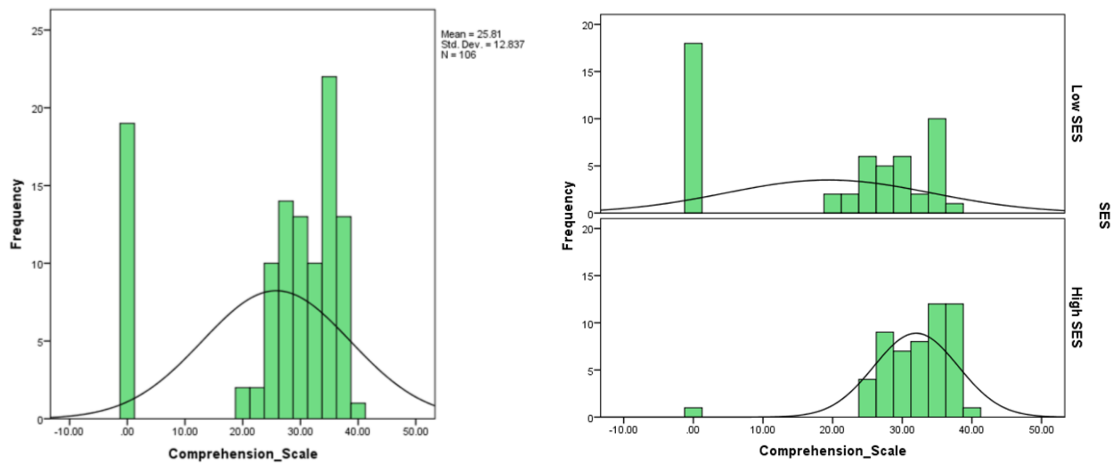
Table 37. Descriptive results – Comprehension

	Word/phrase comprehension	Text comprehension
Mean (SD)	25.6 (12.6)	26.0 (13.5)
N	106	106
Minimum	0	0
Maximum	42	45

Levels of performance on word/phrase and text comprehension were positive and significantly correlated ($r= 0.925$, $p< 0.001$), and they have been collapsed in a category called Comprehension. The descriptive values for this scale are a mean of 25.8 (12.8SD), with a range from 0 to 40.

The Comprehension outcomes does not show a normal distribution according to the Kolmogorov-Smirnov ($p< 0.001$). Considering all participants, the histogram shows two groups, those who got a poor performance in these reading comprehension tasks, and those children who are grouped around the mean of the scale. Similarly to the reading accuracy scale, the Kolmogorov-Smirnov Test presented in graph 4, shows a normal distribution for the high SES group ($p = 0.394$), but a non-normal distribution for the low SES group ($p= 0.003$). This disparity in the distribution between low and high SES can explain the lack of normal distribution when all participants are included. In the particular case of low SES, there is a large proportion of children with a extremely poor performance, which definitely could have affected the normal distribution of the scale.

Graph 4. Histogram – Reading comprehension. All participants and SES groups



5.2. Correlations among components of reading

Table 38 shows that the evaluated components of reading are positive and highly correlated. Accuracy and comprehension scale show the highest correlation (r= 0.891; p<.001).

Table 38. Correlations between fluency, accuracy, and comprehension

	Accuracy	Fluency
Accuracy		
Fluency	.874***	
Comprehension	.891**	.779**

* p<.05; **p<.01; *** p<.001

5.3. Reading and socioeconomic status

In order to estimate possible differences in reading performance by SES group, a series of comparisons were conducted. These comparisons were carried out through t-test to evaluate differences between low and high SES groups.

The comparisons between children from low and high SES show significant differences in the three reading components evaluated in this study [Accuracy: t_{104}= 5,031, p<0.001; Fluency: t_{104}= 3,767, p<0.001; Comprehension: t_{104}= 5,765, p<0.001]. The largest difference between low and high SES groups, among the reading components, appears for reading comprehension. In this component, the eta squared shows a value of 0.242, in simple words, the SES explains 24.2% of the differences in reading comprehension. The distance between low and high SES groups expressed in Cohen's d value is 1.11, which means that the difference between groups is larger than 1 standard deviation. In the case of accuracy, the difference between groups is also large. The eta squared value is 0.196, which states that almost 20% of the difference is explained by the student's SES. The distance between low and high SES groups is almost 1 standard deviation (Cohen's d value: 0.97). Finally, fluency scale also shows similar values to the one in accuracy, this is an eta-squared value of 0.190, and 0.75 SD (Cohen's d value).

5.4. Summary of the chapter

The results presented in this chapter show that the reading tasks evaluated at time 2 of this study were administered to 106 students. The mean for the accuracy subtasks was 77.9 with a standard deviation of 37.4, 30.3 with a standard deviation of 15.0 in the case of fluency, while in the comprehension scale was 25.8 with a standard deviation of 12.8.

In terms of the differences between low and high SES groups, the results show significant differences in the three evaluated dimensions. In the case of accuracy, the distance between groups is almost one standard deviation, which is considered a large effect between groups. In the case of fluency, the distance between groups represents 0.75 standard deviation units, which can be considered a large effect. Finally, the largest distance between low and high SES appears for the Comprehension scale, in which more than one standard deviation was the Cohen's d value. This is, children from low SES perform more than one standard deviation below their peers from high SES groups.

In terms of distribution, only the scale Fluency show a normal distribution when all participants were considered. In the case of accuracy, non-normal distribution is expressed when all participants are included, however, when the distribution is disaggregated according socio-economic groups, the lack of normal distribution appears only for the low SES group (K-S, p-value: 0.02); while a normal distribution has been found for the high SES group (K-S, p-value: 0.33). This lack of normal distribution for the low SES group can be explained for two different performance in this sub-group. In one case, several children perform this task poorly, with difficulties in naming even short and simple words, while the other sub-group perform adequately although in this case the time was not considered for the current study. This differential effect can be attributed to the kind of school in which children attended. The sample for the low SES group considered three schools, and two of them show very poor results in this task [School 1. Mean: 25.1, SD: 29.3; School 2. Mean: 54.1, SD: 43.0], while the students of the third school of the low SES group show better performances in this scale [School 3: Mean: 93.0, SD: 28.6]. The mean of this third school in this scale is almost twice the result of the schools 1 and 2, and it can certainly affect the score distribution.

In the case of reading comprehension, the scores are also non-normally distributed. As in the case of accuracy scale, the lack of distribution appears solely for the low SES group (K-S, p-value: 0.03), while a normal distribution is found for the high SES group (K-S, p-value: 0.35). A plausible explanation can be related to the type of school in which children were attending. The children of two of these schools perform poorly in this task [School 1. Mean: 12.8, SD: 8.6; School 2. Mean: 19.9, SD: 12.6], while the students of the third school from the low SES group show better performances in this scale [School 3: Mean: 38.8, SD: 13.8]. The results of this third school are quite similar to the results found for the high SES group [School 4. Mean: 36.0, SD: 12.6; School 5. Mean: 34.7, SD: 10.9]

In sum, significant differences between low and high SES groups were found for all the reading components. The scores are normally distributed only for the case of reading fluency. In the case of accuracy and comprehension, the non-normal distribution seems to appear just for the low SES group. In this group, seem to be a school effect, with two schools performing poorly and one school perform better in these three scales.

Chapter 6: Results – Foundational reading skills

In chapter 6, the results of foundational reading skills are presented. These skills include: phonological awareness, rapid automatic naming and letter knowledge. Each of them is a scale compound of different tasks, evaluated with different instruments at times 1 and 2 due to factors such as *ceiling effect*, suitability of the tasks, and the age of the students.

In the case of Phonological awareness scale at time 1, three different tasks were included: two scales of phoneme isolation (vowels and consonants), and syllable segmentation. Phonological awareness at time 2 was evaluated through three scales phoneme isolation (initial and final), and phoneme blending. The second component was Rapid automatic naming (RAN). In this task, the four versions were administered, although two of them were considered at each time points. At time 1, RAN Colours and Digits were considered, while at time 2 RAN Digits and Letters were included. Finally, Letter knowledge was included as the third of the reading predictors. At time 1, the Letter knowledge scale was considered from the Spanish version of Woodcock Munoz battery. At time 2, Letter knowledge was evaluated through the knowledge of sounds and names from the Spanish alphabet. All tasks presented in this chapter are compound of interval data. Similarly to the reading components, t-test was considered to estimate the mean comparison between groups, and both eta-squared and Cohen's d value have been included to evaluate the size effect between groups.

The results are presented in descriptive terms, including mean, standard deviation, sample size, and the range of values. The score distribution is presented through histograms, and the Kolmogorov-Smirnov test as the tool to evaluate the normal distribution of the scores. These histograms consider the raw scores from both of the tasks and the scales, which in turn, were compound as an average of them. Histograms are presented twice for all participants and for low and high SES groups as well.

6.1. Phonological awareness

Phonological awareness at time 1

At time 1, three different phonological awareness subtasks were administered: syllable segmentation, phoneme isolation in vowel-initial words and phoneme isolation in consonant-initial words. These tasks are part of the Test de Habilidades Metalinguisticas – *Test of Metalinguistic skills* (Gómez et al., 1995) and the Prueba de Prediccion Lectora - Test of Reading Prediction (Bravo, 1997). In Table 39, the results of phonological awareness of time 1 are presented.

Table 39. Descriptive results – Phonological awareness at time 1

	Syllable segmentation	Phoneme isolation vowels	Phoneme isolation consonants
Mean (SD)	17.8 (2.2)	5.9 (2.5)	4.7 (4.3)
N	133	133	133
Minimum	9	0	0
Maximum	20	8	16

The results of these three subscales were compiled into a scale called Phonological awareness at time 1. These subtasks were averaged from 133 participants, and the descriptive values are a mean of 9.5 (2.4), in a range from 4 to 14.7 points as the maximum reached.

The results of the Phonological awareness subscales at time 1 show a normal distribution according to the Kolmogorov-Smirnov Test ($p = 0.226$). When the distribution is evaluated for the low and high SES groups, the normal distribution appears both for the low ($p = 0.303$), and high SES group ($p = 0.178$) as it is shown in graph 5.

Graph 5. Histogram – Phonological awareness at time 1. All participants and SES groups

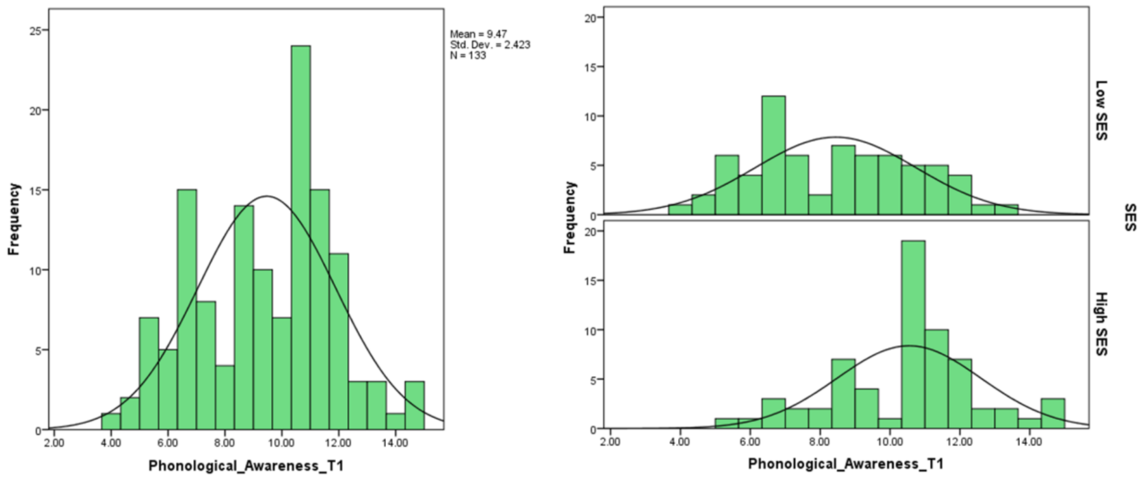


Table 40 shows a summary of the results of phonological awareness at time 1. The comparison between children from low and high SES was calculated by the use of the t-tests.

Table 40. Comparison phonological awareness by SES (t-test) at time 1

	Syllable segmentation	Phoneme isolation vowels	Phoneme isolation consonants
Mean (SD) Low SES	17.4 (2.3)	4.7 (2.7)	3.3 (3.6)
N. Low SES	68	68	57
Min / Max. Low SES	9 / 20	0 / 8	0 / 14
Mean (SD) High SES	18.3 (2.0)	7.2 (1.4)	6.2 (4.4)
N. High SES	65	65	65
Min / Max. High SES	11 / 20	1 / 8	0 / 16
t-test (p-value)	0.021	<0.001	<0.001

The results show significant group differences for the three phonological awareness tasks: syllable segmentation (t_{131}= 2.344, p= 0.021), phoneme isolation task - vowels (t_{131}= 6.739, p< 0.001) and phoneme isolation task - consonants (t_{131}= 4.140, p< 0.001).

In terms of the effect of SES on these three subtasks, the results, evaluated through eta-squared show values of 0.40 for syllable segmentation, 0.257 for phoneme isolation – vowels, and 0.116 for phoneme isolation – consonants. In simple words SES explains 40.0% of the total variance for syllable segmentation, 25.7% for phoneme isolation – vowels, and 11.6% for phoneme isolation – consonants.

Cohen's d value is a statistical tool that evaluates the effect size of the differences between groups, in this case between children from low and high SES. The results show that in the case of syllable segmentation the distance is equal to 0.42 standard deviations (SD), while for phoneme isolation – vowels the Cohen's d value is 1.16 SD, and 0.72 in the case of phoneme isolation – consonants. This means that a medium effect has been found for the syllable segmentation, and a large effect for phoneme isolation vowels and consonants.

Phonological awareness at time 2

At time 2, three subtasks were administered: initial phoneme isolation, final phoneme isolation, and phoneme blending. In table 41, the results of phonological awareness at Time 2 are presented.

Table 41. Descriptive results – Phonological awareness at time 2

	Phoneme isolation – initial	Phoneme isolation – final	Phoneme blending
Mean (SD)	13.7 (3.7)	13.8 (3.5)	16.5 (5.5)
N	106	106	106
Minimum	0	0	0
Maximum	16	16	24

The results of these three subscales were compiled into a scale called Phonological awareness at time 2. These subtasks were averaged from 106 participants, and the descriptive values are a mean of 14.7 (3.9), in a range from 0.7 to 18.7 points as the maximum reached.

The scale Phonological awareness at time 2 does not show a normal distribution according to the Kolmogorov-Smirnov ($p < 0.001$). Considering all participants, the histogram shows a left-skewed distribution. Kolmogorov-Smirnov Test shows a normal distribution for the high SES group (p = 0.176), but a non-normal distribution for the low SES group (p= 0.013). This disparity in the distribution between groups could affect the normal distribution of the scale. In the case of high SES, the result seems to show an adequated level of mastery of this ability, while in the case of low SES, there is a proportion of students disgregrated in the poorest scores in the distribution, as seen in the graph 6.

Graph 6. Histogram – Phonological awareness at time 2. All participants and SES groups

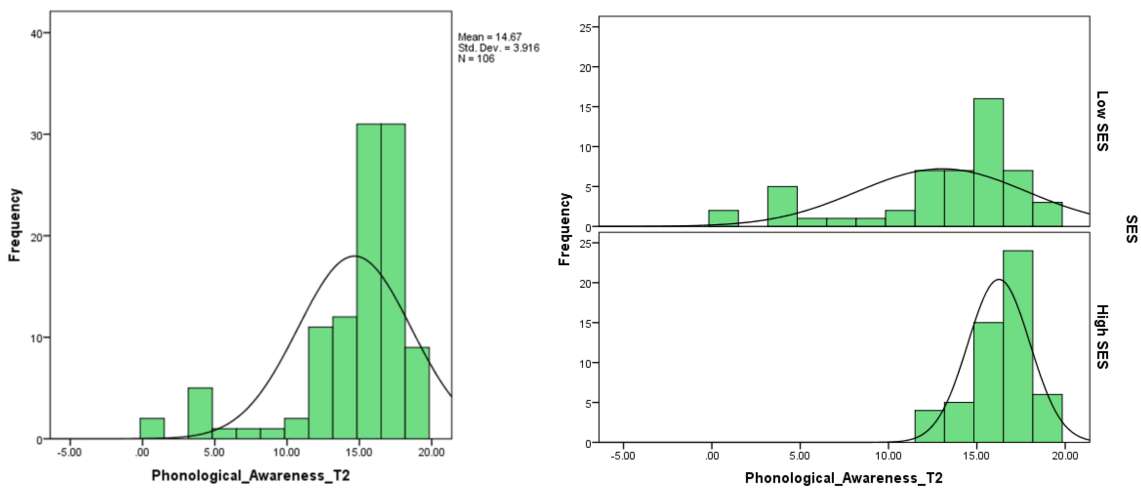


Table 42 shows a summary of the results of phonological awareness at time 2. The comparison between children from low and high SES was calculated using the t-tests.

Table 42. Descriptive results – Phonological awareness at time 2

	Phoneme isolation - initial	Phoneme isolation – final	Phoneme blending
Mean (SD) Low SES	12.2 (4.6)	12.7 (4.6)	14.2 (6.0)
N. Low SES	52	52	52
Min / Max. Low SES	0 / 16	0 / 16	0 / 24
Mean (SD) High SES	15.1 (1.5)	15.0 (1.0)	18.6 (3.8)
N. High SES	54	54	54
Min / Max. High SES	10 / 16	13 / 16	10 / 24
t-test (p-value)	<0.001	<0.001	<0.001

The results show significant group differences for the three phonological awareness tasks evaluated at time 2 of the study. The results of these differences are quite similar among the tasks, i.e. Phoneme isolation - initial [t_{104}= 4,462, p<0.001], Phoneme isolation - final [t_{104}= 3,610, p<0.001], and Phoneme blending [t_{104}= 4,497, p<0.001].

In terms of eta-squared the values for these three subtasks are 0.16 for phoneme isolation – initial, 0.16 for Phoneme isolation - final, and 0.11 for Phoneme blending. In simple words, SES might explain 19.0% of the total variance for phoneme isolation – initial, 16.0% for Phoneme isolation - final, and 11.0% for Phoneme blending.

In terms of the effect size, evaluated through Cohen's d value, the results show that the differences between children from low and high SES, are 0.8 SD for phoneme isolation – initial, 0.7 SD for phoneme isolation – final, and 0.9 for the phoneme blending task. In all cases these values are large according the Cohen's d classification.

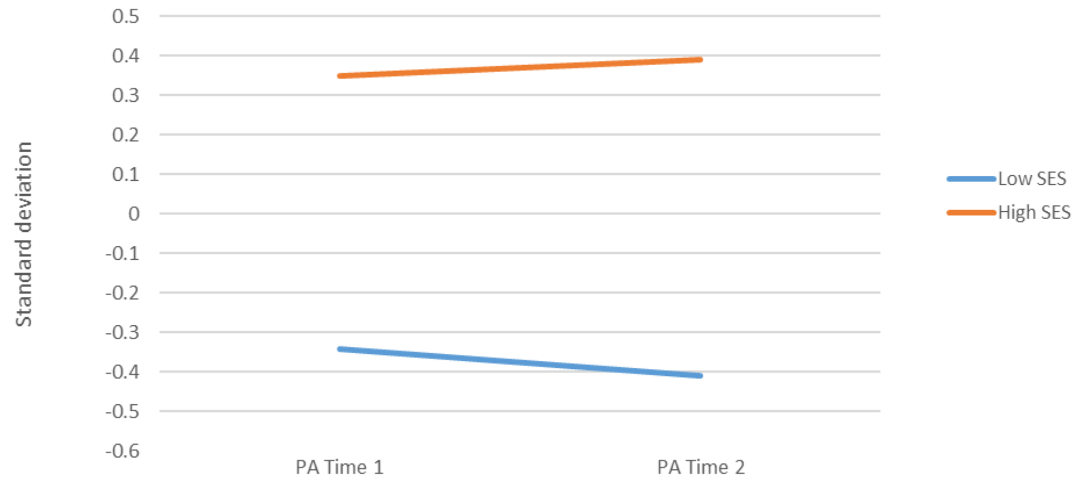
Comparison of phonological awareness - according to SES at times 1 and 2

The tasks were compared by SES at both times. These outcomes were collapsed into a unique variable for each time point. It is important to highlight that phonological awareness at times 1 and 2 was evaluated using different tasks, therefore these results must be considered with caution. Thus, while at time 1 the evaluation at syllable-level was included, the time 2 only included tasks at the phonemic level.

Graph 7 shows a longitudinal comparison of PA according to SES. The idea is to evaluate whether the differences between groups are wider or narrower at time 2 compared to time 1. The results indicate that significant differences were found in favor of the high SES group compared with the low SES group both at time 1 (t_{131}= 5,535, p< 0.001), and at time 2 (t_{104}= 4,627, p< 0.001).

At time 1, the partial *eta* squared value was 0.19; this means that SES explains 19.0% of the variance in the results, while at time 2, 17.1% of the variance was explained by SES. The difference between low and high SES was 0.96 at time 1, and 0.88 at time 2, calculated through Cohen's d value. This means that there was almost 1 standard deviation of difference in the phonological awareness scores, when comparing children from low and high SES groups.

Graph 7. Longitudinal comparison of phonological awareness tasks according to SES



6.1.2. Phonological processing

In this study, phonological processing was evaluated through the GAPS task. It included eight items that were translated and adapted to the Chilean Spanish. The results of this task are presented in Table 43.

Table 43. Group scores for non-word repetition at time 1

	Non-word repetition
Mean (SD)	6.8 (1.2)
N	133
Minimum	4
Maximum	8

The results of non-word repetition show a mean of 6.8 out of 8 points as maximum. The range of the values goes from 4 to 8.

In terms of the distribution, the Non-word repetition subtask does not show a normal distribution according to the Kolmogorov-Smirnov ($p < 0.001$). Considering all participants, the histogram shows a left-skewed distribution. Kolmogorov-Smirnov Test does not show a normal distribution for the low ($p = 0.004$) and neither for the high SES group ($p = 0.003$). In graph 8 it is possible to observe a kind of *ceiling effect* in the task.

Graph 8. Histogram – Non-word repetition at time 1. All participants and SES groups

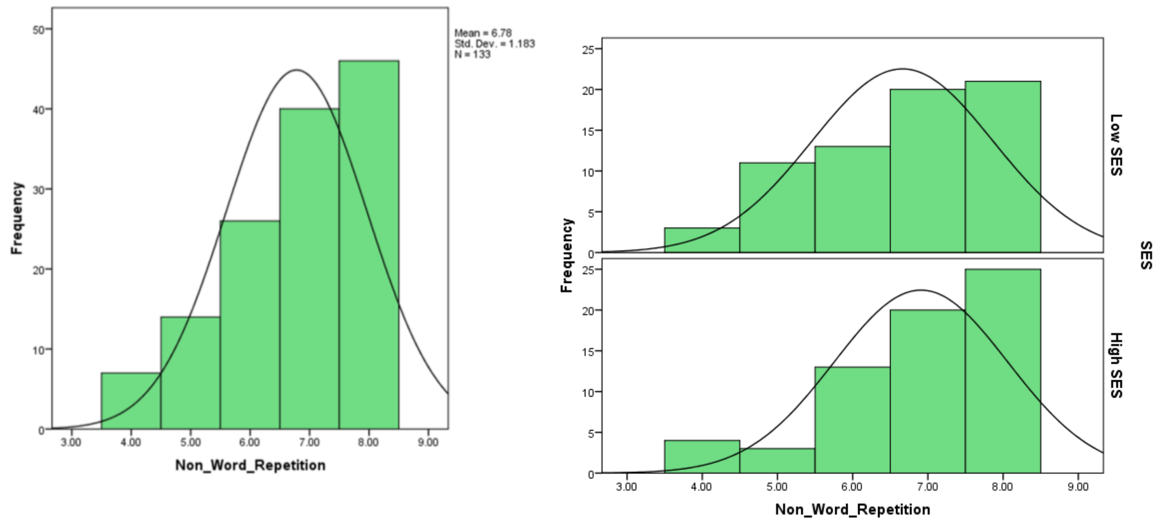


Table 44 shows a comparison between low and high SES group in this task.

Table 44. Group scores for non-word repetition at time 1

	Non-word repetition
Low SES. Mean (SD)	6.7 (1.2)
N Low SES	68
Min / Max	4 / 8
High SES. Mean (SD)	6.9 (1.2)
N High SES	65
Min / Max	4 / 8
t-test (p-value)	0.232

The non-word repetition task did not show significant differences between the groups (t_{131}= 1,201, p= 0.232). The partial eta squared value is 0.01, while the Cohen's d value is 0.17, which shows no difference in the student's performance in this task. To evaluate the difficulty in the non-word items, a percentage of correct responses by item was calculated. Table 45 summarises the results of this analysis.

Table 45. Percentage of correct responses for each item in non-word repetition task

	Overall	Low SES	High SES	Groups differences
1. cuton	99.2	98.5	100	1.5
2. malte	84.1	84.6	83.6	-1
3. gobla	84.9	81.5	88.5	7
4. triduta	72.2	70.8	73.8	3
5. siberol	76.2	76.9	75.4	-1.5
6. glumita	99.2	98.5	100	1.5
7. mofrelo	73.0	75.4	70.5	-4.9
8. purramo	91.3	87.7	95.1	7.4

In the non-word repetition task, there were no group differences. In three items less than 80% of children could repeat correctly. The most challenging non-word was *triduta* (72%). The most common mistake for this non-word was the substitution of /g/ for /d/, with children repeating this word as *triguta*. *Mofrelo* (73%) was also a challenge for some children, and in the majority of incorrect repetitions children substituted /r/ for /i/, producing "*mofielo*" instead of "*mofrelo*". The only other non-word for which repetition accuracy was less than 80% was *siberol* (76%), with repetitions such as "*siberon*" and "*sibelol*". The vast majority of errors for all non-words was segmental in nature and maintained syllabic and prosodic structure.

6.2. Rapid automatic naming

Rapid automatic naming at time 1

In the Rapid automatic naming task, children were asked to name a set of five items that were repeated ten times in a random sequence as quickly as possible. At time 1, RAN colours and objects were presented in a total of 50 items in each of the scales. In the case of RAN Colours, the five colours were green, black, brown, red and blue. In RAN objects five common items were included: chair, tree, house, sun, and cat. Each of the colours and objects were presented in a 203 mm × 267 mm card. The task started with a trial phase where children had to name all 10 colours and objects. 100% for RAN Objects and 94.7% (126 out of 133 students) for RAN colors passed the trial phase. Seven students in the sample were unable to name at least 3 of the presented colours. Children received each of the tasks in separated cards. The scores were calculated estimating the seconds spent between the first and the final item from each task. The results are presented in table 46.

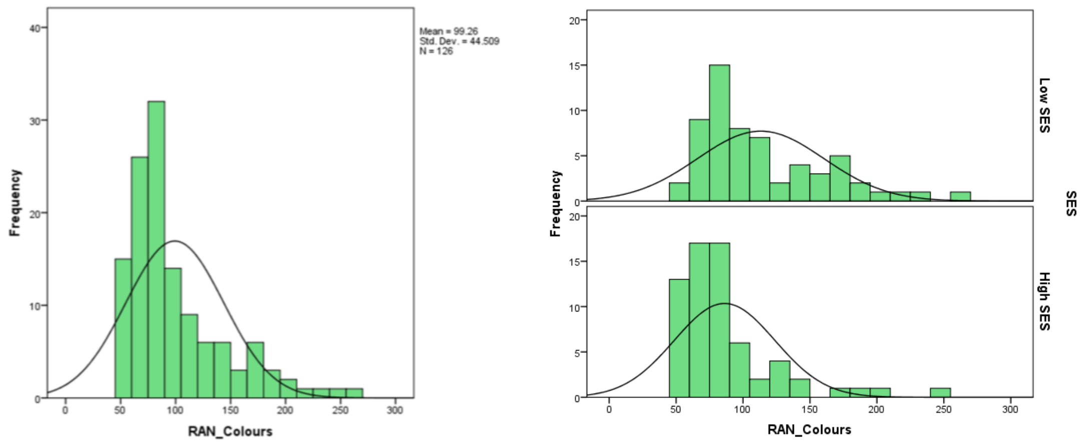
Table 46. Descriptive results – RAN colours and objects at time 1

	RAN colours (seconds)	RAN objects (seconds)
Mean (SD)	99.3 (44.5)	88.1 (25.3)
N	126	133
Minimum	46	53
Maximum	255	222

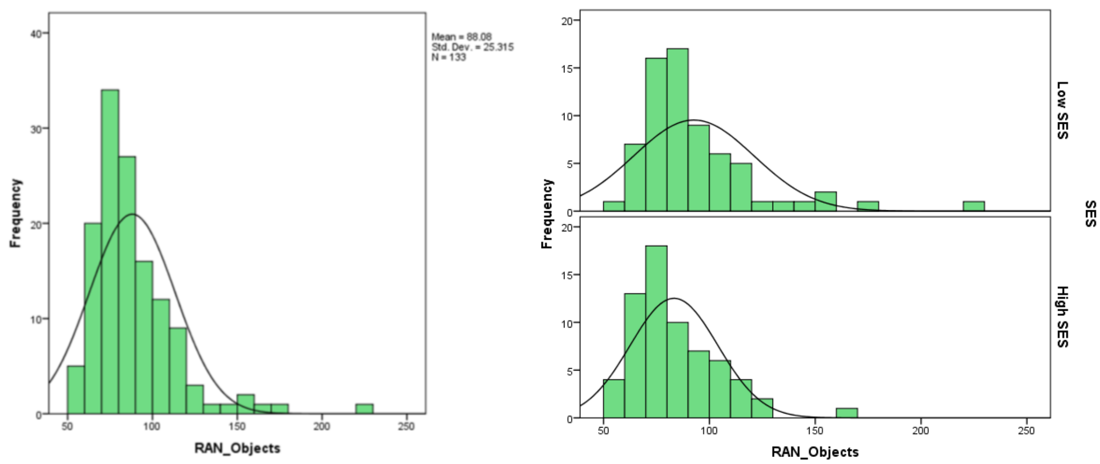
The results in the RAN Colours and Objects do not show a normal distribution according to the Kolmogorov-Smirnov (Colours: $p< 0.001$; and Objects: $p= 0.005$). Considering all participants, the histogram shows a right-skewed distribution, which expresses that an important proportion of students completed each task before 100 seconds. When the distribution is disagregated by low and high SES groups, mixed results were shown.

In the case of RAN colours, a non-normal distribution was found both for the low ($p= 0.016$), and for the high SES group ($p< 0.01$). However, in the case of objects a non-normal distribution was only found for the low SES ($p= 0.04$), while a normal distribution appeared for the high SES group ($p= 0.206$). In sum, it is clear that a non-normal distribution has been found for all participants in RAN Colours, and Objects. It is important to disagregrated these results since each of them seems to follow a variation pattern in the tasks, as seen in the graphs 9 and 10.

Graph 9. Histogram – RAN Colours at time 1. All participants and SES groups



Graph 10. Histogram – RAN Objects at time 1. All participants and SES groups



In terms of the distribution of responses, 59% of the sample in the RAN colours and 66.2% of the sample in the RAN objects spent less than 90 seconds naming the fifty items of each scale. The remaining 41% in RAN colours spent between 91 and 256 seconds, and the remaining 33.8% in RAN Objects spent between 91 and 222 seconds.

Table 47 shows a comparative analysis of the results of RAN colours and objects considering the low and high SES groups.

Table 47. Comparison of SES through ANOVA of RAN Colours and Objects at time 1

	RAN colours	RAN objects
Mean (SD) Low SES	113.2 (47.3)	92.7 (28.4)
N Low SES	61	68
Min / Max	52 / 255	58 / 222
Mean (SD) High SES	86.2 (37.6)	83.3 (20.7)
N High SES	65	65
Min / Max	46 / 247	53 / 167
t-test (p-value)	0.001	0.032

RAN analysis at time 1 shows mixed results. In the case of the colour subscale there was a statistically significant difference between children in the high and low SES groups (t_{124}= 3.555, p= 0.001) with an effect size measured through a partial *eta* square of 0.09, this is 9.0% of the variance explained by the students' SES. The Cohen's d value for this subtask was 0.63, which can be considered as a medium size effect (Cohen, 1977).

In the object subscale, there was a difference of 9.4 seconds between high and low SES groups. This difference is statistically significant (t_{131}= 2.167, p= 0.032), although quite close to the critical value. The partial *eta* squared shows a value of 0.04, this it means that only 4% of the variance is explained by the student's SES. The Cohen's d value is 0.38.

At time 2, two new subtasks, RAN Digits and Letters, were administered. Like at time 1, 50 items for each task were presented. The scores are presented in Table 48.

Table 48. Descriptive results – RAN digits and letters at time 2

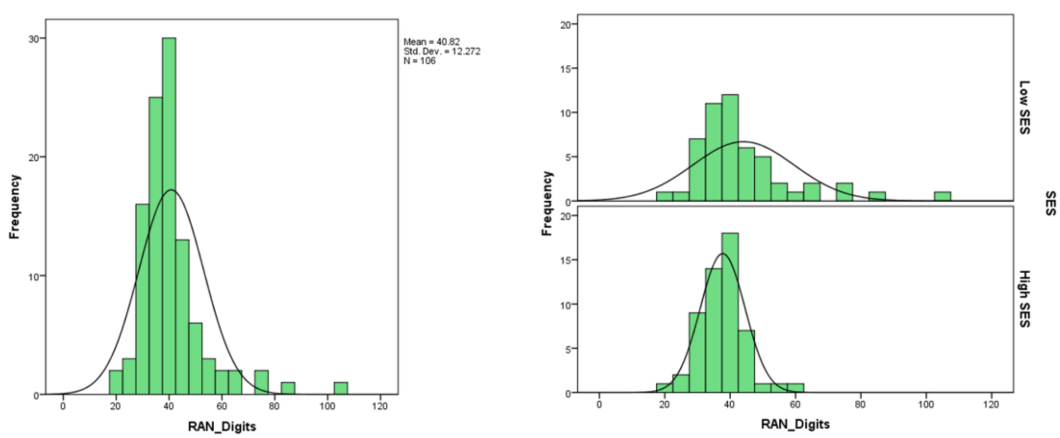
	RAN digits (seconds)	RAN letters (seconds)
Mean (SD)	40.8 (12.3)	45.9 (17.8)
N	106	106
Minimum	20	26
Maximum	107	120

The score distribution in these subscales show that 80.0% of the sample in the RAN Digits and 69.0% of the sample in the RAN Letters spent less than 45 seconds naming the fifty items of each scales. The remaining 20.0% in RAN Digits spent between 46 and 107 seconds, and the remaining 31.0% in RAN Letters spent between 46 and 120 seconds.

The results in the RAN Digits and Letters do not show a normal distribution according to the Kolmogorov-Smirnov (Digits: p= 0.002; and Letters: p= 0.005). Considering all participants, the histogram at time 2 also shows a right-skewed distribution, which expresses that an important proportion of students completed each task before 100 seconds. When the distribution is disagregated by low and high SES group, mixed results were shown.

In the case of RAN Digits, a non-normal distribution was found for the low SES group (p= 0.04). However, in the case of high SES a normal distribution has been found (p= 0.338). The same pattern was found for the subscale Letters, with a non-normal distribution for the low SES (p =0.025), but with a normal distribution for the high SES group (p= 0.920). These mixed results could have affected the normal distribution of the scale when all participants are considered, as well as the lack of a Mid-SES group, as it is expressed in graph 11.

Graph 11. Histogram – RAN Digits at time 2. All participants and SES groups



Graph 12. Histogram – RAN Letters at time 2. All participants and SES groups

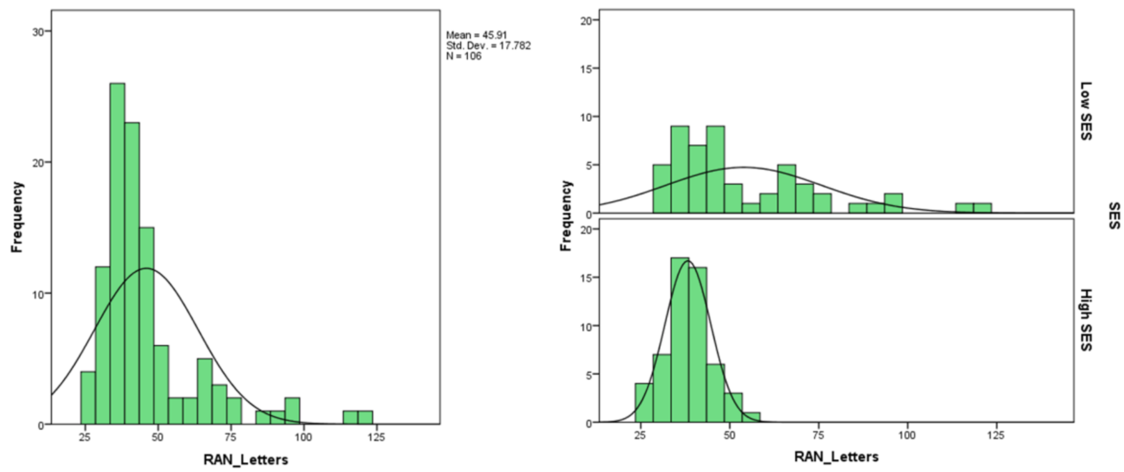


Table 49 shows a summary of the results of RAN Digits and Letters. The results show a mean difference of 9.7 seconds between digits and letters. Naming letters took more time than completing the digits' scale.

Table 49. SES Comparison of RAN digits and letters at time 2

	RAN digits	RAN letters
Mean (SD) Low SES	44.1 (15.5)	53.9 (21.9)
N Low SES	52	52
Min / Max	22 / 107	29 / 120
Mean (SD) High SES	37.7 (6.9)	38.2 (6.4)
N High SES	54	54
Min / Max	20 / 58	26 / 54
p-value	0.007	< 0.001

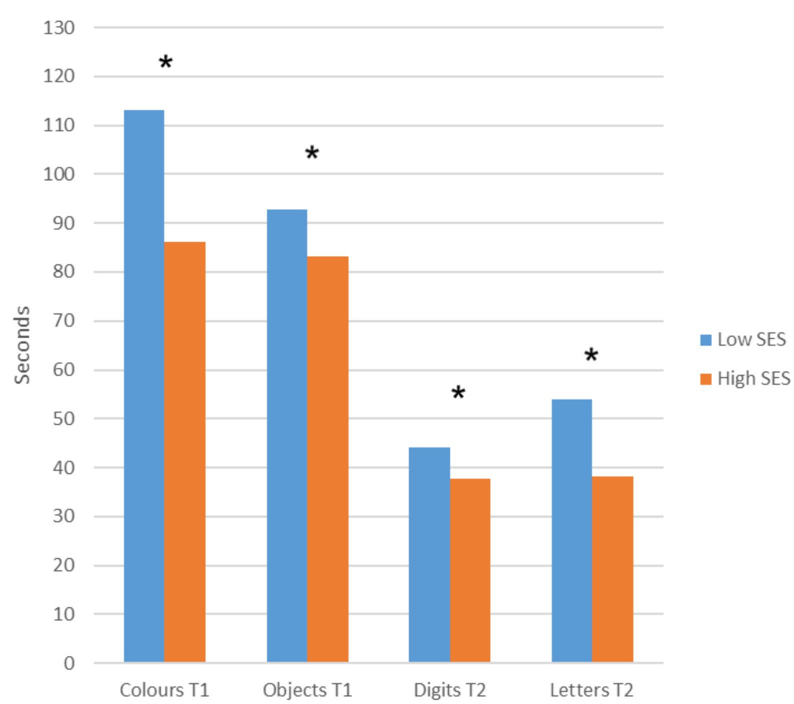
RAN analysis at time 2 shows a substantial effect of SES on the tasks. In the case of the digit's subscale, there was a significant difference (t_{104}=2,747, p= 0.007). The partial eta squared shows a value of 0.07; this means that the SES explains 7.0% of the variance. In the case of the letter subscale there was also a significant difference (t_{104}=5,031, p< 0.001), with an effect size of 0.2 according to the partial eta squared value. In this case, 20.0% of the variance is explained by the SES of the students.

The mean differences in RAN letters and digits are 0.97 and 0.53 respectively, according to the Cohen's d values. In other words, children from the high SES group perform almost one standard deviation above their peers from the low SES group in the RAN letters task, which is considered a large difference according to Cohen (1977). This difference is half a standard deviation in the case of RAN digits and can be considered moderate.

Comparison of RAN according to SES at times 1 and 2

SES was compared in each of the RAN tasks at both time points. Graph 13 shows the administered tasks both at Time 1 and Time 2. All the RAN tasks differ in a significant way when compared by SES. The largest differences appear in colours and letters, where children from the high SES group named them 27 and 15.7 seconds respectively faster than their peers from the low SES group. The smallest difference appears in RAN Digits, with children from the low SES group naming the set 6.4 seconds slower than their peers from the high SES group.

Graph 13. Longitudinal comparison of RAN by SES



6.3. Letter knowledge

Letter knowledge at time 1

The results presented in table 50 show descriptive scores for the letter knowledge from Woodcock Munoz evaluated at time 1 of the study.

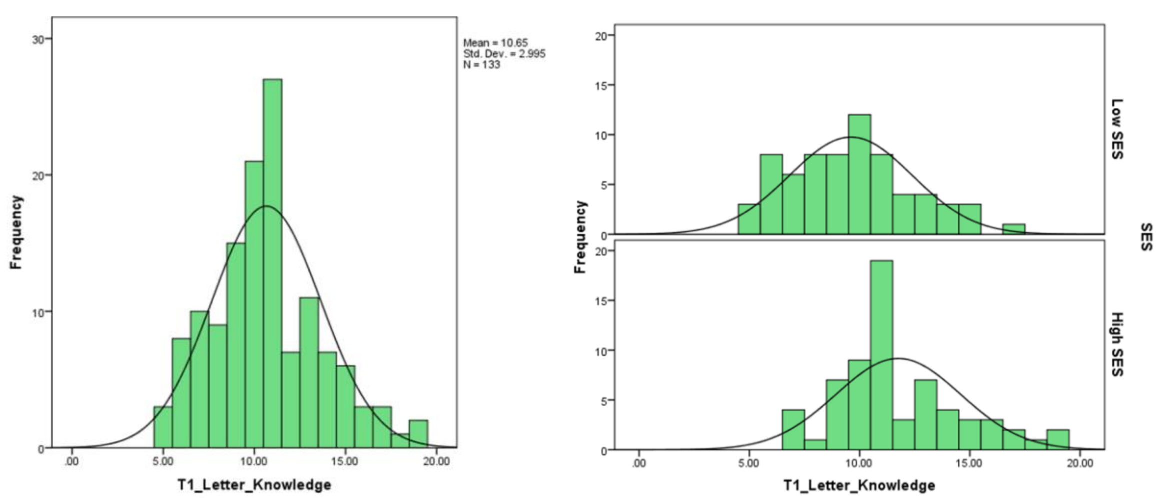
Table 50. Descriptive and comparative results – Letter knowledge at time 1

	Letter knowledge
Mean (SD)	10.7 (3.0)
N	133
Minimum	5
Maximum	19

The results presented in table 50 show that the average among all participants in the Letter knowledge task at time 1 was 10.7 with a standard deviation of 3.0. The range of the values is between 5 to 19 points.

In terms of the distribution, Letter knowledge at time 1 shows a non-normal distribution (p= 0.004). When the results are presented for the low and high SES groups, a normal distribution was found for the low SES group (p= 0.442), but non-normal distribution appears for the high SES group (p= 0.004) as shown in graph 14.

Graph 14. Histogram – Letter knowledge at time 1. All participants and SES groups



In table 51, the comparison between low and high SES group is presented.

Table 51. Comparative results – Letter knowledge at time 1

	Letter knowledge
Mean (SD) Low SES	9.6 (2.8)
N Low SES	68
Min / Max	5 / 17
Mean (SD) High SES	11.8 (2.8)
N High SES	65
Min / Max	7 / 19
t-test (p-value)	< 0.001

The results presented in table 51 show significant differences between low and high SES groups in the Letter knowledge task evaluated at time 1 (t_{131}=4,421, $p< 0.001$). The results show that children from low SES group perform significant below than their peers from high SES. The eta squared value is 13.0 for this difference, and the Cohen's d value is 0.79 SD, which can be considered as large.

Letter knowledge at time 2

Table 52 presents descriptive data from the letter knowledge task evaluated at time 2. The results express a mean between the sounds and names scores of the letters.

Table 52. Descriptive results – Letter knowledge at time 2

	Letter knowledge
Mean (SD)	45.4 (8.8)
N	105
Minimum	5
Maximum	51

The results show that in average 45 points were reached out of 51 points as maximum. The minimum score was 5 and the maximum was 51.

The scores for the Letter knowledge task at time 2 shows a non-normal distribution when all participants are included ($p< 0.001$). When the results are presented for the low and high SES groups, non-normal distribution appears both for the low SES (p< 0.001) and for the high SES group (p= 0.001) as shown in graph 15. The graphs show a *ceiling effect* in the high SES group, and a more distributed scores for the low SES group, with several scores below the average, which undoubtely affected the distribution of all participants.

Graph 15. Histogram – Letter knowledge at time 2. All participants and SES groups

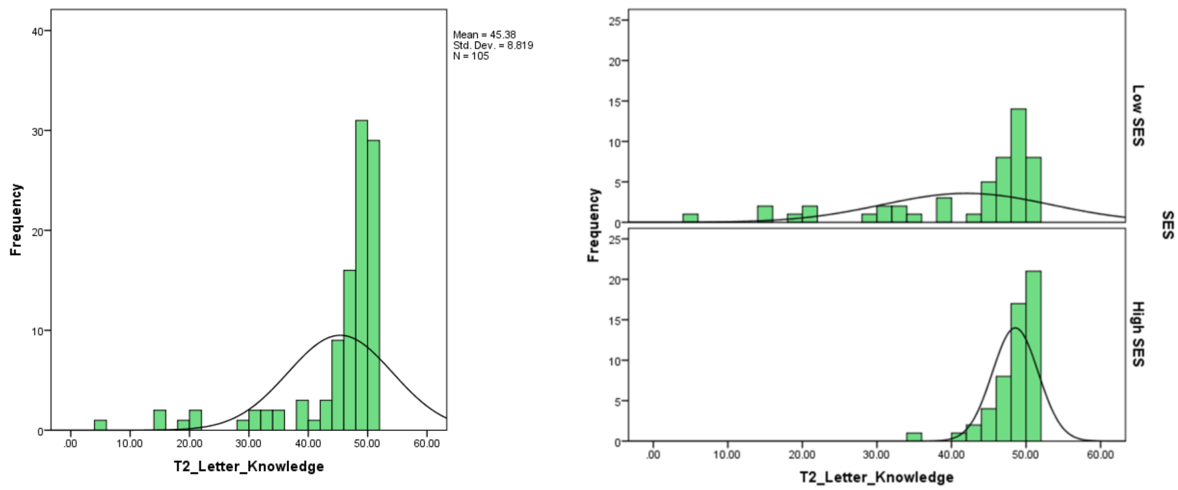


Table 53 presents a comparison between low and high SES groups.

Table 53. Descriptive results – Letter knowledge at time 2

	Letter knowledge
Mean (SD) Low SES	42.0 (11.4)
N Low SES	51
Min / Max	5 / 51
Mean (SD) High SES	48.6 (3.1)
N High SES	54
Min / Max	35 / 51
t-test (p-value)	< 0.001

The results in table 53 shows significant differences between low and high SES groups (t_{103}= 4,070, p<0.001). This is, children from low SES know significantly less words than their peers from high SES. The eta squared value is 0.139, this is, 13.9% of the variance of the results in the letter knowledge are explained by the student's SES group.

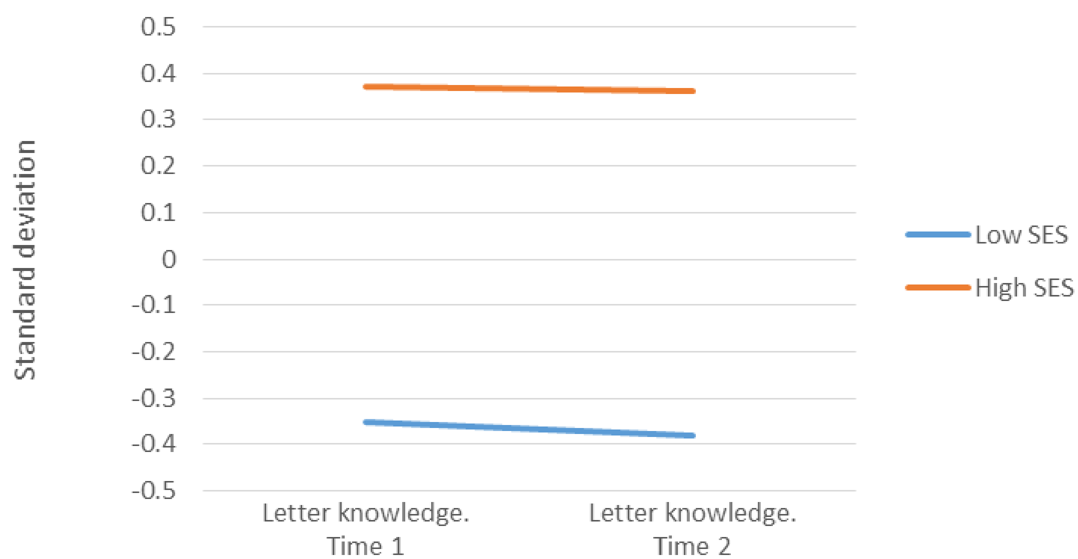
The Cohen's d value is 0.79, this is the standard deviation between low and high SES group is almost 0.8 which is considered a large difference.

The results of Letter knowledge subscales at Time 2 do not show a normal distribution according to Kolmogorov-Smirnov (p< 0.001).

Comparison of Letter knowledge according to SES at times 1 and 2

Graph 16 shows the letter knowledge scores by SES administered at both time points. It is important to highlight that letter knowledge at times 1 and 2 were evaluated using different tasks, therefore it is not possible to evaluate whether the skills improved or not through the years. This graph aims to express the differences in terms of the standard deviation at two time points. The results show that large differences were found both at time 1 (d= 0.78) and at time 2 (d= 0.76) when low and high SES were compared.

Graph 16. Letter knowledge according to SES



6.4. Summary of the chapter

This chapter presents the results of the variables included in the Triple Foundational Model. These variables included phonological awareness, rapid automatic naming (colours, objects, digits and letters), and letter knowledge. All these variables were measured at times 1 and 2.

The first variable included is Phonological awareness. At time 1 the mean was 9.5 with a standard deviation of 2.4. At time 2, the mean was 14.7 with a standard deviation of 3.9. It is important to mention that different tasks were used at both time points. Therefore, it is not possible to estimate an increasing or decreasing of the outcomes in this scale. In terms of the mean comparison between children from low and high SES, the results show significant differences both at times 1 and 2. The distance between groups is 0.88 standard deviation (Cohen's d value) at time 1, and 0.95 at time 2. In both cases, these differences can be considered as large ones. In addition to these tasks, non-word repetition was included as part of the phonological process. The results show a *ceiling effect* with a mean of 6.8 and 1.2 of standard deviation. No significant differences were found when low and high SES were compared in this task.

In terms of the score distribution, normal distribution at time 1 was found (K-S, p-value: 0.23), while non-normal distribution in the case of time 2. In the case of time 2, non-normal distribution appears for the low SES group (K-S, p-value: 0.01), while a normal distribution appear in the case of high SES group (K-S, p-value: 0.18). In this case, as in other skills, the results of the high SES group are normally distributed with raw data close to the mean, with an adequate dispersion of the data. However, in the case of Low SES groups, the data is dispersed throughout the scale, affecting not only the dispersion of this group itself, but also the dispersion for all participants.

The second of the predictors was Rapid automatic naming in its four versions: colours, objects, letters, and digits. The results show that children at time 1 were significantly faster in naming objects than colours (t_{125}= 3,831, $p< 0.001$), and at time 2, children were more efficient in naming digits than letters (t_{105}= 4,339, $p< 0.001$).

In terms of the effect of SES on the RAN tasks, the results show that all tasks have significant differences between low and high SES, with a larger effect for Colours at time 1, and Letters at time 2. The difference between low and high SES groups in RAN Letters is almost one standard deviation, which is quite similar to the effect found in tasks such as reading accuracy, and comprehension. The poor performance in the Low SES group compared to their peers from High SES group seems to show that children in the first group are less familiar with the letters compared to objects, colours and digits. This lack of familiarity with letters, in turn, seems to be related with a deficit of literacy materials at home and school. The automaticity between perceiving the items as letters, and then decoding and articulating them takes longer for the children from low SES group than their peers from high SES. This effect certainly can be linked to the differences in reading fluency between groups, since they share certain common principles in terms of automatizing the decoding processes.

In terms of distribution, none of the RAN subtasks showed a normal distribution. However, in three out of four subtasks, at least one of the subgroups showed normal distribution in their scores. These subtasks with normal distribution in at least one of the subgroups are Objects (High SES. K-S, p= 0.206), Letters, (High SES. K-S, p= 0.92), and Digits (High SES. K-S, p= 0.34). RAN Colours did not show normal distribution for all sample, and neither for the SES groups. In this case a highly positive skew emerged from the data, which affected the normal distribution of this subtask.

Finally, the last predictor included in this category is Letter knowledge. The students participating in this study at time 1 reached an average of 10.7 with a standard deviation of 3.0; while at time 2 the average was 45.8 with a standard deviation of 8.8. At both time points, different tasks were used, and therefore the results cannot be directly interpreted. Regarding the distance between low and high SES, there are significant differences between low and high SES groups. At time 1, the standard deviation is 0.79 between low and high SES groups, and this value is the same at time 2. These results can be labelled as large according Cohen's categories (1977).

In terms of dispersion, the phonological awareness scores at time 1 are normally distributed (K-S, p-value: 0.23), but in the case of phonological awareness at time 2, the distribution is not normally distributed among participants (K-S, p-value: 0.23). At time 2, although the distribution for all participation is not normal when the results are disaggregated by SES, dissimilar results appear for low SES with a non-normal distribution, (K-S, p-value: 0.01), while normal distribution appears for the high SES group (K-S, p-value: 0.18). This lack of normal distribution in the low SES group, can be explained for a large dispersion of the results, with a group of children with an adequate distribution, but the rest of the children performing poorly throughout the distribution.

Chapter 7: Results - Early language predictors

Chapter 7 presents the results of the early language predictors considered in this study. They include Grammar knowledge, Receptive vocabulary, Lexical search and retrieval. Grammar knowledge was evaluated through a sentence repetition task at time 1. Receptive vocabulary was evaluated at both time points through the Peabody test. Finally, lexical search and retrieval were evaluated through semantic and phonological fluency tasks. Semantic fluency was evaluated at times 1 and 2, while phonological fluency was solely included at time 2.

All tasks presented in this chapter are compound of interval data. T-test was considered to estimate the mean comparison between groups, and both eta-squared and Cohen's d value have been included to evaluate the effect size between groups. The results are presented in descriptive terms, including mean, standard deviation, sample size, and the range of values. The score distribution is presented through histograms, and the Kolmogorov-Smirnov test as the tool to evaluate the normal distribution of the scores. These histograms consider the raw scores of the tasks and the scales, which in turn, were compound as an average of them. Histograms are presented twice for all participants and for low and high SES groups.

7.1. Grammar knowledge: Sentence repetition

Table 54 shows the descriptive results for sentence repetition.

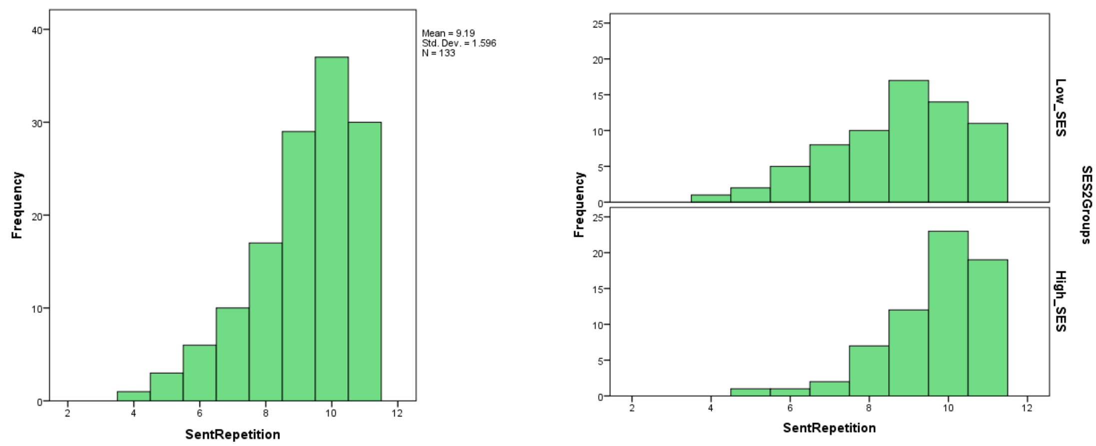
Table 54. Group scores for sentence repetition at time 1

	Sentence repetition
Mean (SD)	9.2 (1.6)
N	133
Minimum	4
Maximum	11

The results of the grammar knowledge evaluated through a sentence repetition task show a certain *ceiling effect* with a mean of 9.2 out of a maximum of 11.

In terms of the distribution, Sentence repetition shows a non-normal distribution ($p < 0.001$). When the results are dissagregated by SES groups, this non-normal distribution appears both in low ($p = 0.026$) and high SES group ($p = 0.001$). In the graph 17 is possible to find a left-skewed distribution.

Graph 17. Histogram – Sentence repetition at time 1. All participants and low and high SES



In table 55, a comparison between low and high SES group is presented.

Table 55. SES Comparison of Sentence repetition at time 1

	Sentence repetition
Mean (SD) Low SES	8.7 (1.7)
N Low SES	68
Min / Max	4 / 11
Mean (SD) High SES	9.7 (1.3)
N High SES	65
Min / Max	5 / 11
t-test (p-value)	0.001

The results for sentence repetition task show that children from the low SES group repeat sentences less accurately than their peers from the high SES group (t_{131}= 3,484, p= 0.001). In this task, the partial eta squared shows a value of 0.085, this is 9.0% of the variance which is explained by SES. The standardised difference between groups shows a value of 0.66 for Cohen's d value, which can be categorised as a medium effect. The difference between the low and high SES groups in this task is equivalent to one sentence.

To examine whether any of the sentences were particularly difficult for the low SES group compared to the high SES group, an analysis of the proportion of correct responses is presented in table 56.

Table 56. Percentage of correct responses for each item in the sentence repetition task

	Overall	Low SES	High SES	% differences
1. El gato con el lazo es gris.	83.3	81.5	85.2	-1.8
2. Los gatos se han comido al pez.	79.4	73.8	85.2	-5.6
3. La leche es arrastrada por el perro.	65.9	58.5	73.8	-7.4
4. ¿Qué ha bebido el perro?	98.4	100	96.7	1.6
5. El perro que los gatos empujan es azul.	38.1	33.8	42.6	-4.3
6. El gato lo lava.	99.2	98.5	100	-0.7
7. Los gatos beben la leche.	84.9	78.5	91.8	-6.4
8. El gato se lava.	97.6	96.9	98.4	-0.7
9. El perro es tocado por el gato.	77.8	73.8	82.0	-4
10. El perro rojo le da la leche.	93.7	90.8	96.7	-2.9
11. ¿A quién están lavando los gatos?	84.1	73.8	95.1	-10.3

In this task, one of the items revealed a large difference between low and high SES groups. The sentence was a wh-object question *¿A quién están lavando los gatos?* (who$_{\text{singular}}$ are the cats washing?), in which children from low SES performed 10.3% lower than high SES group. Space constraints preclude a detailed analysis of all the errors, but for both groups they were principally morphosyntactic in nature, including errors in tense and agreement (highlighted in bold), e.g. *¿A quién **le** están lavando los gatos?* (who **it** are the cats washing?), *¿A quién **ha lavado** los gatos?* (who **has** the cats wash**ed**?) and *¿A **quiénes lavaron** los gatos?* (**who$_{\text{plural}}$ did** the cats **wash**?).

However, this was not the most difficult sentence for children overall. The four sentences that accrued less than 80% of correct repetitions among both groups were the object relative clause *el perro que los gatos empujan es azul* (the dog that the cats push is blue), the present perfect *los gatos se han comido al pez* (the cats have eaten the fish), and the passives *la leche es arrastrada por el perro* (the milk is pulled by the dog) and *el perro es tocado por el gato* (the dog is touched by the cat). Again, for both groups the errors were mainly morphosyntactic in nature.

For the most difficult sentence, *el perro que los gatos empujan es azul* (38%), typical errors included e.g. *el perro que **lo** empujan los gatos es azul* (with insertion of lo, "it"), *and **el gato** que lo empujan es azul* (**the cat** that **it push** is blue). For *los gatos se han comido al pez* (79%) errors included *los gatos se **comieron** al pez* (the cats **ate** the fish) and ***el gato** se **ha** comido al pez* - (**the cat has** eaten the fish). In the two passive sentences, *la leche es arrastrada por el perro* (66%) and *el perro es tocado por el gato* (78%) "es" was sometimes replaced by "está". Both verbs are linking "to be", but only "es" can be used in passive constructions. Other errors included *la leche **se arrastraba** por el perro* (the milk **pulled itself** by the dog) and *el perro es tocado **con** el gato* (the dog is touched **with** the cat).

Repetition accuracy differed between sentences, and although the overall picture is that 10 out of those 11 items were repeated less accurately by the low SES group, there was only one item that was disproportionately difficult for that group. The two groups made similar errors across items.

7.2. Receptive vocabulary

In order to evaluate vocabulary, the Peabody Picture Vocabulary Test (PPVT) or Test de Vocabulario en Imágenes Peabody (TVIP) in Spanish, was administered (Dunn &

Dunn, 1981). The results of the Receptive vocabulary test for both times 1 and 2 are presented in Table 57.

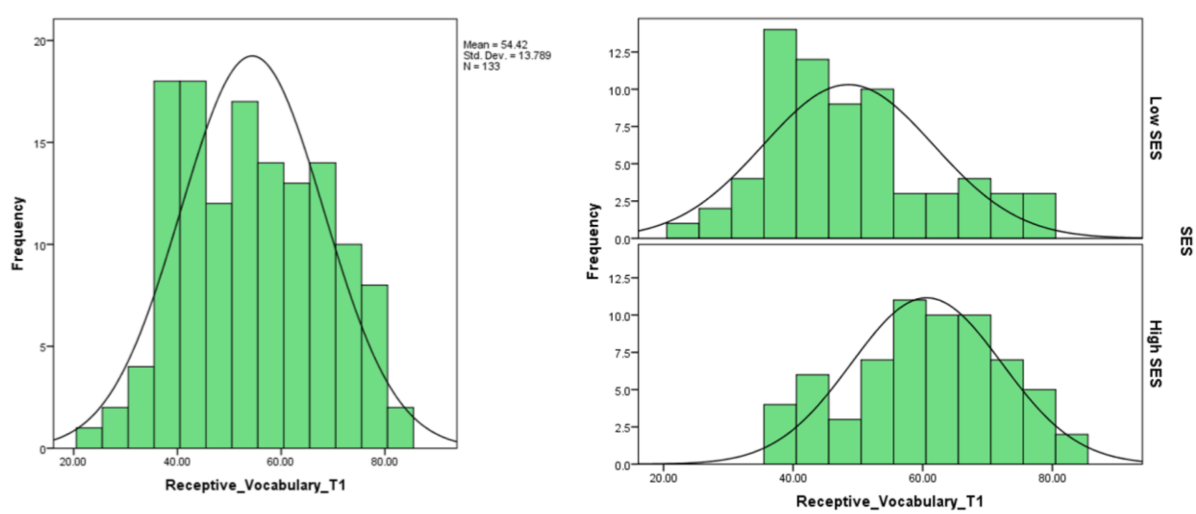
Table 57. Scores for receptive vocabulary at times 1 and 2

	Receptive vocabulary. Time 1	Receptive vocabulary. Time 2
Mean (SD)	54.4 (13.8)	80.7 (13.5)
N	133	106
Minimum	23	55
Maximum	82	118

The results of receptive vocabulary show an increasing of 26.3 points in the scores between time 1 and 2.

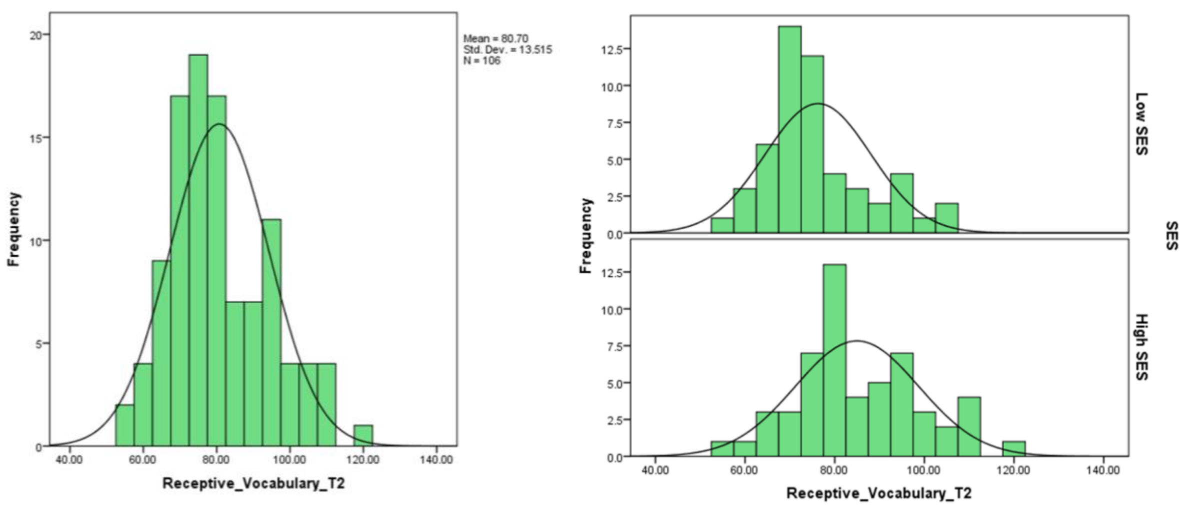
In terms of the distribution, Receptive vocabulay evaluated at time 1 shows a normal distribution according Kolmogorov-Smirnov (p= 0.425). This normal distribution appears both in low (p= 0.439) and high SES group (p= 0.867). Graph 18 shows the score distribution for the Receptive vocabulary at time 1, for all participants and for low and high SES groups.

Graph 18. Histogram – Receptive vocabulary at time 1. All participants and SES groups



Receptive vocabulary evaluated at time 2 shows a normal distribution according to Kolmogorov-Smirnov (p= 0.129). However, this normal distribution appears only for the high SES group (p= 0.492), but not for low SES group (p= 0.036). While in the low SES group the scores are not normally distributed, there is still a proportion of children performing below than expected which can affect the distribution of this specific group as seen in the graph 19.

Graph 19. Histogram – Receptive vocabulary at time 2. All participants and SES groups



The comparisons of time 1 and 2 between low and high SES groups are presented in Table 58.

Table 58. Scores for receptive vocabulary at times 1 and 2

	Receptive vocabulary. Time 1	Receptive vocabulary. Time 2
Low SES. Mean (SD)	48.5 (13.2)	76.3 (11.8)
N Low SES	68	52
Min / Max	23 / 78	55 / 106
High SES. Mean (SD)	60.6 (11.6)	85.0 (13.8)
N High SES	65	54
Min / Max	36 / 82	55 / 118
t-test (p-value)	< 0.001	< 0.001

In terms of the comparison according to SES, receptive vocabulary shows one of the largest differences among tests and tasks. Group differences are significant both at Time 1 (t_{131}= 5,605; p< 0.001) and Time 2 (t_{104}= 3,482; p< 0.001). The partial eta square shows a value of 0.193 at time 1, and 0.104 at time 2. This means that SES explains 19.3% of the variance at time 1 and 10.4% at time 2. In terms of Cohen's d, the value for time 1 is 0.97 and 0.68 for time 2. These values represent large differences between groups according the Cohen (1977) classification.

While there is some narrowing in the gap between low and high SES groups when comparing times 1 and time 2, there are still significant differences. This slight narrowing of the gap may be explained by the fact that the schools offer a range of new words that might improve students' lexical knowledge, especially from those from deprived environments. Increased access to new words can have an effect on this group, although it is not enough to reach the scores of the high SES group who, in turn, continue learning new words.

7.3. Lexical search and retrieval

In the present study, lexical search and retrieval were evaluated at times 1 and 2 via semantic and phonological fluency tasks.

7.3.1. Semantic fluency task

In the semantic fluency task, children were required to name as many words as possible from a category within one minute. The results are presented in Table 59.

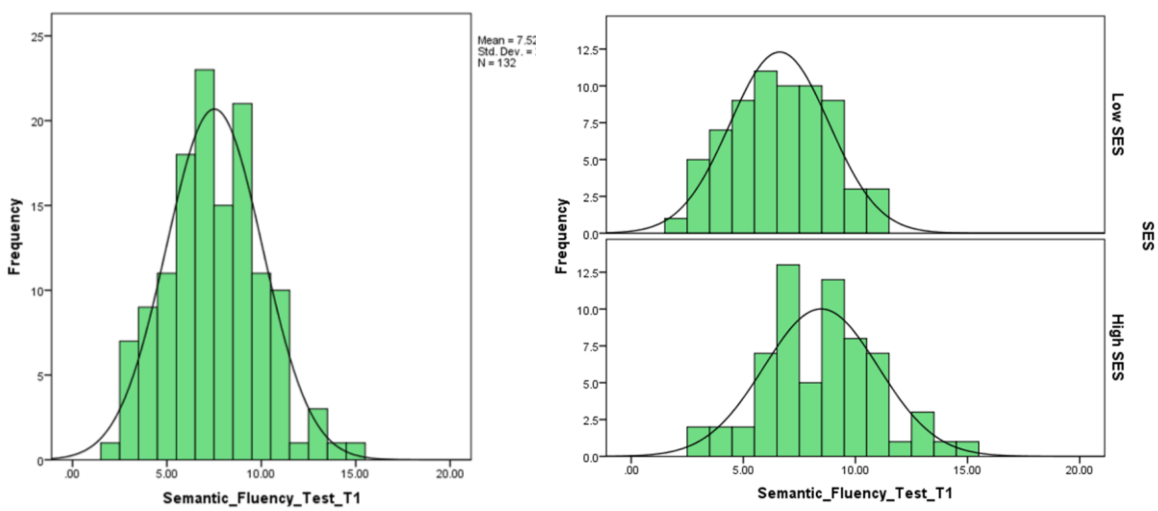
Table 59. Number of produced words for the semantic fluency test at times 1 and 2

	Semantic fluency test T1	Semantic fluency test T2
Mean (SD)	7.5 (2.5)	11.1 (3.7)
N	132	106
Minimum	2	5
Maximum	15	21

The results of semantic fluency task show a significant progression in the results after two years. At time 1, when children were 5 years old, the mean number of animals produced was 7.5. Instead, at Time 2, the number increased to 11.1, meaning that children can produce almost 4 more animals at age 7 than at age 5. This difference is statistically significant (t_{105}=9.950; p< 0.001).

The score distribution for the semantic fluency test evaluated at time 1 shows a normal distribution when all participants are included (p= 0.122). When low and high SES groups are analysed, the Kolmogorov-Smirnov shows normal distribution both for the low (p= 0.476), and the high SES group (p= 0.280), as it can be seen in the graph 20.

Graph 20. Histogram – Semantic fluency at time 1. All participants and SES groups



The score distribution for this task evaluated at time 2 also shows a normal distribution when all participants are included (p= 0.063). Both low (p= 0.338) and high SES groups (p= 0.159) also show a normal distribution in each group, as it appears in the graph 21.

Graph 21. Histogram – Semantic fluency at time 2. All participants and SES groups

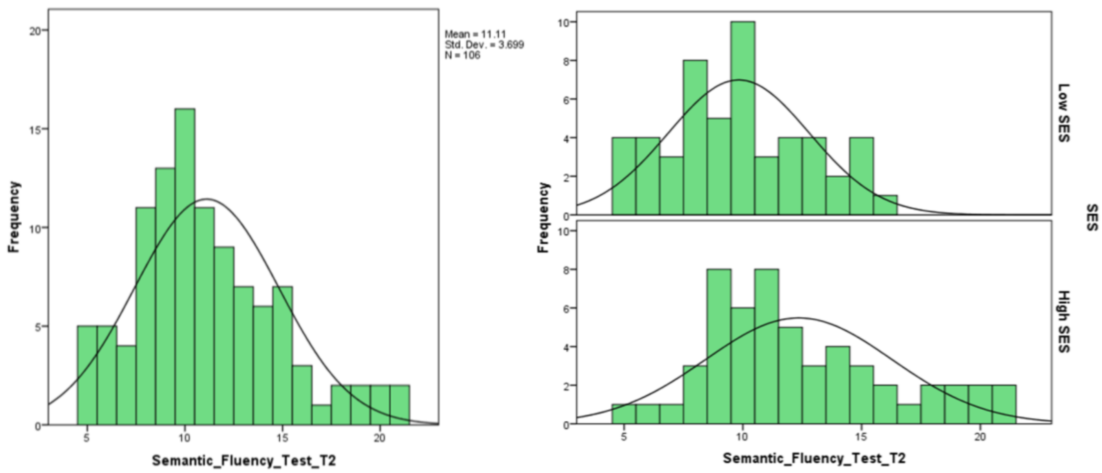


Table 60 presents a comparison of semantic fluency test by SES at times 1 and 2.

Table 60. Scores for Semantic fluency test at times 1 and 2

	Semantic fluency test T1	Semantic fluency test T2
Low SES. Mean (SD)	6.6 (2.2)	9.8 (3.0)
N Low SES	68	52
Min / Max	2 / 11	5 / 16
High SES. Mean (SD)	8.5 (2.6)	12.4 (3.9)
N High SES	65	54
Min / Max	3 / 15	5 / 21
t-test (p-value)	< 0.001	< 0.001

Regarding the comparison by SES, the results show a significant difference in favour of children from high SES both at time 1 and then at time 2. At time 1, children from low SES were able to produce 6.6 animals in one minute, while children from high SES named 8.5 (t_{131}= 4,467, p< 0.001). The partial eta squared shows a value of 0.133, that is, SES explains 13.3% of the variance. The Cohen's d value when comparing low and high

SES is 0.8. The high SES group performed 0.8 standard deviation above the low SES group in this task.

At time 2 both groups produced significantly more animals than at time 1, e.g. children from the low SES group named 3.1 and children from the high SES group named 3.8 more animals than 2 years earlier. At time 2, significant differences were found by SES (t_{104}= 3,722, $p< 0.001$). The partial eta squared shows a value of 0.118, that is, SES explains 11.8% of the variance. The Cohen's d value when comparing low and high SES is 0.75. The high SES group performed 0.75 standard deviation above the low SES group in this task.

In terms of the variety of responses, those responses which include plurals or diminutives were considered in the same category. At time 1, children named 121 different animals. In the case of time 2, children not only produced more words in one minute, but they also named a wider range of animals. At time 2, 163 different animals were produced. Table 61 shows the 10 most typical animals produced by the children at times 1 and 2.

Table 61. Most frequent produced animals in the semantic fluency task

	Animals	Occurrences (times)
Time 1	Leon (*lion*)	83
	Elefante (*elephant*)	73
	Tigre (*tiger*)	62
	Jirafa (*giraffe*)	62
	Gato (*cat*)	41
	Caballo (*horse*)	41
	Perro (*dog*)	39
	Vaca (*cow*)	25
	Mono (*monkey*)	22
	Conejo (*rabbit*)	18
Time 2	Perro (*dog*)	71
	Gato (*cat*)	70

	Leon (*lion*)	69
	Elefante (*elephant*)	58
	Jirafa (*giraffe*)	52
	Caballo (*horse*)	51
	Tigre (*tiger*)	49
	Vaca (*cow*)	36
	Conejo (*rabbit*)	30
	Puma (*cougar*)	27

The analysis shows no significant variations in terms of the most typical animals produced by children. Basically, the same animals, although a different order appears at times 1 and 2, except for Mono (monkey) that does not appear in the top ten of frequency at time 2, and Puma (*cougar*) which did not appear in the list of frequent animals at time 1.

The following analyses include the first animal that children produced at times 1 and 2 only. In both time points: lion, elephant, and horse were the first animals that children named, and in the same order. Table 62 summarises these results.

Table 62. Most frequent animals elicited at the beginning of the task

Time 1		Time 2	
Animals	Occurrences (times)	Animals	Occurrences (times)
Leon (*lion*)	27	Leon (*lion*)	20
Elefante (*elephant*)	26	Elefante (*elephant*)	18
Caballo (*horse*)	13	Caballo (*horse*)	16
Jirafa (*giraffe*)	13	Perro (*dog*)	14
Perro (*dog*)	7	Tigre (*tiger*)	6

Phonological fluency

The results of the phonological fluency test are presented in table 63. These results are sums from the produced words starting with F, A, and S.

Table 63. Scores for phonological fluency (F/A/S) test at time 2

	Letter F/A/S
Mean (SD)	14.2 (5.5)
N	106
Minimum	4
Maximum	27

Regarding the results, the three tasks were challenging for the students at this age, although naming words starting with the letter F was the most difficult task, with an average of only 4 words produced in one minute.

The score distribution for the phonological fluency task evaluated at time 2 also shows a normal distribution when all participants are included (p= 0.292). When low and high SES are considered, a normal distribution was found for the low (p= 0.769) and high SES groups (p= 0.518), as seen in graph 22.

Graph 22. Histogram – Phonological fluency at time 2. All participants and SES groups

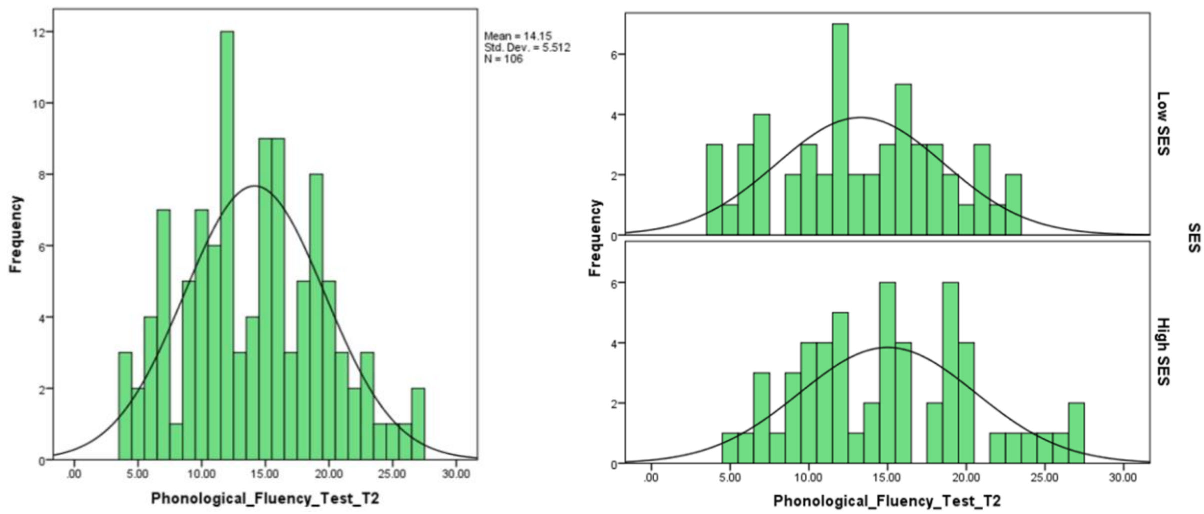


Table 64 shows a comparison in three subtasks of phonological fluency test evaluated at time 2 by SES.

Table 64. Score comparisons for phonological fluency (F/A/S) test at time 2

	Letter F/A/S
Low SES. Mean (SD)	13.3 (5.3)
N Low SES	52
Min / Max	4 / 23
High SES. Mean (SD)	15.0 (5.6)
N High SES	54
Min / Max	5 / 27
t-test (p-value)	0.106

The phonological fluency task was only evaluated at time 2, and the scores do not show a significant difference between low and high SES groups (t_{104}= 1,629, p= 0.106). The eta squared value is 0.025, which means that only 2.5% of the variance in Phonological fluency test is explained by SES. The Cohen's d value is 0.31, which expresses the difference between low and high SES in standard deviations.

Table 65. Most frequent produced words in the phonological fluency task

Sounds	Words	Occurrences (times)
F	Foca (*seal*)	47
	Flor (*flower*)	18
	Familia (*family*)	17
	Feo (*ugly*)	16
	Fantasma (*phantom*)	13
A	Avión (*airplane*)	68
	Abeja (*bee*)	65
	Arbol (*tree*)	50
	Auto (*car*)	39
	Ave (*bird*)	12
S	Sapo (*toad*)	63
	Serpiente (*snake*)	25
	Silla (*chair*)	13
	Sapato (Z) – (*shoe*)	13
	Sala (*room*)	12

7.4. Summary of the chapter

The results of this chapter summarise the descriptive and comparative results for the group of skills labelled as early language predictors that included three tasks: grammar knowledge, receptive vocabulary, and lexical search and retrieval.

Grammar knowledge was evaluated at time 1, through a Sentence repetition task. The results show a kind of *ceiling effect* in the results. When low and high SES are compared, significant differences were found in favour of children from high SES (t_{131}= 3,484, p< 0.001). The distance between groups is 0.66, which can be considered as a medium effect. In terms of the distribution, non-normal distribution emerged when all participants were included, neither normal distribution was found for the low (K-S, p-value= 0.026) and high SES (K-S, p-value= 0.001) groups.

The second set of variables includes receptive vocabulary. Receptive vocabulary was evaluated through a Peabody test. The same test was administered at both time points of this study, and therefore the longitudinal effect of this skill may be interpreted.

There were significant gains for the receptive vocabulary at time 2, compared to the performance at time 1 (t_{105}= 22,669, p< 0.011). Significant differences were found for the means from low and high SES groups ($_{t131}$- 5,605, p< 0.001), with practically one standard deviation of difference between them (Cohen's d value= 0.97). The scores are normally distributed both for all participants (K-S, p-value= 0.425) as well for the low (K-S, p-value= 0.439) and high SES (K-S, p-value= 0.867) groups. At time 2, significant differences were also found in favour of high SES group ($_{t131}$- 3,482, p= 0.001), although the distance between groups is lower than the case of receptive vocabulary at time 1 (Cohen's d value= 0.68). In terms of the distribution, normal distribution was found when all participants are included (K-S, p-value= 0.129). A plausible explanation to the decreasing gaps in vocabulary between times 1 and 2, can be related with the school, which seems to have been more relevant for those children from low SES group. Probably, children from low SES were exposed to less opportunities to access wider and depth vocabulary. The school therefore hold the children's vocabulary performance, decreasing the gap, although not enough to achieve non-significant differences between groups.

Finally, the last set of predictors included in this group refers to the lexical search and retrieval, which was evaluated through a semantic and phonological fluency test. Same task (Semantic fluency test) was administered at two time points, while Phonological awareness test was administered solely at time 2. The results show that a significant improvement was found between Semantic fluency test at time 2 versus 1 (t_{105}= 9,950, p< 0.001). Significant differences were found when low and high SES groups were compared at times 1 (t_{130}= 4,467, p< 0.001) and 2 (t_{131}- 3,722, p< 0.001). The Cohen's d value is quite similar between both time points (Cohen's d value at time 1: 0.79; Cohen's d value at time 2: 0.75). Finally, phonological fluency test was evaluated at time 2 of the study. The results do not show significant differences between low and high SES (t_{104}- 0.518, p= 0.106).

In terms of the distribution, normal distribution was found for all the tasks included in this category (Lexical search and retrieval, vocabulary, and semantic and phonological fluency test). This normal distribution appears when all participants are included. The exception is Sentence repetition test in which normal distribution was unable to be found (K-S, p-value: 0.000). This lack of normal distribution was found both for the low (K-S, p-value: 0.026) and for the high SES (K-S, p-value: 0.001).

Chapter 8: Results - Cognitive skills

Chapter 8 presents the results of the Cognitive skills considered in this study. They include General cognitive, ability, Analogical reasoning, Inferencing, Categorisation, and Executive functions. General cognitive ability was evaluated through the block building task from BAS II, and it was evaluated at time 1. Analogical reasoning was evaluated through a series of cards in which a pattern must be filled. Analogical reasoning includes two subscales: verbal and non-verbal, and the same tasks were evaluated at times 1 and 2 of the current study. Inferencing was evaluated through the Blicket detector approach and it was evaluated at time 1. Categorisation was evaluated to the categorical flexibility approach with a game prepared *ad hoc* to this study. Categorical flexibility was evaluated at time 1 of the study. Executive functions were estimated from a mathematical game called Tower of Hanoi. This game was evaluated at time 2 of the study.

All tasks presented in this chapter are compound of interval data, except Categorisation (categorical flexibility) which was evaluated through ordinal data. T-tests were considered to estimate the mean comparison of the rest of tasks between groups. Eta-squared and Cohen's d value have been included to evaluate the effect size between groups. The results are presented in descriptive terms, including mean, standard deviation, sample size, and the range of values. The score distribution is presented through histograms, and Kolmogorov-Smirnov test has been included as the statistical tool to evaluate the normal distribution of the scores. These histograms consider the raw scores both of the tasks and the scales, which in turn, were compound as an average of them. Histograms are presented twice for all participants and for low and high SES groups.

8.1. General cognitive ability

The raw results of the block building task from the British Ability Scales (BAS) are presented in Table 66. The maximum score in this task was 18 points.

Table 66. Descriptive results – Block building at time 1

	Block building
Mean (SD)	15.5 (2.2)
N	133
Minimum	6.5
Maximum	18

The results in the block building task show a mean of 15.5 with a standard deviation of 2.2 among 133 participants. The range goes from 6.5 as minimum to 18 points as maximum.

The block building task does not show a normal distribution when all participants are included, according to the Kolmogorov-Smirnov Test (p= 0.002). When low and high SES are considered it is possible to find mixed results, with a normal distribution for the high SES group (p= 0.123), and a non-normal distribution for the low SES group (p= 0.018) as seen in graph 23.

Graph 23. Histogram – Block building task at time 1. All participants and SES groups

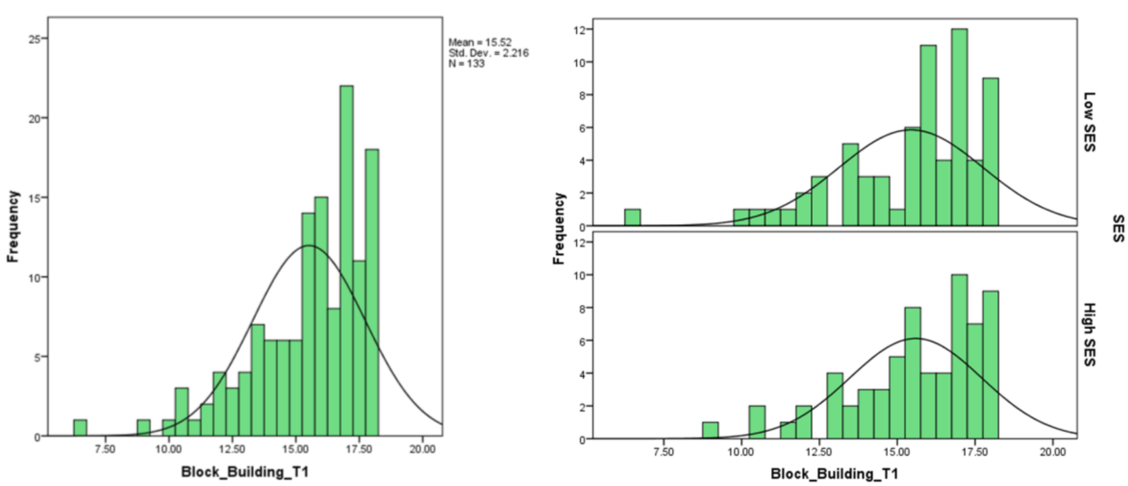


Table 67 shows a summary of the raw scores of the block building task.

Table 67. Scores for block building task at time 1

	Block building
Low SES. Mean (SD)	15.4 (2.3)
N Low SES	68
Min / Max	6.5 / 18
High SES. Mean (SD)	15.6 (2.1)
N High SES	65
Min / Max	9 / 18
t-test (p-value)	0.696

The analysis according to student's SES did not show significant differences when comparing low and high SES groups (t_{131}=0.392, p= 0.696). The effect size measured through partial eta square shows a value of 0.001. The Cohen's d value for this task is 0.09.

8.2. Analogical reasoning

Analogical reasoning at time 1

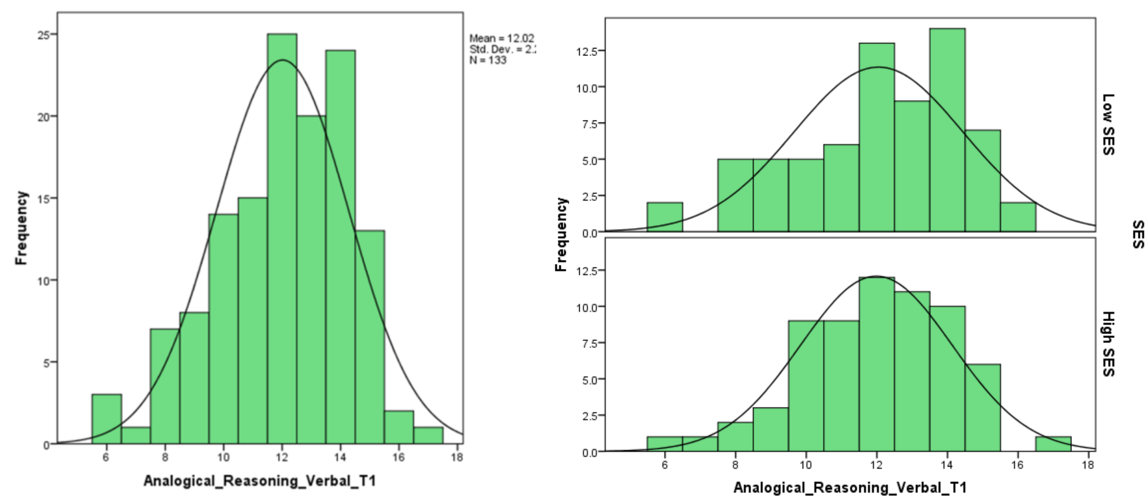
Table 68 includes the scores of both scales. Each correctly identified image was scored with 1 point and 0 for those incorrect responses. The maximum score in each scale was 20 points.

Table 68. Descriptive results – Analogical reasoning at time 1

	Analogical reasoning verbal	Analogical reasoning non-verbal
Mean (SD)	12.0 (2.3)	12.1 (2.0)
N	133	133
Minimum	6	6
Maximum	17	17

Results at time 1 show quite similar outcomes in both analogical reasoning (verbal and non-verbal) scales. The verbal subtask of the Analogical reasoning task evaluated at time 1 does not show a normal distribution when all participants are included, according to the Kolmogorov-Smirnov test (p= 0.014). However, when the scores are divided into low and high SES groups, a normal distribution appears for the low SES (p= 0.078), and for the high SES group (p= 0.323), as seen in graph 24.

Graph 24. Histogram – A. reasoning – Verbal at time 1. All participants and SES groups



In the case of the non-verbal subtask, the situation is quite similar, with a non-normal distribution for all participants (p= 0.014), but with a normal distribution both for the low (p= 0.078), and for the high SES group (p= 0.323), as it appears in the graph 25.

Graph 25. Histogram – A. reasoning – Non-verbal at time 1. All participants and SES groups

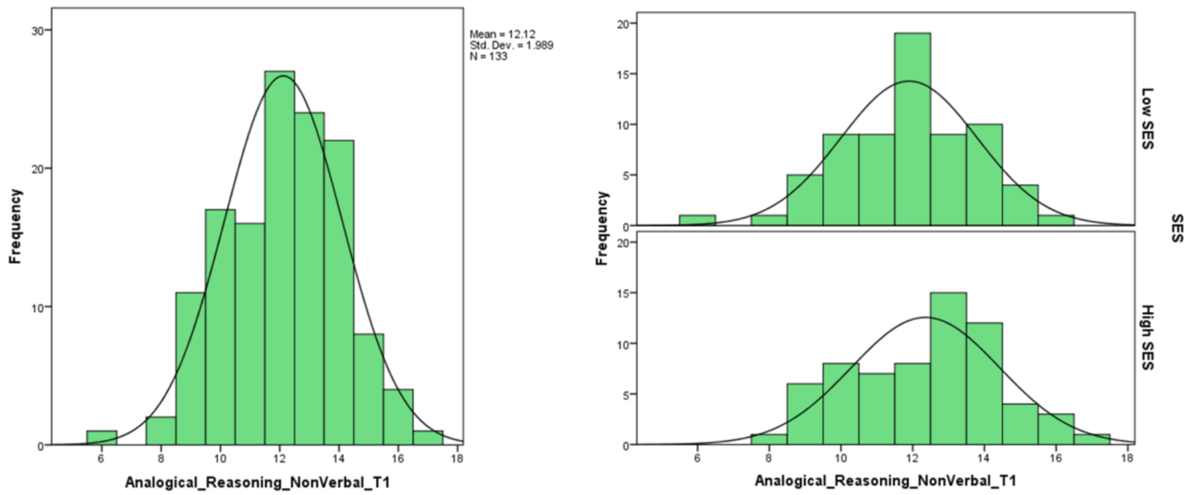


Table 69 presents comparisons between low and high SES groups in both subtasks at time 2.

Table 69. Analogical reasoning Verbal and Non-verbal by SES at time 1

	Analogical reasoning verbal	Analogical reasoning non-verbal
Low SES. Mean (SD)	12.0 (2.4)	11.9 (1.9)
N Low SES	68	68
Min / Max	6 / 16	6 / 16
High SES. Mean (SD)	12.0 (2.1)	12.3 (2.1)
N High SES	65	65
Min / Max	6 / 17	8 / 17
t-test (p-value)	0.880	0.187

Regarding the comparison by SES, the results of verbal scale do not show a significant difference for analogical reasoning verbal task (t_{131}= 0.151, p=0.880), but this difference is significant in the case of analogical reasoning – non-verbal task (t_{131}= 1.328, p=0.013). Thus, the eta squared for the verbal subtask shows a value of 0.000, while for the non-verbal subtask the value was 0.013. In terms of the distance between groups, this is 0.0 SD in the verbal task, and 0.24 SD for the non-verbal task.

Analogical reasoning at time 2

At time 2, the same slides were presented. Table 70 includes the scores of both scales. Each of the correctly identified images was scored with 1 point and 0 for those incorrect responses.

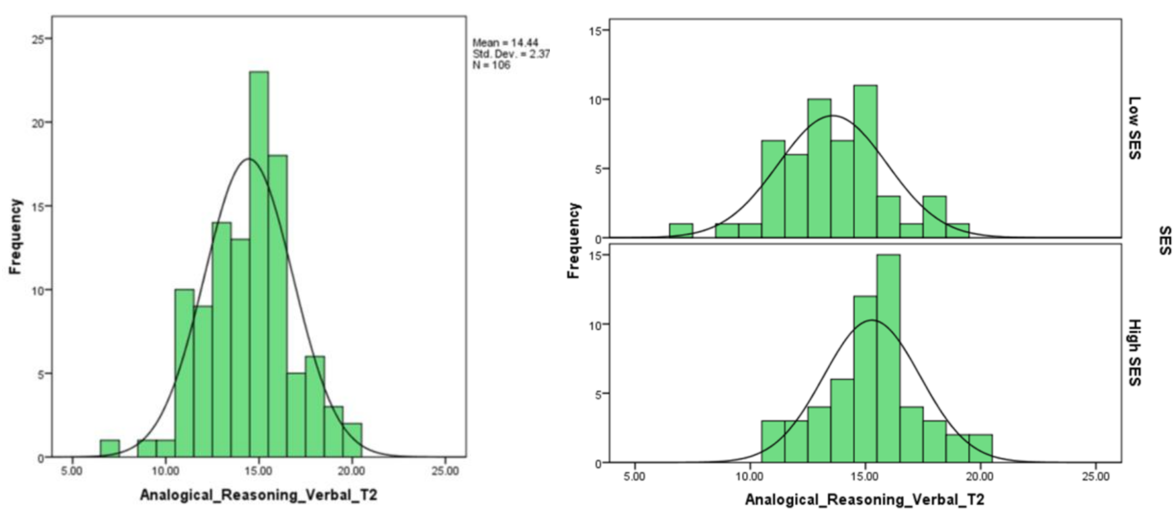
Table 70. Descriptive results – Analogical reasoning at time 2

	Analogical reasoning verbal	Analogical reasoning non-verbal
Mean (SD)	14.4 (2.4)	13.5 (2.2)
N	106	106
Minimum	7	8
Maximum	20	19

Results at time 2 show better performances for the verbal scale than the non-verbal, with 72.0% in the verbal scale and 67.5% in the non-verbal scale of correct responses. At this time, the maximum score was reached in the case of verbal and 19 out of 20 points were reached as maximum score in the case of non-verbal scale.

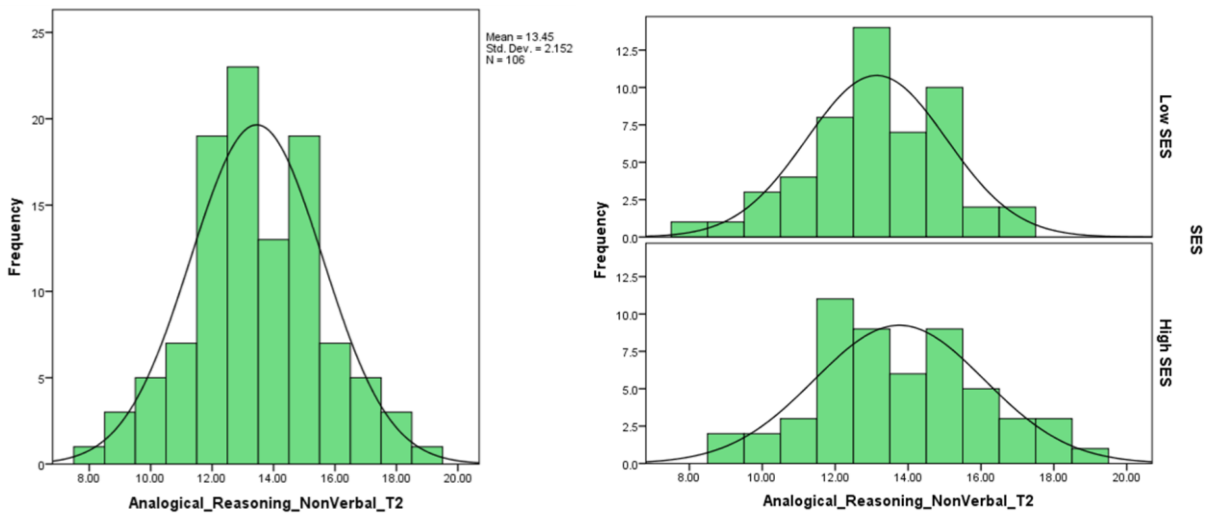
The verbal subtask of the Analogical reasoning task evaluated at time 2 shows a normal distribution when all participants are included, according the Kolmogorov-Smirnov test (p= 0.054). This normal distribution appears both for the low SES (p= 0.454), and for the high SES group (p= 0.120), as it appears in the graph 26.

Graph 26. Histogram – A. reasoning – Verbal at time 2. All participants and SES groups



In the case of non-verbal subtask evaluated at time 2, the situation is quite similar, with a normal distribution for all participants (p= 0.054), and a normal distribution for the low (p= 0.223), and the high SES group (p= 0.342), as seen in graph 27.

Graph 27. Histogram – A. reasoning - Non-verbal at time 2. All participants and SES groups



In table 71 the results at time 2 are compared in terms of the SES groups.

Table 71. Analogical reasoning Verbal and Non-verbal by SES at time 2

	Analogical reasoning verbal	Analogical reasoning non-verbal
Low SES. Mean (SD)	13.6 (2.4)	13.1 (1.9)
N Low SES	52	52
Min / Max	7 / 19	8 / 17
High SES. Mean (SD)	15.3 (2.1)	13.8 (2.3)
N High SES	54	54
Min / Max	11 / 20	9 / 19
t-test (p-value)	<0.001	0.136

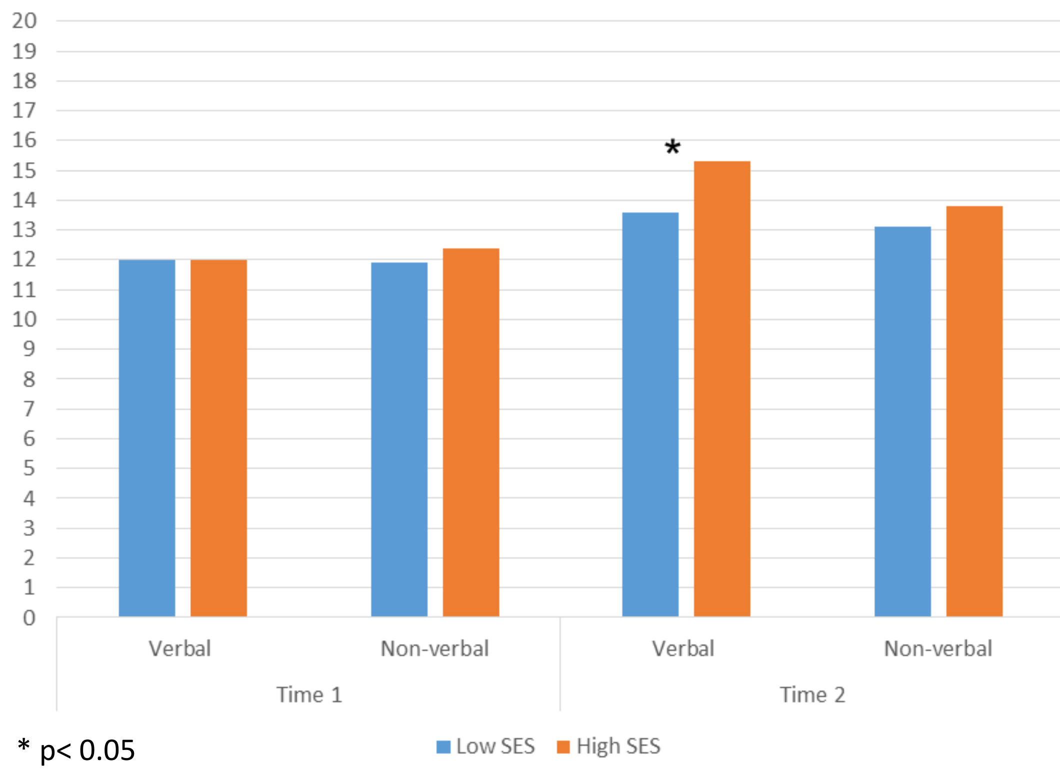
When comparing through SES, the results of the verbal scale show a significant difference by groups (t_{104}= 3,932, p<0.001). The effect size measured through partial eta squared shows a value of 0.129; in other words, SES might explain almost 12.9% of the variance in the verbal task at time 2. The difference between groups expressed in Cohen's d value is 0.75, this is the difference in terms of standard deviation between low and high SES groups.

In the case of the non-verbal scale, the results do not show a significant effect of SES (t_{104}= 1.503, p= 0.136). The eta squared value for the non-verbal task at time 2 is 0.02. Thus, SES might explain just 2.0% of the variance. The Cohen's d value is 0.33, which expresses a difference of 0.3 standard deviation between low and high SES groups, although this difference is not a significant one.

Comparison verbal and non-verbal scales at times 1 and 2

Graph 28 shows a summary of the comparisons between low and high SES groups in the verbal and non-verbal tasks, at times 1 and 2.

Graph 28. Comparison of verbal and non-verbal scales by SES at times 1 and 2



* $p< 0.05$

The verbal scale evaluated at time 2 shows significant differences when comparing low and high SES groups (t_{104}= 3.932, p< 0.01). In the rest of the cases, no significant differences were found.

Table 72. Comparison of verbal and non-verbal scales by SES at times 1 and 2

		Low SES		High SES	
		Mean	SD	Mean	SD
Time 1	Verbal	12.0	2.4	12.0	2.1
	Non-verbal	11.9	1.9	12.4	2.1
Time 2	Verbal	13.6	2.4	15.3	2.1
	Non-verbal	13.1	1.9	13.8	2.3

AR Verbal: $F_{1,104}$= 16,392, p< 0.001 / AR No verbal: $F_{1,104}$= 1,168, p= 0.282.

In order to evaluate whether the SES groups might influence the development of the analogical reasoning skills, two different ANOVA – repeated measures were conducted. One of the reasons to conduct two 2x2 instead of 2x2x2 analysis is because of the features of the scales. While the aim of the scales is filling a pattern of a missing piece, in the verbal subtask children require not only to know the name of the objects, but also some associated features to that object (i.e function, synonym, antonym, etc). This aspect is not required in the non-verbal scale, which can be considered as a more language-free test.

The first analysis compared the Analogical reasoning in the verbal subscale, to estimate whether the children SES had (or not) an effect on the results of this task at times 1 and 2. The ANOVA showed a significant effect on the interaction between SES and Analogical reasoning - verbal ($F_{1,104}$ =16,392, p< 0.001). This finding can be interpreted as evidence of the effect of SES had on the Analogical reasoning performance, expressed as a significant increase for the high SES group. While in average, the low SES increased 1.9 points between times 1 and 2, in the high SES group the results show 3.4 points more between times 1 and 2.

The second analysis followed the same pattern, but it includes the non-verbal scales at two times (1 and 2). The result does not show a significant effect of the interaction between the analogical performance and the low and high SES groups ($F_{1,104}$ =1,168, p= 0.282). In other words, both low and high SES groups improved their performances with no significant differences between them (Low SES: +0.8; High SES: +1.5 points).

8.3. Inferences task. Blicket detector.

In this study, the Blicket detector task has been administered. At time 1, the forward procedure has been used with one and two causes. In the one cause procedure, only one of the two objects activated the machine. In the two-cause procedure, two objects activated or deactivated the machine, when both were placed on it. Table 73 presents a summary of the results.

Table 73. Descriptive results – Inferences (Blicket detector task) at time 1

	Inferences (Blicket detector)
Mean (SD)	10.0 (3.6)
N	133
Minimum	0
Maximum	18

Results of 133 participants show that on average children reached 10 out of 18 points. The range goes from 0 to 18 points.

The Blicket detector scores show a non-normal distribution when all participants are included, according the Kolmogorov-Smirnov test (p= 0.041). However, when the groups are divided, normal distribution appears for the low (p= 0.406) and high SES (p= 0.116). While the distribution is not normal for all participants, it is not far away from a normal distribution, which could be explained for a large proportion of students close to the mean, as seen in graph 29.

Graph 29. Histogram – Blicket detector at time 1. All participants and SES groups

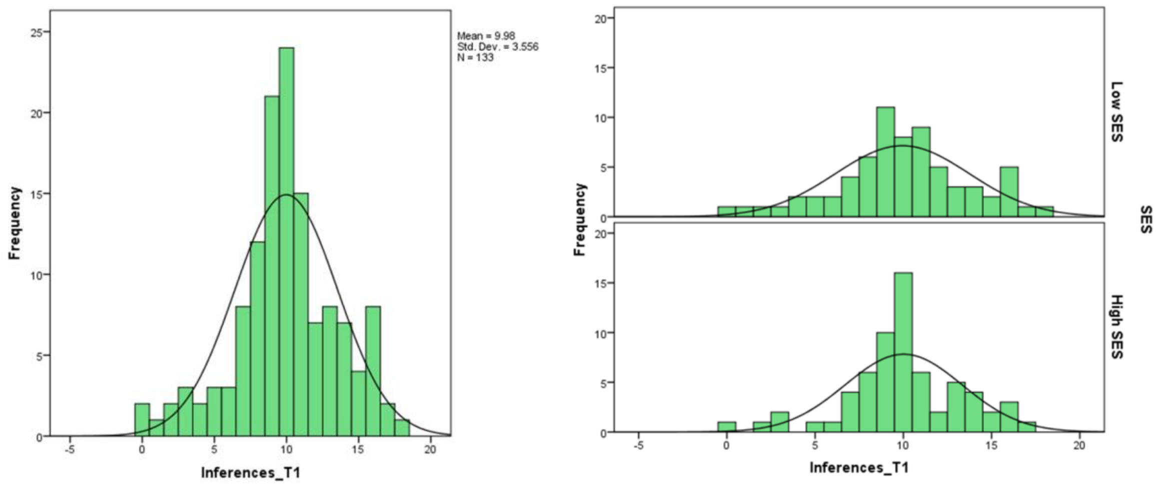


Table 74 presents the results for the blicket detector task when comparing low and high SES groups.

Table 74. Comparative results – Inferences (Blicket detector task) at time 1

	Blicket detector
Low SES. Mean (SD)	9.9 (3.8)
N Low SES	68
Min / Max	0 / 18
High SES. Mean (SD)	10.0 (3.3)
N High SES	65
Min / Max	0 / 17
t-test (p-value)	0.905

The results in the Blicket detector task, evaluated at time 1 show no significant differences when comparing low and high SES groups (t_{131}= 0.120, p= 0.905). The eta squared value is 0.0, and the distance between low and high SES groups expressed in standard deviation is 0.03, which confirms that both children from low and high SES show similar performance in this task.

8.4. Categorisation - Categorical flexibility.

In order to evaluate the processes of categorisation, an adaptation of the Categorical flexibility task was administered at time 1. The way of scoring the categorical flexibility task was to count the number of criteria used for grouping. If a child was able only to group the objects using one criterion such as shapes, colours or sizes, the score was 0. When children were able to group objects using more than 1 criterion, the score reflected the number of the used criterion (1, 2, 3, etc.). In the cases when a child grouped the items in order to draw an image such as a tower, house, or car, no points were given.

Table 75. Summary of results of categorical flexibility task at time 1

	Number of students	Percentage
1 criterion	84	63.2
2 criteria	41	30.8
3 criteria	5	3.8
Missing data	3	2.2

The results presented in table 75 show an important number of children who are not able to exhibit categorical flexibility, i.e., those who are not able to sort the same group of items using different criteria. The following step was to analyse the results of the task when comparing them according SES groups. The results are presented in table 76.

Table 76. Summary of criteria used in the categorical flexibility task and SES at time 1

		Number of student	Percentage from the group	Percentage from the total
Low SES	1 criterion	42	63.6	31.6
	2 criteria	22	33.4	16.5
	3 criteria	2	3	1.5
High SES	1 criterion	42	65.6	31.6
	2 criteria	19	29.7	14.2
	3 criteria	3	4.7	2.3
Missing		3	100	2.3

By analysing the distribution of the results according to the SES, it is possible to find similar results in both groups. Almost two-thirds of the children in each group were not able to sort the items using more than 1 criterion. The results of the t-test do not show a significant difference when both groups are compared (t_{131}=0.033, p=0.973). SES explained 0.0% of the variance according to partial eta squared. The Cohen's d value in this task is 0.0.

Finally, a comparison in the outcomes between girls and boys in order to estimate possible differences. The results of the analysis presented in Table 77 show that a larger proportion of boys than girls were unable to exhibit categorical flexibility (72.1% versus 56.5% respectively). In fact, only 1 boy (0.8%) and 3 girls (3%) were able to sort the items using 3 criteria.

Table 77. Summary of criteria and gender in the categorical flexibility task at time 1

		Number of students	Percentage from the group	Percentage from the total
Girls	1 criterion	35	56.5	26.3
	2 criteria	23	37.1	17.3
	3 criteria	4	6.5	3
Boys	1 criterion	49	72.1	36.8
	2 criteria	18	26.5	13.5
	3 criteria	1	1.5	0.8
Missing		3	100	2.3

To evaluate whether this difference is statistically significant, a t-test analysis was conducted. The results show that girls perform in this task significantly better than boys (t_{128}=2,107; p= 0.037).

8.5. Executive functions

The Tower of Hanoi is a task that evaluates some components of the executive functions. The task consists of three rods and three or four discs of different sizes ordered from larger at the bottom and smaller at the top. Participants are asked to re-construct the tower in a different rod, but following three main rules:

1. Only one disc can be moved at a time.
2. It is forbidden to place one large disc on top of a smaller disc.
3. None of the discs can be placed out of the three rods or holding 2 discs on the hands at the same time.

The task ends when the tower can be built in one of the two rods left, following the rules. In this study, 13 students, which is 12.3% of the sample, were unable to complete the task due to its difficulty or to persevere in only one manner to perform the task; although these moves are not part of the rules. From this group of 13 children, 6 of them belonged to the low SES group and 7 were part of the high SES group.

Table 78 presents the results of this task. The score was calculated according to the number of moves, number of errors, and time spent for solving the task. The number of moves was calculated by adding the moves performed in each of the trials. Errors were defined for each of the moves that did not follow one of the rules. These errors were scored with 1 point. The time spent on the task was calculated only for those who were able to end the task.

Table 78. Descriptive analysis for Executive functions (Tower of Hanoi) at time 2

	Number of moves	Number of mistakes	Time (seconds)
Mean (SD)	34.0 (8.3)	3.8 (3.4)	264.3 (111.3)
N	106	106	106
Minimum	16	0	71
Maximum	77	15	550

The results of Tower of Hanoi show that, on average, 34 moves were required to complete both tasks. To calculate the optimum number of moves for completing the task the following equation is presented $2^n - 1$, where *n* represents the number of discs. Therefore, for 3 discs the optimum number of moves is 7 and for 4 discs the number is

15. The optimum number for both tasks might be 23 (7 + 15). Regarding the number of mistakes, the mean was almost 4. In other words, the proportion might be 1 error every 9 moves. The time for completing the task was 264 seconds for 3 and 4 discs, with a range from 1:11 (71 seconds) to 9 minutes and 10 seconds (550 seconds).

The score distribution has been analysed considering both the number of moves and the errors associated. Time was not considered because the focus of the task in the context of this study was to investigate whether children could solve the task by aiming the objective by following the rules, beyond the time it took.

The number of moves when all participants are included, shows a non-normal distribution according the Kolmogorov-Smirnov test (p=0.041), although it is quite close to the critical point level (p= 0.05). When the analyses are conducted considering the SES groups, they show normal distribution for the low (p= 0.406), and the high SES group (p= 0.116) as seen in graph 30.

When the number of errors is analysed, also a non-normal distribution has been found for all participants (p= 0.018). A next step was to conduct analyses dividing SES groups, they show normal distribution for the low (p= 0.206) and a non-normal distribution for the high SES (p= 0.03) as it can be seen in the graph 30.

Graph 30. Histogram – Number of moves (ToH) at time 2. All participants and SES groups

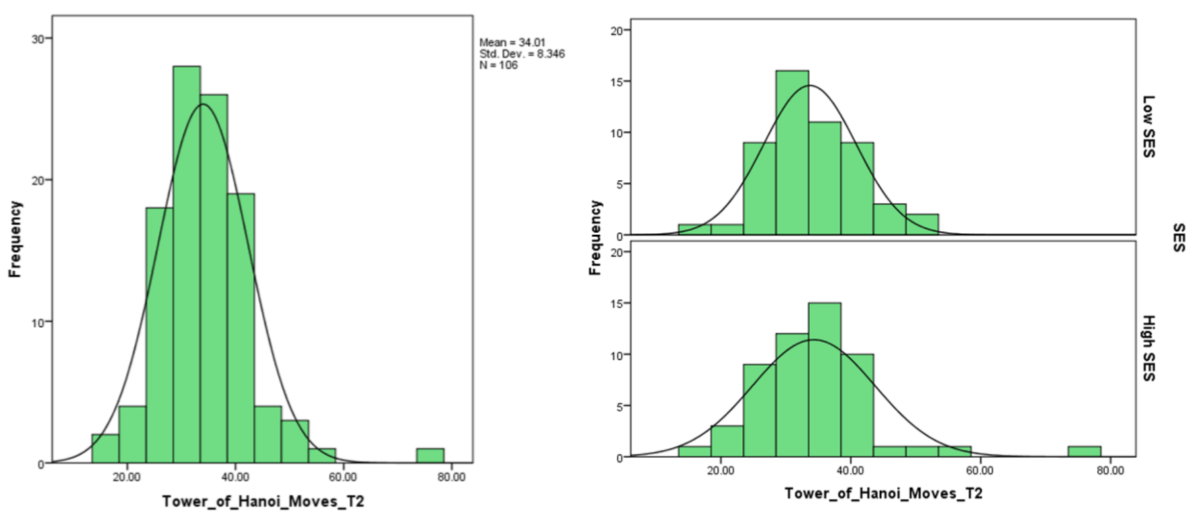


Table 79 compares the performance between low and high SES groups.

Table 79. Scores for Executive functions (Tower of Hanoi) at time 2

	Number of moves	Number of mistakes	Time (seconds)
Low SES. Mean (SD)	33.7 (7.1)	4.8 (3.6)	274.9 (107.8)
N Low SES	52	52	52
Min / Max	18/ 49	0 / 15	102 / 550
High SES. Mean (SD)	34.3 (9.4)	2.9 (2.7)	254.1 (114.6)
N High SES	54	54	54
Min / Max	16 / 77	0 / 12	71 / 545
p-value (F)	0.720	0.003	0.340

When low and high SES groups are compared in terms of the number of moves, children from high and low SES make practically the same number of moves in order to solve the task, and no significant differences were found in this category (t_{104}=0.359, p= 0.720). SES explained 0.0% of the variance, according to the partial eta squared value. The Cohen's d value in this task was 0.07.

Regarding the number of errors, children from low SES made almost two errors more than their peers from high SES (2.9 versus 4.8 respectively). This difference is statistically significant (t_{104}=3.045, p= 0.003) with SES explaining the 8.2% of the variance in the results of this task (eta squared value). In other words, children from low and high SES do not differ in terms of the quantity of moves for completing the tasks but do so in the way in which they are able to retain the rules. The difference between groups evaluated through Cohen's d value is 0.6 SD. This process, in which the central executive is involved, seems to be affected by the SES. Finally, children from high SES tend to complete the task faster than the group from low SES; however, this difference is not significant (t_{104}=0.958, p= 0.340) with SES explaining 0.0% of the variance. The Cohen's d value for the time is 0.18.

8.6. Summary of the chapter

The results of this chapter summarise those cognitive skills included in this study as possible predictor of reading. This category includes four different skills, and they were evaluated both at times 1 and 2. These skills are: block building, analogical reasoning (verbal and non-verbal), inferencing processes, and executive functions.

The main pattern in this category is that no significant effects were found in the cognitive tasks evaluated in the study, except for Analogical reasoning verbal evaluated at time 2, and the number of rule violations in the Tower of Hanoi, which was the tasks used to evaluate executive functions.

In the case of general cognitive abilities, the block building subtask was considered. The results in this task do not show significant differences between low and high SES groups (t_{131}=0.392, p= 0.7). In terms of the distribution, the raw scores appear to be non-normally distributed (K-S, p-value= 0.002). However, as in the case of other skills evaluated in this study, when the sub-groups are disaggregated the lack of normal distribution appear only for the low SES group (K-S, p-value= 0.02); while the opposite situation occurs for the high SES group (K-S, p-value= 0.12).

The second of the variables included is the Analogical reasoning. Analogical reasoning is compound of two sub-scales: verbal and non-verbal. The same task was administered both at time 1 as at time 2. The results show a significant improvement for the verbal and non-verbal scale between time 1 and 2. In terms of the score comparisons between low and high SES groups, the results do not show significant differences between groups, except for the case of the verbal subscale evaluated at time 2 (t_{104}= 3,932, p< 0.001). Therefore, no significant differences appeared for the verbal subscale (t_{131}= 0,151, p= 0.88), and non-verbal (t_{131}= 0,151, p= 0.19) at time 1, and non-verbal at time 2 (t_{104}= 1,503, p= 0.136).

This finding is particularly interesting, because this task does not evaluate directly any language component, but the reasoning skill through analogies. Non-verbal scale presents several patterns based on lines and circles, and therefore, any knowledge about the name or the function of the objects is required to complete this scale. At both time points, children from low and high SES were equally competent in finding the missing piece. However, in the case of verbal scale, the non-significant differences found at time 1 were not replicated at time 2 because significant differences emerged when comparing the groups. A greater knowledge of the objects, their names and functions, a more evident effect of the vocabulary in this task at 7 years-old, or a better work of the school in the analogical reasoning could be considered as factors to explain the difference between the low and high SES groups.

The third variable included in this group is the inferencing processes. This task was evaluated through the Blicket detector task and it was evaluated at time 1. The results, as in the case of the majority of tasks in this group did not show a significant effect when low and high SES groups were compared (t_{131}= 0,120, p= 0.905). The raw scores are close to a normal distribution, although slightly below than the critical point (K-S, p-value= 0.041). The results show normal distribution for the low (K-S, p-value= 0.406) and the high SES group (K-S, p-value= 0.116).

Categorisation task was the fourth of the variables. This task shows similar results in both groups, with no significant differences (t_{131}=0.033, p=0.973).

Finally, executive functions were evaluated through the Tower of Hanoi at time 2 of the study. The results of this tasks have been disaggregated between the number of movements required to complete the task, and the number of violation of rules (or errors) committed in solving the task. In terms of the number of movements, no significant differences were found in the comparison between the low and high SES groups (t_{104}= 0,359, p= 0.720). However, significant differences were found for the number of violations of the rules in the task. Children from low SES group often make a larger number of errors, or violation of rules compared to their peers from high SES (t_{104}= 3,045, p= 0.003). This finding can be related with the way in which children remember the rules, and therefore the allowed and prohibited actions involved in solving the task. A larger number of errors could be related with poor performance in the short-term memory which is one of the underlying process in this task.

In terms of the data dispersion, normal distribution has been found for the number of movements made for solving the task (K-S, p-value= 0.286). However, the errors are not-normally distributed for all participants (K-S, p-value= 0.018). As in other skills, low SES group presents a normal distribution (K-S, p-value= 0.206), while a non-normal distribution, although close to the critical point emerged from the high SES data (K-S, p-value= 0.03). The distribution shows that in the case of high SES group, there are a large frequency of few errors, and most of the distribution is concentrated between 1 to 5 errors, while in the case of low SES the errors are more distributed, from a few to many rules' violation.

In sum, the results of this section showed that except for Analogical reasoning verbal at time 2, no significant differences were found when low and high SES are compared. This is an interesting result, because in practically all tasks children from low and high show significant differences in their performances. In the cognitive skills category, the tasks attempted to use only non-verbal activities in order to estimate the cognitive processes as pure as it was possible, trying to avoid evaluating vocabulary or language abilities in the cognitive tasks. The result can be interpreted as children from low- and high-level progress in the same rate in their cognitive skills, however, this rate is slower for the low SES group. A greater of tasks evaluated at times 1 and 2 could have helped to confirm this hypothesis.

8.7. Summary of the chapters 6, 7, and 8.

Table 80 summarises a matrix correlation among all the evaluated skills and the reading components: accuracy, fluency, and comprehension.

Table 80. Correlations between predictors and reading components

			Reading Accuracy	Reading Fluency	Reading Comprehension
Foundational reading skills	Phonological awareness	Time 1	0.61**	0.63**	0.62**
		Low SES	0.58**	0.58**	0.66**
		High SES	0.47**	0.55**	0.24
		Time 2	0.73**	0.63**	0.74**
		Low SES	0.75**	0.7**	0.75**
		High SES	0.25	0.21	0.25
	Phonological processing	Non-word repetition	0.08	0.08	0.11
		Low SES	0.05	0.06	0.08
		High SES	0.13	0.05	0.07
	Rapid automatic naming	Colours. Time 1	-0.48**	-0.46**	-0.42**
		Low SES	-0.46**	-0.51**	-0.43**
		High SES	-0.28*	-0.23	-0.05
		Objects. Time 1	-0.24*	-0.28**	-0.13
		Low SES	-0.15**	-0.16**	-0.06
		High SES	-0.38**	-0.38**	-0.15
		Letters. Time 2	-0.75**	-0.67**	-0.73**
		Low SES	-0.75**	-0.72**	0.69**
		High SES	-0.28*	-0.35*	-0.33*
		Digits. Time 2	-0.61**	-0.57**	-0.56**
		Low SES	-0.6**	-0.59**	-0.52**
		High SES	-0.43**	-0.42**	-0.43**

	Letter knowledge	Time 1	0.52**	0.62**	0.52**
		Low SES	0.47**	0.56**	0.5**
		High SES	0.41**	0.58**	0.33*
		Time 2	0.73**	0.64**	0.75**
		Low SES	0.73**	0.68**	0.75**
		High SES	0.4**	0.38**	0.37**
Early language predictors	Grammar knowledge	Sentence repetition	0.37**	0.34**	0.4**
		Low SES	0.32*	0.34*	0.38**
		High SES	0.32*	0.18	0.26
	Receptive vocabulary	Time 1	0.32**	0.31**	0.42**
		Low SES	0.21	0.24	0.28*
		High SES	0.09	0.11	0.32*
		Time 2	0.32**	0.38**	0.42**
		Low SES	0.29*	0.34*	0.32*
		High SES	0.13	0.28*	0.43*
	Lexical search and retrieval	Semantic fluency. Time 1	0.32**	0.35**	0.4**
		Low SES	0.18	0.29*	0.26
		High SES	0.17	0.2	0.3*
		Semantic fluency. Time 2	0.41**	0.44**	0.47**
		Low SES	0.4**	0.47**	0.44**
		High SES	0.27*	0.3*	0.39*
		Phonological fluency. Time 2	0.48**	0.46**	0.48**
		Low SES	0.58**	0.64**	0.6**
		High SES	0.36*	0.18	0.32*
Cognitive skills	Block building task		0.31**	0.31**	0.31**
		Low SES	0.38**	0.38**	0.4**
		High SES	0.18	0.18	0.15

Analogical reasoning. Verbal. Time 1	0.19	0.19	0.2*
Low SES	0.4**	0.43**	0.45**
High SES	-0.06	-0.04	-0.1
Analogical reasoning. Non-verbal. Time 1	0.09	0.11	0.13
Low SES	0.23	0.22	0.26
High SES	-0.12	-0.01	-0.06
Analogical reasoning. Verbal. Time 2	0.22*	0.2*	0.24*
Low SES	0.13	0.17	0.1
High SES	-0.03	-0.03	0.02
Analogical reasoning. Non-verbal. Time 2	0.24*	0.23*	0.27**
Low SES	0.25	0.27	0.29*
High SES	0.17	0.13	0.21
Causal reasoning	0.14	0.08	0.13
Low SES	0.16	-0.02	0.08
High SES	0.09	0.18	0.23
Executive functions. Tower of Hanoi (movements)	0.0	-0.05	-0.01
Low SES	0.04	0.04	0.02
High SES	-0.13	-0.19	-0.14
Executive functions. Tower of Hanoi (errors)	-0.31**	-0.29**	-0.35**
Low SES	-0.21	-0.23	-0.24
High SES	-0.23	-0.18	-0.32*

*p< 0.05 level (2-tailed) / **p< 0.01 level (2-tailed)

The resulted expressed in this correlation matrix show that all of predictors included as part of the Triple Foundational Model are significantly correlated with the three reading components included in this study: accuracy, fluency, and comprehension. The only exception is RAN Objects and Reading comprehension, in which no significant associations were reported. For Phonological awareness at times 1 and 2, RAN Colours at time 1, Digits and Letters at time 2, and Letter knowledge at times 1 and 2, are correlated with reading. The correlation of predictors with reading accuracy, fluency, and comprehension are presented in the next pages.

8.7.1. Reading accuracy - correlations

In the case of accuracy, Phonological awareness at time 2 (r= 0.73, p< 0.01) show a correlation slightly higher than Phonological awareness at time 1 (r= 061, p< 0.01). Significant correlations were found for the low (r= 0.58, p< 0.01) and high SES (r= 0.47, p< 0.01) at time 1. However, only the Low SES showed a significant correlation at time 2 (r= 0.73, p< 0.01), while no significant correlations emerged from the high SES group (r= 0.25, p= 0.07). Phonological processing, evaluated through Non-word repetition did not show significant correlation when all participants were included (r= 0.11, p= 0.265).

Rapid automatic naming showed significant associations with reading accuracy in the subscales: Colours (r= -0.48, p< 0.01), Objects (r= -0.24, p< 0.05), Letters (r= -0.75, p< 0.01), and Digits (r= -0.61, p< 0.01). These significant correlations also appear in each of the SES groups [Colours (Low SES: r= -0.46, p< 0.01; High SES: r= -0.28), Objects (Low SES: r= -0.15, p= 0.29; High SES: r= -0.38), Letters (Low SES: r= -0.75, p< 0.01; High SES: r= -0.28, p< 0.05), and Digits [(Low SES: r= -0.6, p< 0.01; High SES: r= -0.43, p< 0.01)].

Letter knowledge showed significant association with reading accuracy for all participants at time 1 (r= 0.52, p< 0.01) and at time 2 (r= 0.73, p< 0.01). These patterns appeared for the low [Time 1 (r= 0.47, p< 0.01), Time 2 (r= 0.73, p< 0.01)], and high SES groups [Time 1 (r= 0.41, p< 0.01), Time 2 (r= 0.4, p< 0.01)].

In terms of the early language predictors, the results show significant association for all participants in the Grammar knowledge (r= 0.37, p< 0.01), Receptive vocabulary at time 1 (r= 0.32, p< 0.01), and at time 2 (r= 0.32, p< 0.01), and lexical search and retrieval evaluated through the semantic fluency test at time 1 (r= 0.32, p< 0.01), and at time 2 (r= 0.41, p< 0.01), as in the case of phonological fluency evaluated at time 2 (r= 0.48, p< 0.01). In terms of the SES, the results in the case of Grammar knowledge evaluated at time 1 show significant association with accuracy both for the low (r= 0.32, p< 0.05), and high SES groups (r= 0.32, p< 0.05). Receptive vocabulary evaluated at time 1 show significant associations with accuracy for all participants, but when the groups are divided according to SES, no significant relations were found for the low ($r = 0.21$, $p = 0.14$), and high SES groups ($r = 0.09$, $p = 0.52$). At time 2, receptive vocabulary only shows to be significant when being associated with accuracy for the low SES ($r = 0.29$, $p < 0.05$), while no significant association was found for the high SES group ($r = 0.13$, $p = 0.34$). In the case of the lexical search and retrieval, no significant association between semantic fluency test at time 1 and reading accuracy were found when the groups are disaggregated [Low SES ($r = 0.18$, $p = 0.2$); and High SES ($r = 0.17$, $p = 0.22$)]. At time 2, these associations are becoming significant for both groups [Low SES ($r = 0.4$, $p < 0.01$); and High SES ($r = 0.27$, $p < 0.05$)]. In the case of Phonological fluency test, significant association were found not only for all participants, but also when the groups are divided according to SES [Low SES ($r = 0.58$, $p < 0.01$); and High SES ($r = 0.36$, $p < 0.05$)].

The last group of predictors of reading accuracy is called cognitive skills. In this group general cognitive skills ($r = 0.31$, $p < 0.01$), analogical reasoning verbal ($r = 0.22$, $p < 0.01$) and non-verbal ($r = 0.24$, $p < 0.05$) evaluated at time 2, and executive functions for errors, showed significant association with reading accuracy. In the case of general cognitive skills, evaluated at time 1, the significant association appear only for the low SES group ($r = 0.38$, $p < 0.01$), while no significant correlation appears for the high SES group ($r = 0.18$, $p = 0.18$). The analogical reasoning verbal and non-verbal evaluated a time 2 show significant association when low and high SES groups are disaggregated [Analogical reasoning verbal (Low SES: $r = 0.13$, $p = 0.37$; High SES: $r = -0.03$, $p = 0.81$); Analogical reasoning non-verbal (Low SES: $r = 0.25$, $p = 0.08$; High SES: $r = -0.17$, $p = 0.23$)]. Finally, executive functions (Tower of Hanoi – Errors) showed to be significant associated with reading accuracy when all participants are included ($r = -0.31$, $p < 0.01$), however this association disappears when the groups are disaggregated (Low SES: $r = -0.21$, $p = 0.13$; High SES: -0.23, $p = 0.1$).

In sum, all variables included in the Triple Foundational Model, Early language predictors, and General cognitive skills and Analogical reasoning verbal and non-verbal evaluated at time 2 of the study showed significant association with reading accuracy. In the case of these variables, significant associations appear both for low and high SES groups, except the variables indicated in the previous paragraphs.

8.7.2. Reading fluency - correlations

All variables included as part of the Triple Foundational Model show significant correlation with reading fluency. These include Phonological awareness at time 1 (r= 0.63, p< 0.01) and at time 2 (r= 0.63, p< 0.01). These results are maintained at both time points for the low SES group [Time 1: r= 0.58, p< 0.01; Time 2: r= 0.7, p< 0.01]. In the case of high SES the significant correlation appear only at Time1 [Time 1: r= 0.55, p< 0.01; Time 2: r= 0.21, p= 0.12]. Phonological processing, evaluated through Non-word repetition did not show significant correlation when all participants were included (r= 0.08, p= 0.39).

Rapid automatic naming showed significant associations with reading fluency in all the subscales: Colours (r= -0.46, p< 0.01), Objects (r= -0.28, p< 0.05), Letters (r= -0.67, p< 0.01), and Digits (r= -0.57, p< 0.01). Except for the high SES group in the RAN Colours (r= -0.23, p= 0.1) all the tasks show significant associations in each of the SES groups, [Colours (Low SES: r= -0.51, p< 0.01; High SES: r= -0.23, p= 0.1), Objects (Low SES: r= -0.16, p= 0.27; High SES: r= -0.38), Letters (Low SES: r= -0.72, p< 0.01; High SES: r= -0.35, p< 0.05), and Digits [(Low SES: r= -0.59, p< 0.01; High SES: r= -0.42, p< 0.01)].

Letter knowledge showed significant association with reading fluency for all participants at time 1 (r= 0.62, p< 0.01) and at time 2 (r= 0.64, p< 0.01). These patterns emerged from the low [Time 1 (r= 0.56, p< 0.01), Time 2 (r= 0.68, p< 0.01)], and high SES groups [Time 1 (r= 0.58, p< 0.01), Time 2 (r= 0.38, p< 0.01)].

In terms of the early language predictors, the results show significant association for all participants in Grammar knowledge (r= 0.34, p< 0.01), Receptive vocabulary at time 1 (r= 0.31, p< 0.01), and at time 2 (r= 0.38, p< 0.01), and lexical search and retrieval evaluated through the semantic fluency test at time 1 (r= 0.35, p< 0.01), and at time 2 (r= 0.44, p< 0.01), as in the case of phonological fluency evaluated at time 2 (r= 0.46, p< 0.01). The results in the case of Grammar knowledge, only show significant association for the low SES group (r= 0.34, p< 0.01), while no significant associations were found for the high SES group (r= 0.18, p= 0.18). Receptive vocabulary evaluated at time 1 did not show significant associations when groups are divided by SES [Low SES (r= 0.24, p= 0.09); High SES (r= 0.11, p= 0.41)]. At time 2, receptive vocabulary shows significant association for both SES groups [Low SES (r= 0.34, p< 0.05); High SES (r= 0.28, p< 0.05)]. A significant association with reading fluency for all participants was found for Lexical search and retrieval, evaluated through semantic fluency test at time 1 (r= 0.35, p< 0.01) and at time 2 (r= 0.44, p< 0.01). These significant association also emerged for the phonological fluency test evaluated at time 2 (r= 0.46, p< 0.01). When the groups are disaggregated, significant associations appeared for the low SES group both in semantic fluency test [Time 1: r= 0.29, p< 0.01; Time 2: r= 0.47, p< 0.01], and in phonological fluency test (r= 0.64, p< 0.01). In the case of high SES group, significant association with reading fluency appear only for the semantic fluency evaluated at time 2 (r= 0.3, p< 0.05).

The last group of predictors of reading accuracy is called cognitive skills. In this group general cognitive skills (r= 0.31, p< 0.01), analogical reasoning verbal (r= 0.2, p< 0.01) and non-verbal (r= 0.23, p< 0.05) evaluated at time 2, and executive functions (r= -0.29, p< 0.01) showed significant association with reading fluency. In the case of general cognitive skills evaluated at time 1, significant associations appear only for the low SES group (r= 0.38, p< 0.01), while no significant correlation appear for the high SES group (r= 0.18, p= 0.21). Both for the analogical reasoning verbal and non-verbal evaluated a time 2 no significant differences were found for the SES groups [Analogical reasoning verbal (Low SES: r=0.13, p= 0.37; High SES: r= -0.03, p= 0.81); Analogical reasoning non-verbal (Low SES: r=0.25, p= 0.08; High SES: r= 0.17, p= 0.23)]. No significant associations appear for the Executive functions – errors when the low (r= -0.23, p= 0.10) and high SES (r= -0.18, p= 0.2) groups are evaluated separately.

In sum, as in the reading accuracy category, all variables included in the Triple Foundational Model, Early language predictors, and three variables from the Cognitive skills of the study (general cognitive skills, Analogical reasoning verbal and non-verbal evaluated at time 2, and executive functions) showed significant association with reading accuracy. In the case of these variables significant associations appear both for low and high SES groups, except the variables indicated in the previous paragraphs.

8.7.3. Reading comprehension - correlations

All variables included as part of the Triple Foundational Model show significant correlations with reading comprehension, except for RAN Colours, and Letter knowledge at time 2. These include Phonological awareness at time 1 ($r= 0.62$, $p< 0.01$) and at time 2 ($r= 0.74$, $p< 0.01$). These results are maintained at both time points for the low SES group [Time 1: $r= 0.66$, $p< 0.01$; Time 2: $r= 0.75$, $p< 0.01$], while in the case of high SES no significant correlations appear at any time points [Time 1: $r= 0.24$, $p= 0.08$; Time 2: $r= 0.25$, $p= 0.07$]. Phonological processing, evaluated through Non-word repetition did not show significant correlation when all participants were included ($r= 0.11$, $p= 0.26$).

Rapid automatic naming showed significant associations with reading comprehension in three out of four subscales: Colours ($r= -0.42$, $p< 0.01$), Letters ($r=-0.73$, $p< 0.01$), and Digits ($r= -0.56$, $p< 0.01$), while RAN Objects did not show a significant association with reading comprehension ($r= -0.13$, $p= 0.17$). Except for the high SES group in the RAN Colours ($r= -0.05$, $p= 0.71$) all tasks show significant associations in each of the SES groups [Colours (Low SES: $r= -0.43$, $p< 0.01$; High SES: $r= -0.05$, $p= 0.71$), Letters (Low SES: $r= -0.69$, $p< 0.01$; High SES: $r= -0.33$, $p< 0.05$), and Digits [(Low SES: $r= -0.52$, $p< 0.01$; High SES: $r= -0.43$, $p< 0.01$)].

Letter knowledge showed significant association with reading fluency for all participants at time 1 ($r= 0.52$, $p< 0.01$) and at time 2 ($r= 0.75$, $p< 0.01$). These patterns emerged for the low SES group [Time 1 ($r= 0.5$, $p< 0.01$), Time 2 ($r= 0.75$, $p< 0.01$)], and high SES group [Time 1 ($r= 0.33$, $p< 0.01$), Time 2 ($r= 0.37$, $p< 0.01$)].

In terms of the early language predictors, the results show significant association for all participants in all evaluated tasks, which include Grammar knowledge ($r= 0. 4$, $p< 0.01$), Receptive vocabulary at time 1 ($r= 0.42$, $p< 0.01$), and at time 2 ($r= 0.42$, $p< 0.01$), and lexical search and retrieval evaluated through the semantic fluency test at time 1 ($r= 0.4$, $p< 0.01$), and at time 2 ($r= 0.47$, $p< 0.01$), as in the case of phonological fluency evaluated at time 2 ($r= 0.48$, $p< 0.01$). The results in the case of Grammar knowledge, only show significant association for the low SES group ($r= 0.38$, $p< 0.01$), while no significant associations were found for the high SES group ($r= 0.26$, $p= 0.05$). Receptive vocabulary showed significant associations when groups are divided by SES both at time 1 [Low SES (r= 0.28, p< 0.05); High SES (r= 0.32, p< 0.05)] as at time 2, [Low SES (r= 0.32, p< 0.05); High SES (r= 0.43, p< 0.05)]. Significant associations with reading fluency for the high SES groups were found for Lexical search and retrieval, evaluated through semantic fluency test at time 1 (r= 0.3, p< 0.05) and at time 2 (r= 0.39, p< 0.05), and for phonological fluency test evaluated at time 2 (r= 0.32, p< 0.05). Similar situation is for the low SES group for semantic fluency test at time 2 (r= 0.44, p< 0.01) and for phonological fluency test a time 2 (r= 0.6, p< 0.01), although no significant associations were found for the semantic fluency test at time 1 (r= 0.26, p= 0.07).

Finally in the group of cognitive skills, general cognitive skills (r= 0.31, p< 0.01), analogical reasoning verbal at time 1 (r= 0.2, p< 0.05), analogical reasoning verbal (r= 0.24, p< 0.05) and non-verbal (r= 0.27, p< 0.01) evaluated at time 2, and executive functions (r= -0.35, p< 0.01) showed significant association with reading comprehension. In the case of general cognitive skills, evaluated at time 1, significant associations appear only for the low SES group (r= 0.4, p< 0.01), while no significant correlation appear for the high SES group (r= 0.15, p= 0.29). A similar situation occurs for the analogical reasoning verbal evaluated at time 1, in which significant associations appear only for the low SES group (r= 0.45, p< 0.01), as in the case of analogical reasoning non-verbal evaluated at time 2 (r= 0.29, p< 0.05), with no significant differences for high SES group were found for analogical reasoning verbal (r= 0.02, p= 0.87), and non-verbal (r= 0.21, p= 0.12). Executive functions (Tower of Hanoi – movements) do not show significant association with reading comprehension for the low SES (r= -0.04, p= 0.86), and high SES (r= -0.14, p= 0.3). In terms of the Tower of Hanoi for errors (r= -0.24, p= 0.09), but significant associations were found for the high SES (r= -0.32, p= 0.02).

In sum, as in the reading accuracy and fluency, all variables included in the Triple Foundational Model, Early language predictors, and three variables from the Cognitive skills of the study (general cognitive skills, Analogical reasoning verbal and non-verbal evaluated at time 2, and executive functions) showed significant association with reading comprehension. In the case of these variables significant associations appear for low and high SES groups, except the variables indicated in the previous paragraphs.

Table 81. Summary of results (differences, partial eta squared, and Cohen's d value)

			Significant group differences?	Partial eta squared	Cohen's d
Reading	Accuracy		Yes	0.2	0.97
	Fluency		Yes	0.12	0.75
	Comprehension		Yes	0.24	1.1
Foundational reading skills	Phonological awareness	Time 1	Yes	0.19	0.95
		Time 2	Yes	0.17	0.88
	Phonological processing	Non-word repetition	No	0.01	0.2
	Rapid automatic naming	Colours. Time 1	Yes	0.09	0.63
		Objects. Time 1	Yes	0.04	0.38
		Letters. Time 2	Yes	0.2	0.97
		Digits. Time 2	Yes	0.07	0.53
	Letter knowledge	Time 1	Yes	0.13	0.78
		Time 2	Yes	0.14	0.77
Early language predictors	Grammar knowledge	Sentence repetition	Yes	0.09	0.66
	Vocabulary (receptive)	Time1	Yes	0.19	0.97
		Time 2	Yes	0.1	0.68
	Lexical search and retrieval	Semantic fluency. Time 1	Yes	0.13	0.79
		Semantic fluency. Time 2	Yes	0.12	0.75
		Phonological fluency. Time 2	No	0.03	0.31
Cognitive skills	Block building task		No	0.0	0.09
	Analogical reasoning. Verbal. Time 1		No	0.0	0.0

Analogical reasoning. Non-verbal. Time 1	No	0.01	0.2
Analogical reasoning. Verbal. Time 2	Yes	0.13	0.75
Analogical reasoning. Non-verbal. Time 2	No	0.02	0.33
Causal reasoning	No	0.0	0.03
Categorisation. Categorical flexibility	No	0.0	0.0
Executive functions. Tower of Hanoi - Movements	No	0.0	0.07
Executive functions. Tower of Hanoi - Errors	Yes	0.08	0.6

The results of these tasks show a significant effect of the socioeconomic background on all reading components: accuracy, fluency, and comprehension. In terms of the variables included in the Triple Foundational Model: phonological awareness, rapid automatic naming and reading comprehension show significant differences between low and high SES groups. In phonological processing, evaluated through non-word repetition, no significant differences were found by SES groups.

Regarding the variables included in the early language predictors all the factors show significant differences between low and high SES groups. These variables include: grammar knowledge (sentence repetition), receptive vocabulary at times 1 and 2, semantic fluency test at times 1 and 2, and phonological fluency test.

Finally, in the cognitive skills no significant differences between low and high SES were found for general cognitive abilities, Analogical reasoning verbal and non-verbal at time 1, and non-verbal at time 2, inferencing processes, categorisation processes and executive function. The only exceptions appear for the analogical reasoning verbal at time 2, and the number of errors made by children in the Tower of Hanoi task.

The strongest discrepancy in all the evaluated factors and reading components appear in reading comprehension, in which more than one standard deviation separated the low and high SES; although in these three reading components large differences were found: Accuracy (Cohen's d value: 0.97), and Fluency (Cohen's d value: 0. 75).

In terms of the foundational predictors of reading, phonological awareness at time 1 (Cohen's d value: 0.95) shows the largest discrepancy between low and high SES groups. Phonological awareness at time 2 (0.88), RAN letters (0.97), and Letter knowledge at time 1 (d= 0.78) and 2 (d= 0.77), can also be classified as showing a large effect according to Cohen's categories (Cohen, 1977). The rest of the variables included in this category show medium effect: RAN Colours (d= 0.63), Objects (d= 0.38), and Digits (d= 0.53).

The second group of predictors is the early language predictors. In this group Grammar knowledge (d= 0.66), Receptive vocabulary at time 1 (0.68), and time 2 (d= 0.97), Semantic fluency test at time 1 (d= 0.79), and at time 2 (d= 0.75) can be categorised as showing a large effect according Cohen's classification. A medium effect was found for phonological fluency test evaluated at time 2 (d= 0.31).

Finally, in the cognitive skills, only Executive functions – Tower of Hanoi for errors (d= 0.6), and Analogical reasoning verbal evaluated at time 2 (d= 0.75) show large effects between low and high SES groups. A medium effect was found for analogical reasoning non-verbal evaluated at time 2 (d= 0.33). The rest of the variables did not show significant differences between low and high SES groups.

Chapter 9: Home literacy environment (SES), reading predictors, and reading components

In this chapter, the relationships between predictors and the three reading components (accuracy, fluency, and comprehension) is discussed. The SES variable has been considered by merging some of the direct and indirect factors related to reading outcomes.

9.1. Home literacy environment

In the current study, Home learning environment was operationalised as incorporating both those questions regarding socio-economic indicators and those items related to the frequency of support in home literacy environment indicators. These variables were collected from the Encuesta sobre Ambiente familiar (*Family Environment Survey - EAF)* administered to the parents of the participants.

The variables that the home literacy index included are: financial aspects (belongings at home, family income), human capital (highest educational level of father and mother), literacy materials at home (including books), and the frequency of support in activities such as identifying letters and numbers, expectations about the age in which their children should start to read, shared reading frequency, and the frequency of literacy activities (i.e. writing the child's name, writing the letters of the alphabet, among others). The responses were compiled in the Home Literacy environment index presented in table 82.

Table 82. Home literacy environment index and SES factors

Factors	Question	Contents	Mean (SD)	Range
Socio-economic status	4	List of the appliances at home index (e.g. TV, Car, etc.)	7.9 (2.3)	1 – 10
	5	Number of people living in the family house	2.8 (1.6)	
	7	Educational attainment – mother and father (e.g. Primary, Secondary)	7.0 (2.4)	2 – 10

	25	How many books/magazines did you acquire the last month? (e.g. None, 1 to 5, 6 to 10 and more than 11)	1.9 (0.6)	0 - 3
	26	How many books there are in your home? (e.g. None, 1 to 5, 6 to 10, etc.)	3.9 (2.1)	0 – 6
	27	How many children's books are there in your home? (e.g. None, 1 to 5, 6 to 10, etc.)	3.8 (1.7)	0 - 6
Home literacy environment	11b	Expectations about the educational attainment that will be reached for your son/daughter	4.6 (0.9)	1 - 5
	15	The frequency of support (to children) in order to write letters and numbers/identify letters and numbers/do you talk about any special event?	3.4 (0.5)	1 – 4
	17	Frequency of conversations between adults/adults, children/adults, child/child, etc.	2.7 (0.4)	1 – 3
	19	Frequency and types of conversations between mother/father and children.	2.5 (0.3)	1 – 3
	21	Literacy activities in family (e.g. Write shopping lists, read stories, write letters, etc.).	1.9 (0.4)	1 – 3
	22	Level of agreement of several literacy statements. "e.g. I read just when it is compulsory" (1=absolutely disagree; 5=absolutely disagree).	2.1 (0.5)	0 – 3
	23	Frequency of shared reading.	2.6 (0.9)	0 – 3
	24	Frequency of literacy activities (e.g. write the names of family members).	3.7 (0.7)	1 – 5

In the case of question 7, regarding educational attainment, the scores of the mother and the father were collapsed into one variable. In the case of question 25, each item (e.g. books/magazines/newspapers) was averaged into one scale. All items presented in Table 82 were collapsed into a single scale called Home Literacy Environment index. The items of the Home Literacy Environment index were chosen because they best represented the specific factors related to literacy development. In order to evaluate the internal consistency of this scale, Cronbach alpha was estimated for this specific set of variables. The Cronbach alpha presents a value of 0.79 which is an acceptable level in terms of its consistency. Regarding HLE distribution, the Kolmogorov-Smirnov shows a p-value of 0.676, which represents a normal distribution of this scale. This scale has been transformed into standardized scores (Z-scores) for the path analyses.

9.2. Direct effect of Home Literacy scale on the variables

The first part of the analyses estimated the effect of the Home literacy scale in each of the reading components, and in the variables included in the Triple Foundational Model, Early Language predictors and Cognitive skills. The analysis was conducted through a Linear Simple regression and the summary of the results, including the standardised beta coefficients, and the associated p-value are presented in table 83. In order to avoid the combined effect of two or more variables on the estimation, each variable was analysed separately. This decision was made in order to avoid the spurious effect of HLE on each of the variables included in the study.

Table 83. Effect of HLE on reading components and predictors

	Effect of SES (HLE)	Standardised β	p-value
Reading components	Accuracy scale	0.403	p< 0.001
	Fluency scale	0.281	p= 0.011
	Comprehension scale	0.449	p< 0.001
Triple foundational model	Phonological awareness at time 1	0.352	p< 0.001
	Phonological awareness at time 2	0.408	p< 0.001
	Phonological processing: Non-word repetition.	0.106	p= 0.286
	RAN Colours at time 1	-0.248	p= 0.012
	RAN Objects at time 1	-0.152	p= 0.124
	RAN Letters at time 2	-0.378	p< 0.001
	RAN Digits at time 2	-0.272	p= 0.013
	Letter Knowledge at time 1	0.324	p= 0.001
	Letter knowledge at time 2	0.351	p= 0.001
Early language predictors	Grammar knowledge: Sentence repetition at time 1	0.233	p= 0.017
	Receptive vocabulary at time 1	0.414	p< 0.001
	Receptive vocabulary at time 2	0.277	p= 0.012
	Lexical search and retrieval: Semantic fluency test at T1	0.202	p= 0.041
	Lexical search and retrieval: Semantic fluency test at T1	0.298	p= 0.006
	Phonological search and retrieval: Phon fluency test at T2	0.082	p= 0.467
Cognitive skills	General cognitive skill	0.058	p= 0.556
	Analogical reasoning verbal at time 1	0.093	p= 0.349
	Analogical reasoning non-verbal at time 1	-0.013	p= 0.895
	Analogical reasoning verbal at time 2	0.252	p= 0.022

Analogical reasoning non-verbal at time 2	0.269	p= 0.014
Inferences at time 1	-0.09	p= 0.365
Central executive. Tower of Hanoi movements at time 2	-0.122	p= 0.273
Central executive. Tower of Hanoi errors at time 2	-0.283	p= 0.01
Categorical flexibility	0.01	p= 0.917

As it was mentioned previously, the results were conducted considering each variable as a dependent factor with only one predictor: the home literacy scale. The results show that for all the variables included in the Triple foundational model [except for Phonological processing (Non-word repetition), and for RAN Objects at time 1], significant percentage of the variation in the scores is explained by the effect of the socio-economic background in which children are living.

The same pattern can be found in early language predictors. In this case, no exceptions were found to explain the significant effect of HLE on all the variables included in the category: Grammar knowledge, Receptive vocabulary (times 1 and 2), Lexical search and retrieval – through Semantic fluency test (times 1 and 2), and Phonological fluency test evaluated at time 2.

Finally, the opposite situation was found for the variables included in the cognitive skills, with no significant effect on the factors, except for Analogical reasoning verbal (β= 0.093, p= 0.022) and non-verbal (β= 0.269, p= 0.014), but solely in time 2 of the study, and in the executive functions evaluated through the Tower of Hanoi. In this case, the effect was found in the number of violation of rules (β= -0.283, p= 0.01).

In order to evaluate the effect of time 1 on the concurrent variables, evaluated at time 2, several Simple linear regressions were conducted, and they are presented in the next section.

9.3. Concurrent Effect of Home Literacy scale on the variables

Given the limited sample size in this study, the path analyses that will be presented in the next section consider only a few number of the 23 predictors evaluated in the study. To this purpose, several simple linear regressions have been conducted in order to estimate whether the variance at time 2 is being explained by the performance in the same (or similar) task at time 1. These regressions include seven pairs of variables at times 1 and 2: phonological awareness, RAN, Letter knowledge, Receptive vocabulary, Semantic fluency test, Analogical reasoning – verbal, and Analogical reasoning non-verbal. In the case of RAN at time 1 and 2, the subscales Colours and Objects were collapsed as part of the RAN time 1, while Letters and Digits were collapsed as part of the RAN time 2. The summary of the results is presented in table 84.

Table 84. Explained variance between times 1 and 2

Variables	Standardised β	p-value
Phonological awareness at time 2 ← PA T1	0.508	p< 0.001
RAN T2 ← RAN T1	0.325	p< 0.001
Letter Knowledge at time 2 ← LK 1.	0.454	p< 0.001
Receptive vocabulary T2 ← Receptive vocabulary T1	0.635	p< 0.001
Semantic fluency T2 ← Semantic fluency T1	0.391	p< 0.001
Analogical reasoning verbal T2 ← AR Verbal T1	0.297	p< 0.001
Analogical reasoning Non-Verbal T2 ← AR Non-verbal T1	0.130	p= 0.184

The results from the model show that in practically all the abilities evaluated at time 1 and 2, a significant portion of the variance is explained by the student's performance in this ability 2 years before, which is the time 1 of this study. The variation is slightly higher in the phonological awareness (β= 0.508, p< 0.001) and receptive vocabulary (β= 0.635, p< 0.001). No significant coefficients were found for the analogical reasoning non-verbal task between time 1 and 2. In simple words, the student's performance in this task at time 2 seems to not be related with the performance at time 1.

9.4. Path Analysis: conceptualisation

In order to evaluate the effect of multiple independent and dependent variables, different path analyses were estimated. One of the advantages of path analysis is to avoid oversimplifying the analysis of the reading components in children from different socioeconomic backgrounds, as in the case of bivariate analysis or similar. Path analysis has been used in other similar studies investigating predictors of reading (Caravolas et al., 2012; Mellard et al., 2010).

Path analysis is considered a variation of the multiple-regression tool, and it is useful in models where causal effects are involved in several factors. Originally, the model was used to check some prespecified causal models, conducting a series of regressions in which it is expected to evaluate the influence of each variable on the dependent variable(s). In path analysis, the same variables can be considered independent and then dependent variables, and vice-versa (Stage, Carter, & Nora, 2004). In this study, only one variable in each of the three analysed models is considered the dependent variable (fluency, accuracy, and comprehension).

Path analysis seeks to provide an estimation of the magnitude and significance of those connections among sets of variables displayed through path diagrams (Stage et al., 2004). Path diagrams illustrate a set of equations that allow estimation of each path in the models. In these models, there are several path coefficients, which are numbers that indicate the direct effect of one variable on another variable. There are two types of coefficients: unstandardised and standardised. Standardised path coefficients allow direct comparisons of the importance of the variables presented in the models. Unstandardised path coefficients are affected by the measurement units in the study, and therefore, cannot be compared directly. In the present study, the term β standardised will be used as a synonym of standardised coefficient, and it will be presented next to the straight arrows in the next figures. The standardised beta coefficients (β) refer to how many standard deviations a dependent variable will change, per standard deviation in the predictor. Because unstandardised path coefficients allow the comparison between studies with different sample sizes, the values will be presented in tables alongside the standardised beta coefficients (Pedhazur, 1997).

One of the limitations of the path analysis tool is that it does not recognise the direction of the causal effect. In other words, if in the model A is defined as affecting B, path analysis cannot distinguish whether this is a causal effect or if the causal direction is from B to A. Therefore, the rationale or theoretical definition of the paths is critical when the model is estimated (Stage et al., 2004).

In order to estimate the goodness of fit of the fluency model, four different statistical tools are considered in these models: Chi-square, Normed fit index (NFI), Comparative fit index (CFI), and Root mean square error of approximation (RMSEA). Chi-square evaluates the null hypothesis that the reduced (or proposed) model fits with a more complex or saturated model. Non-significant chi-square value means that the fit between the perfect model (created by the software) and the data is not significantly worse than the fit between the proposed model and the data. In sum, a p-value higher than 0.05 can be considered a good model. The normed fit index (NFI) and the comparative fit index (CFI) hold that the expected value for a good model fit should be higher than 0.9. The NFI is based on the chi-squares and evaluates the difference between the two models. The CFI is quite similar to NFI, but CFI adjusts the results according to the sample's size. Finally, the root mean square error of approximation (RMSEA), is related to the analysis of the residual in the model. RMSEA presents values range from 0 to 1, a value of 0.06 or less in RMSEA indicates a good model fit (Hu & Bentler, 1999).

In the following path diagrams, the numbers over the straight unidirectional arrows represent the standardised path coefficients. These coefficients are reported in terms of their significance. The models were estimated using the maximum likelihood, in the software AMOS v.23.

Three different path analyses were estimated considering the effect that Triple Foundational model on the reading components: accuracy, fluency and comprehension. The relation between early language predictors, and cognitive skills are presented later. Only the variables evaluated at time 1 of the study will be included as predictors, this decision aims to maintain the models as simple as possible, given the constraints related with the sample size and the non-normal distribution in several factors. This will be discussed at the end of this chapter.

9.5. Triple foundational model and reading

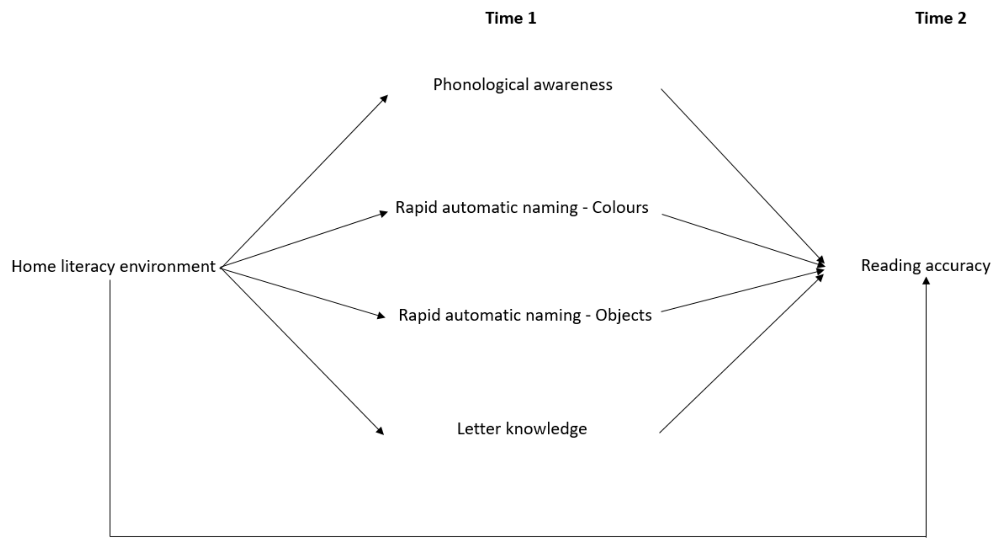
In the next section, the variables included in the Triple foundational model will be presented to estimate the effect on reading accuracy, fluency and comprehension. These models include the direct effect of HLE scale both on reading components as on their predictors.

9.5.1. Triple foundational model and reading accuracy

Six variables were included in the reading accuracy path analysis, these are: home literacy scale (exogenous variable), phonological awareness, rapid automatic naming for colours (time 1), objects (time 1), letter knowledge (time 1) and reading accuracy outcomes. While RAN could had been included as one unitary construct, in the three models estimated in this project, they will be included separately in order to evaluate the differential effect that RAN Colours and Objects has on reading accuracy, fluency, and comprehension. This methodological decision was taken in order to evaluate whether the any of them can be considered a better predictor (i.e. colours as better predictor than objects), following other studies using RAN components as predictor of reading in hierarchical statistical models (Farukh & Vulchanova, 2014; Georgiou, Papadopoulos, Fella, & Parrila, 2012).

The model aims to show a path from HLE to reading accuracy. The hypothesis is that HLE significantly explains the variance in the predictors of reading included in the Triple foundational model, which in turn might affect the student's reading accuracy performance. A direct impact of HLE on reading accuracy has also been estimated.

Figure 9. Reading accuracy and predictors – proposed model



9.5.2. Path analysis. Reading accuracy model

Tables 85 and 86 summarise descriptive and correlation data of the variables included in the reading accuracy model.

Table 85. Descriptive data from reading accuracy model

	n	Mean (SD)
Home literacy environment	104	0.0 (0.56)
Phonological awareness	133	28.4 (7.3)
RAN - Colours	126	99.3 (44.5)
RAN - Objects	133	88.1 (25.3)
Letter knowledge	133	10.7 (3.0)
Accuracy	106	78.0 (37.4)

Table 86. Descriptive data from reading accuracy model

	1.	2.	3.	4.	5.	6.
1. Home literacy environment	-					
2. Phonological awareness	0.35**	-				
3. RAN - Colours	-0.25*	-0.44	-			

4. RAN - Objects	-0.15	-0.24*	0.58**	-		
5. Letter knowledge	0.32**	0.6**	-0.35**	-0.24**	-	
6. Accuracy	0.4**	0.61**	-0.48**	-0.24*	0.52**	-

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

The estimation model for Reading accuracy is presented in the figure 10.

Figure 10. Reading accuracy and predictors – path analysis model

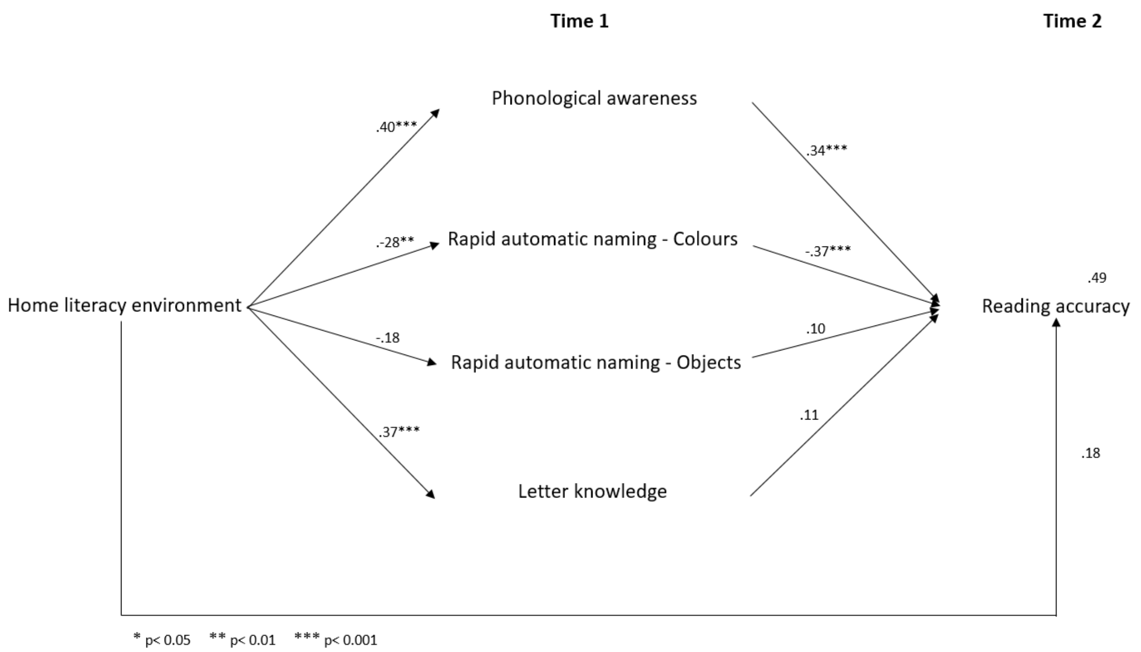


Table 87 summarises the information about unstandardised and standardised β coefficients, standard error and the associated p-value of the variables included in the model.

Table 87. Decomposition of effects from path analysis – Accuracy model

Variables	β unstandardised	S.E.	β standardised	p-value
Phonological awareness ← HLE	1.69	0.37	0.4	< 0.001
RAN Colours ← HLE	-21,656	7,190	-0.28	0.003
RAN Objects ← HLE	-7,692	4,075	-0.18	0.059

Letter knowledge ← HLE	1,952	0.457	0.37	< 0.001
Accuracy ← Phonological awareness	5,247	1,312	0.34	< 0.001
Accuracy ← RAN Colours	-0.305	0.079	-0.37	< 0.001
Accuracy ← RAN Objects	0.146	0.130	0.10	0.261
Accuracy ← Letter knowledge	1,406	0.959	0.11	0.173
Accuracy ← HLE	11,799	5,954	0.18	0.047

The first step in the path analysis was to estimate the direct contribution of the exogenous variable (HLE) on reading accuracy. The analysis does not show a significant effect (β= 0.18, p= 0.047), although the value is quite close to the critical point. It is important to mention, that the direct effects of the foundational skills on reading accuracy is being controlled by the effect of HLE on this variable (in this case, reading accuracy). This pattern is similar in the three models presented in the study (reading accuracy, fluency, and comprehension).

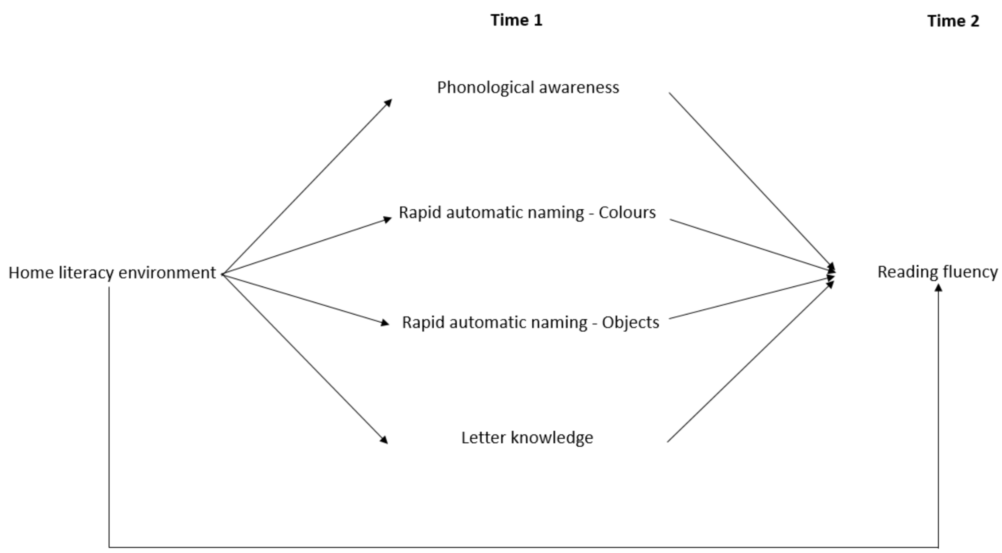
The next step was to identify the effect of HLE on the predictors. The results of the path analysis show that HLE explains that by increasing one unit in the HLE 0.4 standard deviation is modified in Phonological awareness results (β= 0.4, p< 0.001). Letter knowledge is also affected by the HLE with a change of 0.37 standard deviation by changing one unit in the HLE scale (β= 0.37, p< 0.001). These results also show an effect of HLE on RAN Colours (β= -0.28, p= 0.003), but not in RAN Objects (β= -0.18, p= 0.059).

The final step was to evaluate the contribution of the predictors on reading accuracy. The results show that reading accuracy seems to be better explained by Phonological awareness (β= 0.34, p< 0.001), and RAN Colours (β= -0.37, p< 0.001). RAN Objects (β= 0.1, p= 0.261), and Letter knowledge (β= 0.11, p= 0.173). The model, considering all the variables from the Triple Foundational Model explained 49.0% of the variance in the reading accuracy results.

9.5.3. Triple foundational model and reading fluency

Six variables were included in the reading fluency path analysis, practically the same variables that reading accuracy were included in the reading fluency model. The model aims to show a path from HLE to reading fluency, including the estimation of a direct effect from HLE to reading fluency. Figure 11 summarises the proposed model.

Figure 11. Reading fluency and predictors –proposed model



9.5.4. Path analysis. Reading fluency model

Tables 88 and 89 summarise the descriptive and correlation data of the variables included in the reading fluency model.

Table 88. Descriptive data from reading fluency model

	n	Mean (SD)
Home literacy environment	104	0.0 (0.56)
Phonological awareness	133	28.4 (7.3)
RAN - Colours	126	99.3 (44.5)
RAN - Objects	133	88.1 (25.3)
Letter knowledge	133	10.7 (3.0)
Fluency	106	30.3 (15.0)

Table 89. Correlations among variables in the reading fluency model

	1.	2.	3.	4.	5.	6.
1. Home literacy environment	-					
2. Phonological awareness	0.35**	-				
3. RAN - Colours	-0.25*	-0.44	-			
4. RAN - Objects	-0.15	-0.24*	0.58**	-		
5. Letter knowledge	0.32**	0.6**	-0.35**	-0.24**	-	
6. Fluency	0.28*	0.63**	-0.46**	-0.28*	0.62**	-

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

The estimation model for Reading fluency is presented in the figure 12.

Figure 12. Reading fluency and predictors – Path analysis model

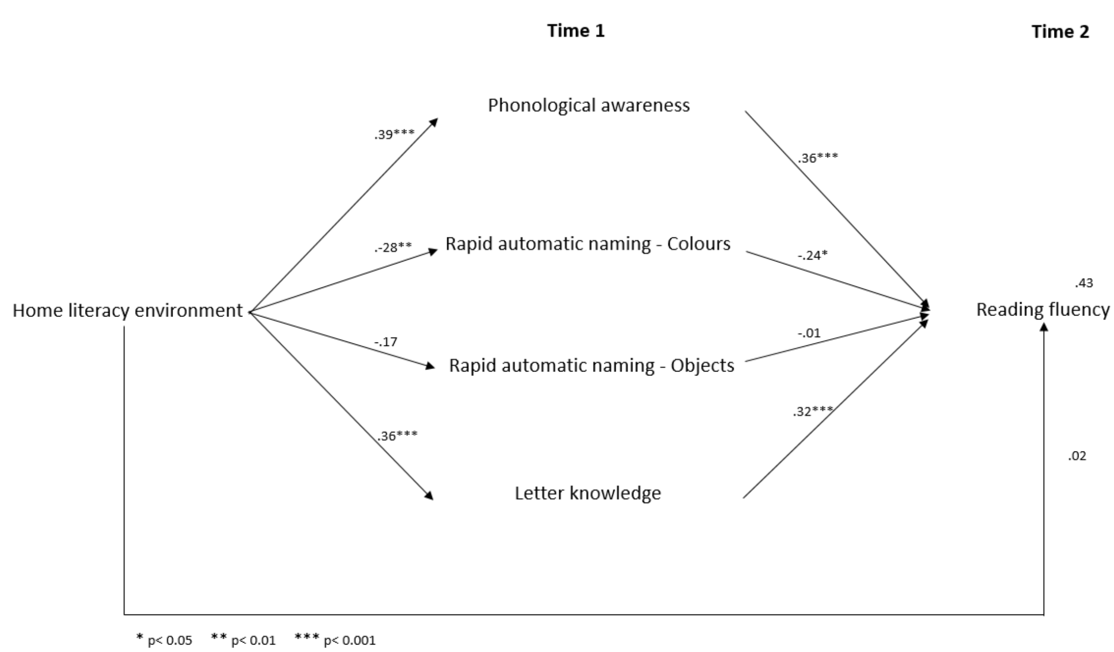


Table 90 summarises the information about unstandardised and standardised β coefficients, standard error and the associated p-value of the variables included in the model.

Table 90. Decomposition of effects from path analysis – Fluency model

Variables	β unstandardised	S.E.	β standardised	p-value
Phonological awareness ← HLE	5,013	1,110	0.4	< 0.001
RAN Colours ← HLE	-21,675	7,223	-0.28	0.003
RAN Objects ← HLE	-7,678	4,118	-0.18	0.062
Letter knowledge ← HLE	1,915	0.464	0.37	< 0.001
Fluency ← Phonological awareness	0.681	0.171	0.36	< 0.001
Fluency ← RAN Colours	-0.705	0.031	-0.24	0.017
Fluency ← RAN Objects	0.006	0.051	-0.11	0.902
Fluency ← Letter knowledge	1,506	0.376	0.32	< 0.001
Fluency ← HLE	0.586	2,379	0.02	0.805

The first step in the path analysis was to estimate the direct contribution of the exogenous variable (HLE) on reading fluency. The analysis does not show a significant effect ($\beta = 0.02$, $p = 0.805$).

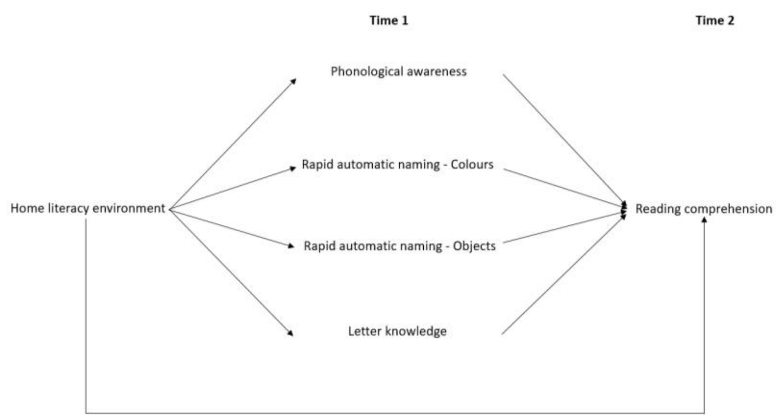
The next step was to identify the effect of HLE on the predictors. As in the case of reading accuracy, the increasing of one unit in the HLE scale is associated with an increasing of 0.36 standard deviations in the Phonological awareness outcomes ($\beta = 0.36$, $p < 0.001$). The variation in reading fluency is 0.24 standard deviations in the variation of one unit of RAN Colours ($\beta = -0.24$, $p = 0.017$). This value is 0.32 SD for the Letter knowledge ($\beta = 0.32$, $p < 0.001$). In sum, Phonological awareness, RAN Colours, and Letter knowledge significantly explain the variance in the reading fluency outcomes. RAN Colours did not contribute to explain the variance in the reading fluency outcomes. Probably, as in the same case of reading accuracy, this lack of effect can be related with the fact of RAN Colours and Objects share a large proportion of variance. In this case, the correlation between them is significant at 0.01 level ($r = 0.584$, $p < 0.01$).

The model considering all the variables from the Triple Foundational Model explained together a 43.0% of the variance in the reading accuracy results.

9.5.5. Triple foundational model and reading comprehension

As in the case of reading accuracy and fluency, six variables were included in the reading comprehension path analysis. They are the same variables, but now including the reading comprehension outcomes. The model aimed to show a path from HLE to reading comprehension, including the estimation of a direct effect from HLE to reading comprehension. Figure 11 summarises the proposed model.

Figure 11. Reading comprehension and predictors – proposed model



9.5.6. Path analysis. Reading comprehension model

Tables 91 and 92 summarise the descriptive and correlation data of the variables included in the reading comprehension model.

Table 91. Descriptive data from reading comprehension model

	n	Mean (SD)
Home literacy environment	104	0.0 (0.56)
Phonological awareness	133	28.4 (7.3)
RAN - Colours	126	99.3 (44.5)
RAN - Objects	133	88.1 (25.3)
Letter knowledge	133	10.7 (3.0)
Comprehension	106	25.8 (12.8)

Table 92. Correlations among variables in the reading comprehension model

	1.	2.	3.	4.	5.	6.
1. Home literacy environment	-					
2. Phonological awareness	0.35**	-				
3. RAN - Colours	-0.25*	-0.44	-			
4. RAN - Objects	-0.15	-0.24*	0.58**	-		
5. Letter knowledge	0.32**	0.6**	-0.35**	-0.24**	-	
6. Comprehension	0.45**	0.62**	-0.42**	-0.13	0.52**	-

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

The estimation model for Reading comprehension is presented in the figure 12.

Figure 13. Reading comprehension and predictors – path analysis model

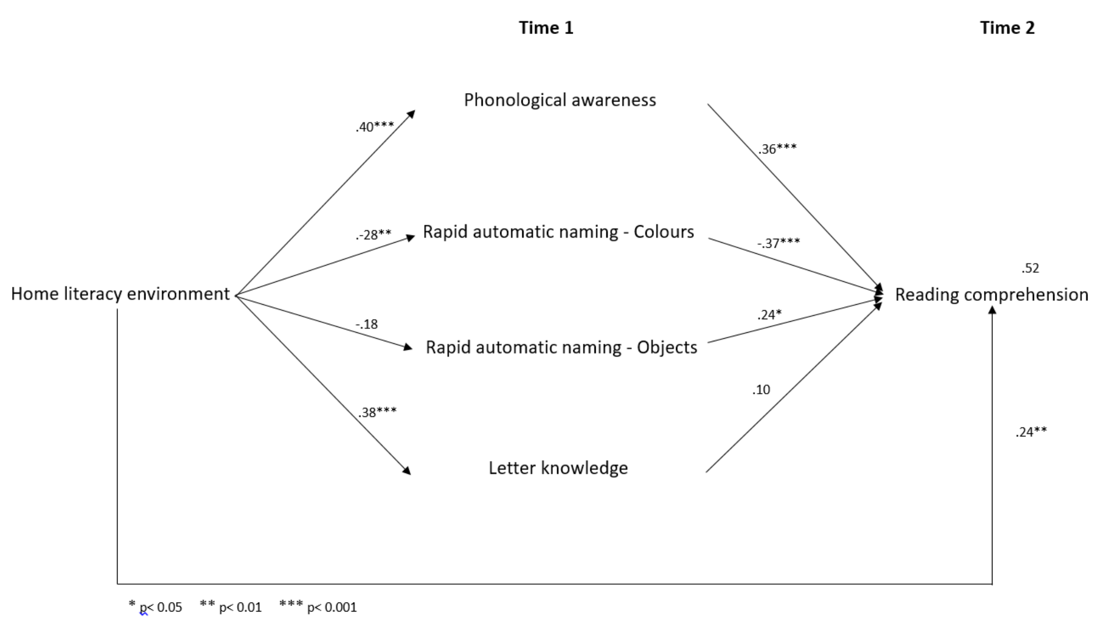


Table 93 summarises the information about unstandardised and standardised β coefficients, standard error and the associated p-value of the variables included in the model.

Table 93. Decomposition of effects from path analysis – Comprehension model

Variables	β unstandardised	S.E.	β standardised	p-value
Phonological awareness ← HLE	4,996	1,097	0.395	< 0.001
RAN Colours ← HLE	-22,223	7,171	-0.283	0.002
RAN Objects ← HLE	-7,729	4,064	-0.18	0.057
Letter knowledge ← HLE	1,963	0.456	0.38	< 0.001
Comprehension ← Phon. awareness	0.625	0.146	0.36	< 0.001
Comprehension ← RAN Colours	-0.104	0.027	-0.37	< 0.001
Comprehension ← RAN Objects	0.123	0.044	0.24	0.005
Comprehension ← Letter knowledge	0.430	0.322	0.1	0.182
Comprehension ← HLE	5,364	1,975	0.24	0.007

The first step in the path analysis was to estimate the direct contribution of the exogenous variable (HLE) on reading fluency. The analyses show a significant effect of the HLE on the reading comprehension outcomes (β= 0.24, p= 0.007), which means that for every variation in one unit in the HLE outcomes, a variation of 0.24 standard deviation is expected in reading comprehension.

The next step was to identify the effect of HLE on the predictors. As in the case of reading accuracy and fluency, the increasing of one unit in the HLE scale is associated with an increasing of 0.4 standard deviations in the Phonological awareness outcomes (β= 0.39, p< 0.001), -0.28 SD in the RAN Colours (β= -0.24, p= 0.017), and 0.38 SD in the Letter knowledge (β= 0.38, p= 0.017).

The variation in reading comprehension is 0.36 standard deviations in the variation of one unit of Phonological awareness (β= 0.36, p< 0.001), -0.37 SD in the case of RAN Colours (β= -0.37, p< 0.001), and 0.24 SD in the case of RAN Objects (β= 0.24, p= 0.005). No significant effect was found for the Letter knowledge on the reading comprehension outcomes (β= 0.1, p= 0.182).

The model considering all the variables from the Triple Foundational Model explained together a 52.0% of the variance in the reading accuracy results.

9.6. Early language and cognitive skills as predictors of reading

The model considering all the variables from the Triple Foundational Model explained together a 52.0% of the variance in the reading accuracy results.

9.6.1. Early language predictors and reading components

Three different models were estimated in order to evaluate the contribution of HLE on the early language predictors, and then their impact on reading accuracy outcomes. As in the case of the models presented for the Triple Foundational Model, significant direct effects were found for the HLE on Grammar knowledge (β= 0.3, $p<$ 0.001), Receptive vocabulary (β= 0.48, $p<$ 0.001), and Lexical search and retrieval (β= 0.1, p= 0.182). These results show that for the variation in one unit of the HLE, 0.3 SD deviations of modification is expected for Grammar knowledge, 0.48 for receptive vocabulary and 0.28 for lexical search and retrieval respectively. In terms of the contribution of HLE on reading accuracy, the results show that for the one-unit variation in HLE and increasing of 0.36 SD is expected in the reading accuracy outcomes. The model which considers the early language predictors explains 27.0% of the variance in reading accuracy (β= 0.36, $p<$ 0.001).

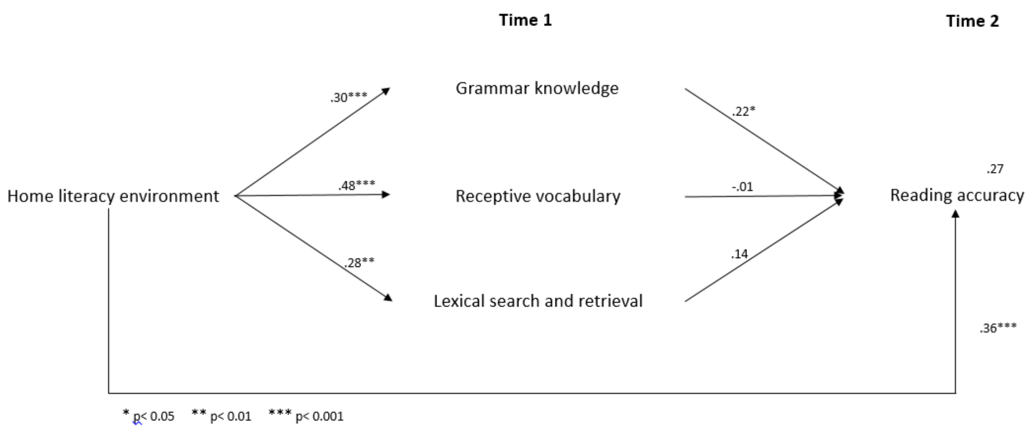
This strong effect of HLE on accuracy and the early language predictors is quite similar to the reading fluency and reading accuracy. In the case of reading fluency, the effect of HLE on the predictors is 0.36 SD for the Grammar knowledge (β= 0.36, $p<$ 0.001), 0.47 SD for Receptive vocabulary (β= 0.47, $p<$ 0.001), and Lexical search and retrieval (β= 0.27, $p<$ 0.001). Despite HLE and the Early language predictors are exactly the same ones used in the reading accuracy model, the variation in the standardized β coefficients is related with the differential direct effect of HLE on the outcomes, in this case reading fluency, in which no significant effect was found (β= 0.21, p= 0.072). Finally, solely the Lexical Search and retrieval show a significant contribution to the variance in the reading fluency outcomes (β= 0.21, p= 0.028).

In the case of the effect of HLE on the early language predictors for the Reading comprehension model, the same pattern emerged. The effect of the variation of one unit in HLE modifies 0.31 for the Grammar knowledge (β= 0.31, p< 0.001), 0.48 SD for Receptive vocabulary (β= 0.48, p< 0.001), and Lexical search and retrieval outcomes (β= 0.28, p< 0.001). A significant effect of HLE on reading comprehension was also found (β= 0.35, p< 0.001).

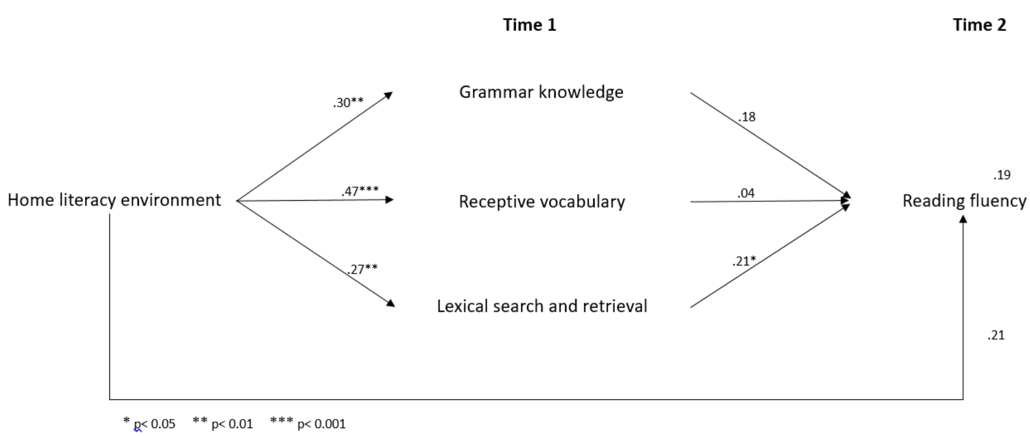
The path analyses models for the HLE, early language predictors and reading components (accuracy, fluency, and comprehension) are presented in figure 13.

Figure 14. HLE, Early language predictors and reading components

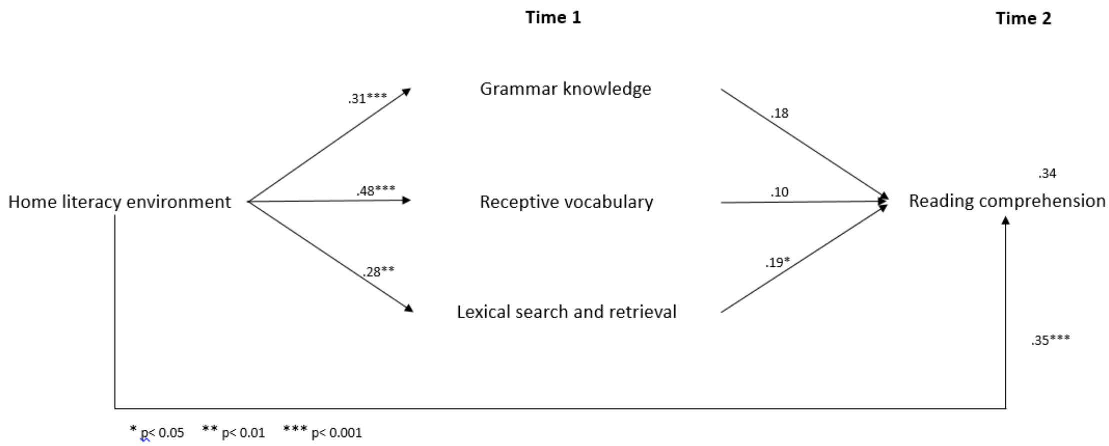
Path analysis. Reading accuracy model



Path analysis. Reading fluency model



Path analysis. Reading comprehension model



9.6.2. Cognitive skills and reading components

As in the case of early language predictors, three different models were estimated to evaluate the contribution of HLE on the cognitive skills, and then their impact on reading accuracy outcomes. Contrary to all of the previous models presented, HLE did not make any contribution to explain the variation of the variables included in the cognitive skills category: General cognitive skills (β= 0.13, p= 0.188), Analogical reasoning – verbal (β= 0.11, p= 0.255), Analogical reasoning – non-verbal (β= 0.01, p= 0.890), inferencing (β= -0.06, p= 0.512), Executive functions – Movements (β= -0.13, p= 0.213). The only exception in this group is a significant effect of HLE on the number of violation of rules in the Tower of Hanoi - Executive functions (β= -0.31, p= 0.03).

No significant effects were found for any of the evaluated cognitive skills and the variance in the reading accuracy outcomes. These abilities include: General cognitive skills (β= 0.17, p= 0.055), Analogical reasoning – verbal (β= 0.13, p= 0.134), Analogical reasoning – non-verbal (β= -0.01, p= 0.932), Inferencing (β= 0.17, p= 0.048), Executive functions – Movements (β= -0.08, p= 0.335), and Executive functions - errors (β= -0.13, p= 0.141).

A direct effect of HLE on reading accuracy was found for this model (β= 0.35, p< 0.001). The model including all the cognitive skills explains 27.0% of the variance in reading accuracy outcomes.

In the case of HLE, cognitive skills and reading fluency, similar pattern that in the case of reading accuracy has been found. No significant effect was found for the HLE on cognitive skills: General cognitive skills (β= 0.13, p= 0.269), Analogical reasoning – verbal (β= 0.11, p= 0.245), Analogical reasoning – non-verbal (β= 0.01, p= 0.958), Inferencing (β= -0.06, p= 0.457), Executive functions – Movements (β= -0.13, p= 0.234). As in the case of reading accuracy, the exception is for the number of violation of rules in the Tower of Hanoi - Executive functions (β= -0.31, p= 0.004).

No significant effects were found for any of the evaluated cognitive skills and the variance in the reading accuracy outcomes. These abilities include: General cognitive skills (β= 0.18, p= 0.048), Analogical reasoning – verbal (β= 0.12, p= 0.194), Analogical reasoning – non-verbal (β= 0.01, p= 0.884), Inferencing (β= 0.1, p= 0.275), Executive functions – Movements (β= 0.02, p= 0.817), and Executive functions - errors (β= -0.14, p= 0.139).

A direct effect of HLE on reading accuracy was found for this model (β= 0.23, p< 0.001). The model including all the cognitive skills explains 17.0% of the variance in reading fluency outcomes.

Finally, a path analysis was conducted to evaluate the links among HLE, cognitive skills and reading comprehension. No significant effect was found for HLE and the cognitive skills: General cognitive skills (β= 0.12, p= 0.204), Analogical reasoning – verbal (β= 0.10, p= 0.279), Analogical reasoning – non-verbal (β= 0.02, p= 0.852), Inferencing (β= -0.07, p= 0.464), Executive functions – Movements (β= -0.13, p= 0.234). As in the case of reading accuracy, and fluency, the exception is for the number of violation of rules in the Tower of Hanoi - Executive functions (β= -0.30, p= 0.003).

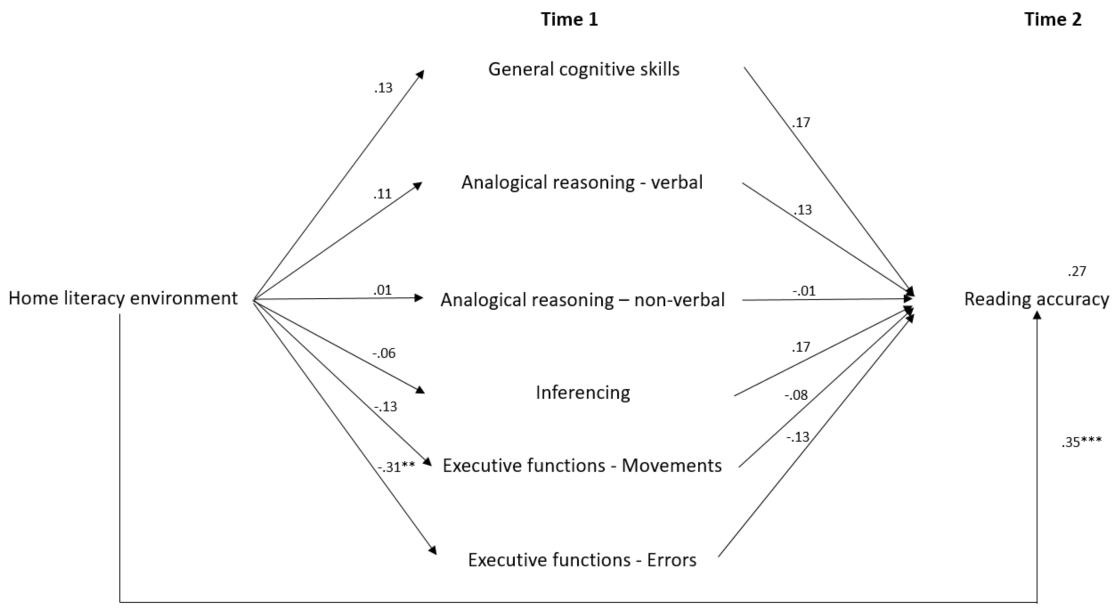
No significant effects were found for any of the evaluated cognitive skills and the variance in the reading accuracy outcomes. These abilities include: General cognitive skills (β= 0.15, p= 0.083), Analogical reasoning – verbal (β= 0.14, p= 0.108), Analogical reasoning – non-verbal (β= 0.03, p= 0.716), Inferencing (β= 0.16, p= 0.063), Executive functions – Movements (β= 0.09, p= 0.309), and Executive functions - errors (β= -0.16, p= 0.067).

A direct effect of HLE on reading accuracy was found for this model (β= 0.39, p< 0.001). The model including all the cognitive skills explains 31.0% of the variance in reading comprehension outcomes.

The path analyses models for the HLE, cognitive skills and reading components (accuracy, fluency, and comprehension) are presented in figure 14.

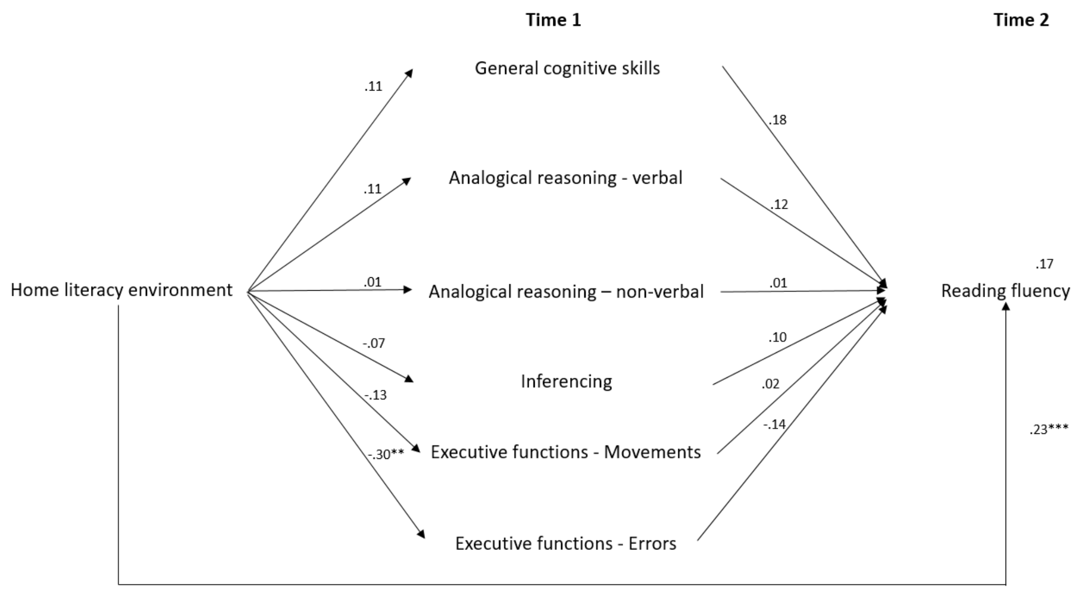
Figure 15. HLE, Cognitive skills predictors and reading components

Path analysis. Reading accuracy model



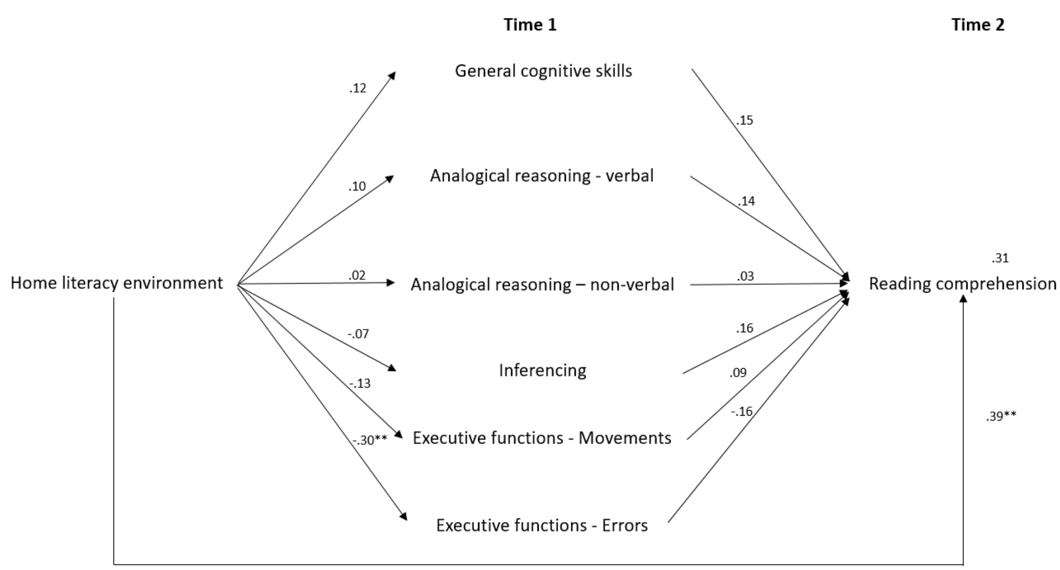
* p< 0.05 ** p< 0.01 *** p< 0.001

Path analysis. Reading fluency model



* p< 0.05 ** p< 0.01 *** p< 0.001

Path analysis. Reading comprehension model



* p< 0.05 ** p< 0.01 *** p< 0.001

9.7. Summary of results

The results presented in this chapter confirm the importance that Phonological awareness, Rapid automatic naming, and Letter knowledge have on the reading components. These predictors in turn are strongly affected by the home literacy environment factors.

In the case of reading accuracy, both phonological awareness and RAN – Colours can be considered significant predictors of reading accuracy. In this case, Letter knowledge, did not significant contribute to the reading accuracy outcomes. HLE significant explained both directly the variance of reading accuracy, and also the predictors included in the model. The model explains 49.0% of the variance in reading accuracy.

From the Early language predictors, three variables were included in the model: Grammar knowledge, Receptive vocabulary, and Lexical search and retrieval. These variables were significantly affected by the Home literacy environment. However, only Grammar knowledge was the main predictor to explain later reading accuracy outcomes. Finally, a group of cognitive skills were included. These variables included: General cognitive skills, analogical reasoning (verbal and non-verbal), inferencing, and executive functions (movements and errors). From these cognitive skills solely, the number of errors in the Tower of Hanoi (Executive functions) was significantly affected by HLE. None of the cognitive skills explained later reading accuracy outcomes.

The second reading component was reading fluency. From the Triple Foundational Model, the same pattern between HLE and the variables was found, this is HLE significantly explained the variance in the predictors. As in the case of reading accuracy, the three factors significantly explained later reading fluency. From these factors, phonological awareness, and letter knowledge were the main predictors of reading fluency. RAN Colours also contributed to predict reading fluency, although slightly less strong than the other two factors. Triple foundational model explains 43.0% of the variance in reading accuracy outcomes. Finally, from the cognitive skills category, none of the variables included explained later reading fluency outcomes.

The final component evaluated in this study was Reading comprehension. As in the rest of the presented models, all variables were significantly explained by the HLE (Phonological awareness, RAN Colours and Objects, and Letter Knowledge). From these variables, Phonological awareness and RAN Colours evaluated at time 1 significantly predicted the reading comprehension outcomes. Letter knowledge was not considered a significant factor in this model. The variables included in the Triple Foundational Model, including the direct contribution of HLE to reading comprehension, can explain 52.0% of the variance in this model.

In terms of the Early language predictors, these factors were significantly affected by HLE. From they in turn, solely Lexical search and retrieval can be considered as a factor to explain later reading fluency. Finally, a group of cognitive skills were also included. None of these variables were affected by HLE (except for Executive functions (number of errors in Tower of Hanoi). None of the cognitive skills can explain later reading comprehension outcomes.

In sum, accuracy was significantly explained by two out of three factors in the Triple foundational model: Phonological awareness and RAN Colours, and one of the factors from the Early Language predictors: Grammar knowledge. Reading fluency outcomes was significantly predicted by all the factors included in the Triple foundational model: Phonological awareness, RAN Colours, and Letter knowledge. In addition, Lexical search and retrieval was the only factor from the Early language skills that explained later reading fluency outcomes. Finally, the variance in the Reading comprehension outcomes was predicted by Phonological awareness and both RAN Colours and Objects. Letter knowledge did not explain significantly the variance of Reading comprehension. As in the previous model, only the variable called Lexical search and retrieval explained later reading comprehension. None of the factors include in the Cognitive skills was useful to explain any of the reading components: accuracy, fluency and comprehension.

9.8. Goodness of fit of the models

The goodness of fit is a key component in those Structural equation Model (SEM). It evaluates the extent in which a hypothesized model reproduces the multivariate structure that underlies a set of variables (Ryu, 2014). Four different estimators were conducted in order to evaluate the goodness of fit in the presented models: Chi-square, Normed fit index (NFI), Comparative fit index (CFI), and Root mean square error of approximation (RMSEA).

In the case of Chi-square a value less than 0.05 is considered a bad model. Both the Normed fit Index (NFI) and the Comparative fit Index (CFI), requires a coefficient above of 0.9 to express an adequate fit. The last tool is the Root mean square error of approximation (RMSEA) and it evaluates the distribution of residuals in the model, and the values above 0.06 can be considered a good indicator of goodness of fit. In the table 94, the estimations for the goodness of fit in the models is presented.

Table 94. Goodness of fit in the path analysis models

		Chi-square		NFI	CFI	RMSEA
		Value	p-value			
Triple foundational model	Accuracy	49,585	0.000	0.783	0.776	0.344
	Fluency	50,394	0.000	0.785	0.778	0.346
	Comprehension	49,854	0.000	0.787	0.78	0.344
Early language predictors	Accuracy	10,622	0.001	0.908	0.904	0.270
	Fluency	10,902	0.001	0.898	0.893	0.274
	Comprehension	10,330	0.001	0.919	0.917	0.266
Cognitive skills	Accuracy	25,113	0.005	0.716	0.712	0.107
	Fluency	25,638	0.004	0.644	0.566	0.109
	Comprehension	25,113	0.005	0.716	0.712	0.107

Table 94 shows that in general, the proposed models, do not show and adequate goodness of fit. This is, the expected and the observed values are significantly different. A better goodness of fit appears for those early language predictors models with NFI and CFI above a coefficient of 0.9, in all the three presented models. Despite the importance of the goodness of fit, the models should not be completely dismissed. The standardized beta coefficients show a pattern which is coincident with previous studies in the area. The lack of goodness of fit affects the accurateness of the estimations, but the levels of significance of the variables surely will be confirmed with a larger sample size.

In order to deal with this lack of goodness of fit in the models, three different procedures were attempted. These procedures are related with the sample size, index modifications, normal distribution and the analysis of residuals.

9.8.1. Sample size

In terms of sample size, path analyses are sensitive to the number of variables and relations among them. In other words, for more complex models, a greater sample size is needed. A ratio of 20 cases per parameter (q) has been suggested in the path models (Klein, 1998). Six variables in the Triple foundational model, five variables in the Early language model, and and eight variables were included in the cognitive skills models. The nine models were conducted with a sample size of 104. When only that indicator is considered, the Early language skills models fit with this criteria. These models are in turn, those in which both NFI and CFI show adequate levels of Goodness of fit.

In this line, the nine models were conducted reducing the number of predictors. These reduction allowed to improve the goodness of fit, and the adequate levels of fit were reached when only three variables were included in the model (i.e. HLE → Phonological awareness → Reading accuracy).

Even though parsimony in the path analysis, as in the rest of structural equation models (SEM), is a desirable condition. Marsh and Hau (2014) have developed a case where parsimony, in terms of the reduction of the variables (parameters) according to the sample size, may be undesirable. The authors conclude that although goodness of fit is very beneficial, it does not replace the theoretical proposal in the models. It also been suggested that a reduction of the parameters in a model (according to the rules of ratio of participants) can induce an overestimation of the coefficients present in the models, which has negative effects on the interpretation of the relations.

9.8.2. Modification indices

In line with the sample size, a number of path analyses were conducted in order to evaluate the goodness of fit by adding or removing certain variables. The modification indices allow to suggest how much the estimation varies when the parameters change. Unfortunately, and in addition to the problems with the sample size, not all estimators are based in the same number of participants. This is, not all the variables considering the same number of children, and this is the reason because modification indices were not possible to calculate. The longitudinal features of this study, did not allow that same children participate at times 1 and 2 of the current study. The same models presented were in turn calculated using multiple linear regressions, and the coefficients are quite similar to those presented in these path analysis models.

9.8.3. Normal distribution and the analysis of residuals

Path analysis require that the models show a normal distribution in the predictors. The lack of normal distribution in the variables can negatively affect the fit of the models. As it has been discussed in previous sections, a significant number of the variables included in this study are not normally distributed. One of the reason to explain this lack of normal distribution is related with the sub groups included in the study. The Kolmogorov-Smirnov tool show that in general for those variables in which non-normal distribution appeared in the scores, at least one of the sub-groups (low and high SES), showed a normal distribution, or having normal distribution in each subgroup, by analysing all participants these distribution seemed to be bi-modal. A logical further step might be to analyse different models considering each sub-group, in order to fit with the idea of fitting with the normal distribution assumptions. However, by dividing the sample the estimation power decreases dramatically, and therefore the goodness of fit is not reached.

Other of the ways to analyse the goodness of fit is related with the analysis of residuals. This analysis allows a detailed look of what is left over after explaining the variation betwwen independent and dependent variables. These residuals should be small, unstructured, and normally distributed; in the rest of cases not linear regression could emerge by the analysis of residuals, or to check whether the assumtions in the model have been (or not) violated. To evaluate this, the residuals were analysed through the Kolmogorov-Smirnov, considering all participants and the low and high SES groups.

Table 95. Analysis of residuals. Kolmogorov-Smirnov

		All participants	Low SES	High SES
Reading components	Accuracy	0.153	0.022	0.348
	Fluency	0.298	0.597	0.328
	Comprehension	0.035	0.003	0.394
Triple foundational model	Phonological awareness	0.626	0.303	0.178
	RAN Colours	0.000	0.016	0.10
	RAN Objects	0.008	0.04	0.206
	Letter knowledge	0.016	0.442	0.004
Early language predictors	Grammar knowledge	0.000	0.026	0.001
	Receptive vocabulary	0.693	0.439	0.867
	Lexical search and retrieval	0.176	0.843	0.280
Cognitive skills	General cognitive skills	0.007	0.018	0.123
	Analogical reasoning- verbal	0.02	0.078	0.323
	Analogical reasoning- Non verbal	0.094	0.08	0.068

Inferencing	0.053	0.406	0.116
Exec. Functions - movements	0.447	0.556	0.122
Exec. Functions - errors	0.016	0.206	0.03

The analyses presented in table 95 shows that in general terms, an adequate distribution of residuals appears in an important proportion of the variables. From the reading comprehension, the distrbution is not normal (p= 0.035) although quite close to the critical point. Non-normal distribution in the Triple foundational model was found for RAN and Letter knowledge. In Early language predictors only Grammar knowledge does not show a normal distribution of their residuals. Finally, in the cognitive skills cateroy, both General cognitive skills and analogical reasoning verbal did not show a normal distribution of the residuals for all participants. In sum seven of the variables did not show a normal distribution when all participants are included. Five out of these seven predictors showed in turn, normal distribution for at least one of the subgroups included [i.e. Reading comprehension (High SES), K-S, p-value: 0.394; RAN Objects (High SES), K-S, p-value: 0.206; Letter knowledge (Low SES), K-S, p-value: 0.442; Reading comprehension (High SES), K-S, p-value: 0.394; General cognitive skills (High SES), K-S, p-value: 0.123; Analogical reasoning verbal (High SES), K-S, p-value: 0.323]. RAN Colours and Grammar knowledge were the only two variables in which not normal distribution of the residuals were found for all participants and also for the low and high SES groups.

In sum, the sample not only in terms of the number of participants, but also the features of the groups included in this study negatively affected the adequate distribution of the scores, and therefore an adequate goodness of fit level. While the performance in the low and high SES groups showed to be significantly different, these extremes did not allow to reach the normal distribution in the data. This lack of distribution affected the accurateness in the path analysis models. Despite this lack of goodness of fit, the results should not dismiss completely. This study show that HLE is significantly associated with the early language predictors and with those skills considered in the Triple foundational model. This group of variables, consistently with previous studies, proved to explain later reading accuracy, fluency, and comprehension.

Chapter 10: General discussion

The existing research literature shows that there are significant differences in reading outcomes from the first years of primary education, in accordance to children's families' SES (Arnold & Doctoroff, 2003; Chiu & McBride-Chang, 2006; Kieffer, 2011). Not surprisingly, the current study confirmed those findings. Children aged 7 significantly differed in terms of reading outcomes (accuracy, fluency and comprehension) when they were compared according to their SES. This longitudinal study aimed to understand the underlying reasons of these differences in two ways: identifying what are the main predictors of reading and evaluating whether these predictors are significantly affected by the learning opportunities associated with the families' socioeconomic background, in a sample of 133 monolingual-Spanish speaking children at age 5 (time 1) and 106 children at age 7 (time 2). This chapter discusses the main findings of the studies, including educational implications, limitations, and directions for future studies.

10.1. Summary of findings

This section briefly presents the main findings of this study from three approaches: firstly, the contribution of the Triple foundational predictors, early language skills, and cognitive skills on reading outcomes; secondly, the effect of HLE on the path analyses to explain reading outcomes is presented. Finally, the summary of findings of each of the variables according to the children's' SES is presented.

10.1.1. Contribution of evaluated skills on reading outcomes

The first aim of the study was to evaluate the contribution of the variables included in the Triple foundational model (phonological awareness, rapid automatic naming and letter knowledge), early language skills (grammar, receptive vocabulary, and lexical search and retrieval), and cognitive skills (general cognitive ability, analogical reasoning, inferencing, categorisation, and executive functions) to reading (accuracy, fluency and comprehension).

The results of this longitudinal study show that the variables included in the Triple Foundational Model at time 1, significantly predicted the reading accuracy, fluency and accuracy at time 2, as found in previous studies (Caravolas et al., 2013; Guardia, 2010). From the Early language skills, grammar knowledge significantly predicted reading accuracy, while lexical search and retrieval predicted reading fluency and comprehension. Cognitive skills did not explain any of the reading outcomes.

In the case of reading accuracy, phonological awareness evaluated at time 1 was a strong predictor. This finding is in line with previous studies showing the effect of phonological awareness on reading accuracy (Savage & Frederickson, 2005; Thaler, Ebner, Wimmer, & Landerl, 2004), which is particularly strong in languages with a high grapheme-phoneme consistency as Spanish (Anthony et al., 2006; Bravo, 1995; Caravolas et al., 2013; Guardia, 2003). Rapid automatic naming was other of the strongest predictors of reading accuracy (Wolf & Bowers, 1999; Wolf et al., 2000).

In the case of reading fluency, Phonological awareness, RAN Colours, and Letter knowledge were the most important predictors, in line with previous studies (Landerl & Wimmer, 2008; Tobia & Marzocchi, 2014). The strong effect that RAN has on fluency outcomes could be explained by the automaticity that both tasks require. Once automaticity is reached, the predictors of fluency are better explained by other factors such as vocabulary, verbal short-term memory, and attention (Tobia & Marzocchi, 2014).

Finally, in the reading comprehension outcomes, Phonological awareness, RAN Colours, RAN Objects, Letter Knowledge, and Lexical search and retrieval were significant predictors.

Cognitive skills did not explain the variance in any of the reading outcomes evaluated in this study, and at least three hypotheses can be formulated to explain this lack of relationship. Firstly, in this study, the use of cognitive skills was not a required ability to complete the reading tasks, at least at this age; and therefore, it was not expected to find a strong effect of these cognitive tasks on reading outcomes. Probably, in the future, when reading comprehension tasks require higher order skills such as inferring, categorising, and analogical reasoning, the effect of cognitive skills on reading outcomes could be found. Secondly, the way in which the results were presented in the different path analyses could have made invisible the effects of cognitive skills on the reading outcomes. In this sense, it was a methodological decision, to avoid the inclusion of cognitive skills as moderator or mediator in the diagrams, and because no significant differences associated to the HLE were found in almost all the evaluated cognitive tasks, and because the statistical power was just enough to represent the foundational and early language predictors. This decision was taken to avoid the statistical "fishing", this is to find or force specific results to corroborate some hypotheses, rather than following previous theoretical models.

10.1.2. Effect of HLE on the path analyses

The results were analysed using path analyses to understand the influence of Home Literacy environment on the reading predictors and reading outcomes. Path analyses also allowed an estimation of the direct effect of HLE on reading accuracy, fluency, and comprehension. These analyses showed that in the case of reading accuracy, HLE significantly impacted on six abilities evaluated at time 1, which are: phonological awareness, RAN, Letter knowledge, grammar knowledge, receptive vocabulary, and lexical search and retrieval. The number of violation of rules in the Tower of Hanoi (executive functions) also was significantly predicted by HLE. Home literacy environment also had a significant direct impact on the reading accuracy, fluency, and comprehension.

The results show a strong impact of HLE on reading and on their predictors (Triple Foundational Model, and Early language skills), but not on the non-verbal cognitive tasks evaluated at both times, which in turn did not predict the reading outcomes. General cognitive ability, non-verbal analogical reasoning, inferences, categorisation and executive functions (movements) did not show HLE effect. These results do not fit with previous studies that reported a strong relationship between HLE, particularly in terms of the socio-economic status and cognitive skills (Botting et al., 2008; Carneiro, Crawford, &

Goodman, 2007; Downer & Pianta, 2006; L. Fernald et al., 2011; Noble et al., 2006)[3]. In this study, almost all tasks that tapped those cognitive skills underlying learning, and language and literacy were not affected by SES at the ages 5 and 7, whereas those tasks that required existing knowledge *were* affected by the SES. This discrepancy could be due the fact that children from low SES are more likely to grow up in context of impoverished learning opportunities, and therefore, those tasks that captured the previous knowledge showed a significant effect when children from low and high SES were compared.

In this study for example, one of the factors included in the HLE model is the parent educational attainment. In the high SES group, 86.0% of the mothers and 85.0% of the fathers did complete tertiary education, while in the low SES group this percentage is more than three times less, with only 24.0% of the mothers and 16.0% of the fathers completing this educational level. Other of the factors refers to the number of books at home. The results show that only 8.0% in the low SES group and 60.0% in the high SES group reported to have more than 15 books at home. In addition, while only 10.0% of the families from low SES reported to read books to their children, the percentage is increased to 25.0% in the case of families from high SES group.

In this study, cognitive skills were evaluated through non-verbal tasks to attempt to isolate as much as possible the influence of linguistic knowledge on cognitive performance. If the results of this study in cognitive abilities can be replicated on a larger scale, it could be hypothesized that although the distinction between the cognitive and the linguistic areas can be considered artificial one, it is worth using non-verbal tasks for evaluating cognitive skills instead of using linguistic components for the assessment, since this can lead to misinterpretations in the results.

10.2. Educational implications

One of the main findings that emerged from this study is that interactions and opportunities in which children grow up have a significant impact on those abilities that

[3] An interesting summary of the relationship between cognitive skills and SES can be found in R. Bradley and Corwyn (2002).

will allow children to learn to read. These opportunities include the number of books at home, frequency of share reading, print exposure, and all those pre-literacy activities. These factors play a crucial role in the reading acquisition processes. In this study, it was evident that there are significant gaps in children from low and high SES not only in reading but also in those foundational reading and early language predictors. In socioeconomic segregated countries, not only the family income and educational attainment are unequally distributed, but also the required opportunities to learn to read. This lack of opportunities affects significantly those children from deprived environments.

The reading gaps detected in this study at the end of the first year of primary will be maintained or increased over the years (MINEDUC, 2007, 2013, 2014; Stanovich, 1986), and therefore devoting efforts to improve children's literacy learning in this group is not only a necessary but also an urgent topic. Given some family features of the low SES groups found in the parent survey such as low educational attainment, lack of printed materials (e.g. books), fewer interactions between parents and children, among others, the role that schools must assume is crucial not only in terms of teaching in early years, but also in enhancing the family-school alliance. Designing strategies for developing language and literacy skills must be considered an urgent matter in educational policies, particularly in those levels in which these differences start, this is early childhood years. These strategies are challenging since they have to consider not only the limited resources at school settings, but also to deal with the reduced elements included in the home literacy environment in which children grow up.

Although this study did not aim to design strategies to improve reading acquisition, the findings highlight at least three aspects regarding reading and its predictors: a) phonological awareness, in line with previous studies, was the strongest predictor of reading in Spanish; b) RAN and letter knowledge can be also considered important predictors of reading; c) cognitive mechanisms that underlie vocabulary and reading were not affected by the SES. Regarding phonological awareness, although the Chilean curriculum recognises its importance, the way in which phonological awareness must be taught in classes has not been clearly established, and most children from low

SES are just able to segment words into syllables, and less capable to perform other phonological awareness tasks, such as phoneme isolation, deletion, and rhymes. In this study, all the phonological tasks were affected by SES, except syllable segmentation at time 1. This excess in the promotion of syllable segmentation, instead of other phonological awareness tasks has proved to have an impact on the development of reading fluency (Guardia, 2010).

The proven contribution of RAN and letter knowledge to later reading achievement can also be considered one of the challenges to improve at this level. However, RAN has been described as an easier skill to measure, but very hard to improve, at least quickly (Jong & Vrielink, 2004). RAN integrates higher visual and linguistic level processes, and they can be evaluated in a non-reading stage. Children at this age should not be trained specifically in these tasks, but teaching should promote strategies to develop automaticity in relating visual codes and in their phonological representations. In terms of Letter knowledge, the current study showed that children who knew not only the sound of the letters, but also the name of them, had a better performance in reading tasks.

Finally, one of the most important considerations in terms of the educational implications of this study is that teachers might benefit from a quick and updated report about the performance of their students, not only before but also during the process of learning to read. Designing a simple, efficient and easy-to-use battery of tests that brings together those factors that best predict the different components of reading, would allow teachers to know the strengths and weaknesses of their students, acting quickly and contingently before these issues require to be urgently corrected. In other words, it is essential not only developing test batteries to evaluate reading predictors, but also to develop mechanisms to transfer that information in a useful way to teachers and parents and to improve teaching particularly in low SES children.

10.3. Limitations of the study

The limitations of this study can be summarised into three categories: sample, tasks and interpretation of the results.

10.3.1. Sample size

In terms of the sample used in this research, two main limitations can be found. Firstly, *a greater sample size was required.* The current study used a great number of tasks at two different time points. The results not only were analysed in terms of evaluating how predictive they are on the components of reading, but comparisons between low and high SES groups were also contrasted. The sample size of the current study was calculated considering an effect size from 0.3 onwards, with an alpha error of 0.05, as used in other similar psychological and educational studies. The expected sample size for the comparisons between two groups (low and high SES) was calculated in 122 participants. The actual study considered the participation of 133 children at time 1, and a subset of 106 at time 2.

Notwithstanding, regarding the path analysis this number of participants was not the optimal since the number of estimations is associated with the required sample size. In other words, the greater number of variables added in the predictive model, the greater number of participants is required. From the path analyses only, those early language skills models seemed to be close to reach an adequate level of goodness of fit with values above the critical points (NFI, CFI). This model included fewer variables in the explicative model than the rest of the models. It has been suggested a ratio of 20 cases per parameter (variable) which allows to reach good levels of goodness of fit, although the sample size is just one of the requirements (Klein, 1998). Thus, 16 and 56 additional cases were required for the accuracy and cognitive models respectively.

Even though one of the aims of this study was to compare children from low and high SES, *the lack of a middle SES group was also one of the limitations of the study.* Some tasks scores were not distributed according to a Normal or Gaussian distribution curve, therefore some of the assumptions in which t-test, or path analyses are based on were not reached. Since only low and high groups were evaluated, the score distribution in some cases showed a bi-modal curve, with two different means, medians and modes. Probably, the inclusion of a middle SES group could have filled the space between curves allowing a normal distribution in the scores. Unfortunately, in the city in which this study was conducted (Linares), there **are 30 schools**, and only **10** of them have preschool and primary education**, 3 out of 10** receive a high proportion of children from mid SES group, but unfortunately, they did not agree to participate in this study. This study was conducted in a small city because the longitudinal feature of the study required that students remained in the same schools at times 1 and 2. It has been established that in Chile, the student's migration from one school to another is significantly lower in small cities (Espinola, et al, 2011).

10.3.2. Tasks and tasks administration

In a previous study about reading predictors in Chile, Guardia (2010), suggested that future studies should consider not only foundational predictors of reading but also other language and cognitive skills, in a larger and more varied sample size. The current study included more variables, with a greater sample size (133 versus 94) divided in low and high SES groups. The inclusion of a greater number of tasks allowed designing a more complex net of relationships between skills involved in reading in the context of Spanish monolingual children. Notwithstanding, the inclusion of more tasks in a larger sample size brings with it, certain difficulties, for example in terms of the tasks. It has been noted that the inclusion of more demanding tasks (i.e. phonological awareness) improves the prediction of reading (Caravolas, 2005; Guardia 2010). However, since the groups in this study were dissimilar, it was not easy to find an adequate balance between floor and ceiling effects when choosing the tasks. More demanding tasks could have affected the criteria of achievement in the tests, and therefore to exclude the low SES group. On the contrary, those simpler tasks could have made invisible the variance in the outcomes among children from high socioeconomic status.

In this study, not only the floor and ceiling effects were considered when choosing the tasks, but also including these criteria: a) tasks had to be *designed or adapted to Spanish*. In those cases where the translation was not available, the task was adapted by the researcher and later piloted; b) tasks instructions *had to be easy to follow to permit all children participate*, and c) t*asks had not to be too time-consuming* in order to avoid the cognitive and attentional fatigue of participants. Despite the attempts, children from low SES could have felt that the tests and tasks required more time than they initially thought. This possible attentional fatigue could have negatively affected the student's performance in the low SES group as in the case of several studies reporting how long testing time affect the student's performance, particularly in those tests and tasks administered at the end of the session (McCauley & Swisher, 1984; Bachman, 1990).

Given these constraints and according to the analysis, some tasks worked undoubtedly better than others in terms of their prediction about reading outcomes, but this is always an *ex post* process, and it is difficult to fully predict it before the task administration. Even so, those tasks in which the floor effect became evident at time 1 were replaced by more challenging tasks at time 2 (e.g. RAN for colours and objects at time 1 was replaced by letters and digits at time 2).

10.3.3. Interpreting the results

Some of the results of this study must be taken with caution to avoid the type I and II errors, i.e., incorrectly rejecting a true null hypothesis or failing to reject a false null hypothesis.

This study did not find a significant relationship between any of the cognitive skills and any of the components of reading. This finding must be interpreted with caution, and the reasons that could explain it are related with those already discussed in the previous section, this is, the text features, how cognitive skills were evaluated, the imbalance in the sample size among those who could effectively complete the non-verbal cognitive tasks, and those who completed reading tasks. A recent study using path analysis about reading predictors in Chinese language, found that cognitive skills (executive functions) not make a direct but an indirect contribution to reading, via the influence on phonological awareness (Chung, Liu, McBride, Wong, & Lo, 2016).

The lack of an adequate level of goodness of fit has been explained by difficulties in reaching the expected number of participants given the predictors included in the model, or the features associated with the low and high SES groups. However, another possible explanation is related with the period between time 1 and 2. Children were evaluated when they were 5 years-old, and then the evaluation took place 2 years later. In this period, probably the school effect, changes in terms of the teacher in charge of the level, changes in the expectations about reading could have been modified affecting the correct estimation of the models. Probably, the inclusion of a three instead of two time points in the measurements could have helped to design better and more accurate path analysis models.

10.4. Directions for future studies

In this section, a brief discussion about direction of future studies is presented. The section includes four subsections: the study of the impact of HLE on reading from a wider perspective, methodological and practical issues, the inclusion of a third-time point of this longitudinal study, and future challenges.

As it was established in this study, there are significant differences in those variables related with Home literacy environment. These factors have an impact on the development of those literacy skills, affecting the way in which children learn to read. Unfortunately, Chilean schools that provide education for these pre-schoolers from low SES devote little time to learning activities. In fact, more than half of the time of the day is spent in non-instructional activities such as unstructured games, snack, and managing the children's behaviour (Strasser et al., 2009). Future studies exploring the effect of SES on reading should include not only the influence of teaching on children's reading performance, but also evaluating which are the most appropriate strategies for promoting reading at this level, because this kind of studies do not have an impact on reading outcomes if they are not accompanied by changes in the teacher's strategies.

This study highlighted the effect that opportunities have on literacy development. Children from low SES should not be condemned to receive few or bad quality opportunities to develop language and literacy, and to ensure that children from low and high receive same good opportunities, the quality of teaching is crucial. The effect of teaching on literacy in deprived contexts should be analysed and intervened from at least two perspectives: as promoting an alliance between the school and the family and developing strategies for promoting literacy.

Despite the temptation to believe that everything is the responsibility of the school, the fact is that children spend more time with their parents than in school (NICHD, 2000), and therefore the school-family alliance becomes crucial for promoting literacy, particularly in those groups of less educated families. In Chile, for a couple of years the Un buen comienzo (*A good start*) project developed by the School of Education at Harvard University has devoted efforts in promoting learning involvement in literacy activities by parents of toddlers and pre-schoolers, with promising results (Mendive, Lissi, et al., 2016).

In addition, developing strategies for changing teaching practises in children from low SES has been shown to have an impact on the literacy outcomes (Mendive, Weiland, Yoshikawa, & Snow, 2016; Yoshikawa et al., 2015). For example, Strasser, Mendive, Vergara, and Darricades (2017), conducted a study based on an intervention to investigate the reasons about teachers in preschool level do not offer enriched language experiences to their students. They found that the frequency of enriched language from teachers was affected by devices related with remembering and monitoring. One of the Chilean universities installed a library for children at the Faculty of Education. In this library, teacher trainers are taught about how conduct reading activities with children and they are supported in terms of developing shared reading activities, in line with previous studies confirming the importance of books have on later reading outcomes (K. Fletcher & Reese, 2005; Reese, Leyva, Sparks, & Grolnick, 2010; Reese, Sparks, & Leyva, 2010).

Secondly, the present study encompassed a greater number of tasks, instead of deeply proving the influence of a few of them, which have already been widely established in other languages like English. This methodological approach was based on the little and vague systematisation of tasks that evaluate reading predictors in Spanish, and particularly in Latin America. Future studies must consider these findings as a first step towards the development of better evaluative tools to capture the variations of children from all socioeconomic groups. This includes devoting efforts to validate instruments in Spanish, not only in terms of reliability and consistency, but also in avoiding the appearance of floor or ceiling effects. In summary, it seems reasonable to believe that the foundational reading skills, such as phonological awareness, are indeed the best predictors of reading also in Spanish, in line with previous studies. However, are these tests and tasks the best way to evaluate these skills? How can these tests and tasks be designed to be useful in teaching?

In this line, one of the most interesting findings in this study is that all tasks which required verbal interactions were significantly affected by the students' SES. However, those cognitive skills in which no verbal interactions or responses were required showed to be less affected by SES. In simple terms, why children from low SES perform significantly below than their peers from high SES in the Triple foundational model, and early language skills, but at the same time are able to complete the cognitive tasks with no significant differences with the group of reference? Is that a pattern that it is possible to evaluate in a large-scale study? Or instead it refers to the difficulties of the tasks in capturing these differences?

One hypothesis to explain this unexpected finding is related with the features in which cognitive skills are being evaluated. An important number of cognitive tasks are permeated by the knowledge of concepts, objects, or functions, and therefore, children with poor vocabulary could exhibit poor performances given this constraint. In other words, children in cognitive tasks are being evaluated both in solving tasks, but also in their vocabulary performance.

Thirdly, as it has been previously mentioned, it is needed to include a third-time point in the current study. This inclusion would allow analysing the data by using a more sophisticated statistical tool such as those from the structural equation modelling (SEM). Three time points of the evaluation will allow skill development to be analysed through growth curve models, which not only improve the estimations of the comparisons, but also allow an estimation of the sequence in which the skills have critical points. In other words, more sophisticated statistical models allow not only a better estimation regarding reading predictors, but also knowing about the patterns in which these skills progress. What is the sequence in which these skills develop in both groups of children? Are the sequences the same? The information about the development pattern could improve the educational curriculum both in preschool and primary years.

Finally, the fact of continuing developing research that evaluates the course of reading skills in Spanish, and particularly with a sample of children from low socioeconomic level, is a challenge that has both theoretical and practical applications. At theoretical level, the findings of this study confirm the importance that some abilities have on reading in the Spanish of Chile. In practical terms, the findings show that children from low and high SES are equally competent in a range of cognitive tasks. This is undoubtedly good news, since it indicates that the cognitive mechanisms that underlie some language and literacy processes are not affected by SES, and therefore, if we make a collective effort to provide good learning conditions for children from low SES children, there is no cognitive reason to doubt about how children will acquire knowledge and improve their skills as children from high SES.

References

[NICHD], National Institute of Child Health and Human Development. (2000). *National reading panel*.

Adlof, S., Catts, H., & Little, T. (2006). Should the simple view of reading include a fluency component? . *Reading and Writing, 19*(9), 933–958. doi: 10.1002/rrq.99

Aguirre, A. (2009). Política social e indicadores distributivos. Elementos para una caracterización de la política social en Chile Social - Policy and distributive indicators. Elements for a characterization of the Chilean social policy model. *Revista de la Universidad Bolivariana, 8*(22), 231-248.

Ahmadian, M. J., & Tavakoli, M. (2010). The effects of simultaneous use of careful online planning and task repetition on accuracy, complexity, and fluency in EFL learners' oral production. *Language Teaching Research, 15*, 35-59.

Aikens, N., & Barbarin, O. (2008). Socioeconomic differences in reading trajectories: The contribution of family, neighborhood, and school contexts. *Journal of Educational Psychology, 100*(2), 235-251. doi: 10.1037/0022-0663.100.2.235

Alloway, T., Gathercole, S., 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. doi: 10.1016/j.jecp.2003.10.002

Altemeier, L., Abbott, R., & Berninger, V. (2008). Executive functions for reading and writing in typical literacy development and dyslexia. *Journal of Clinical and Experimental Neuropsychology, 30*(5), 588-606. doi: 10.1080/13803390701562818

Altemeier, L., Jones, J., Abbott, R. D., & Berninger, V. W. (2006). Executive functions in becoming writing readers and reading writers: note taking and report writing in third and fifth graders. *Developmental Neuropsychology, 29*(1), 161-173. doi: 10.1207/s15326942dn2901_8

Álvarez, C., Carreiras, M., & de Vega, M. (2000). Syllable-frequency effect in visual word recognition - evidence of sequential-type processing. *Psicológica, 21*, 341 - 374.

Anderson, R., & Freebody, P. (1981). Vocabulary knowledge. In J. Guthrie (Ed.), *Comprehension and teaching: Research reviews* (pp. 77–117). Newark, DE: International Reading Association.

Anderson, R., Hiebert, E. H., Scott, J., & Wilkinson, I. (1985). *Becoming a nation of readers*. Washington, DC.: National Institute of Education.

Anthony, J., & Francis, D. (2005). Development of Phonological Awareness. *Current directions in Psychological Science, 14*(5), 255-259.

Anthony, J., & Lonigan, C. (2004). The nature of phonological awareness: Converging evidence from four studies of preschool and early grade school children. *Journal of Educational Psychology, 96*(1), 43-55. doi: 10.1037/0022-0663.96.1.43

Anthony, J., Lonigan, C., Burgess, S., Driscoll, K., Phillips, B., & Cantor, B. (2002). Structure of preschool phonological sensitivity: Overlapping sensitivity to rhyme, words, syllables, and phonemes. *Journal of Experimental Child Psychology, 82*(1), 65-92. doi: 10.1006/jecp.2002.2677

Anthony, J., Lonigan, C., Driscoll, K., Phillips, B., & Burgess, S. (2003). Phonological Sensitivity: A quasi-parallel progression of word structure units and cognitive operations. *Reading Research Quarterly, 38*(4), 470-487.

Anthony, J., Williams, J., McDonald, R., Corbitt-Shindler, D., Carlson, C., & Francis, D. (2006). Phonological processing and emergent literacy in Spanish-speaking preschool children. *Annals of Dyslexia, 56*(2), 239-270.

Ardila, A. (2013). Development of metacognitive and emotional executive functions in children. *Applied Neuropsychology: Child, 2*(2), 82-87. doi: 10.1080/21622965.2013.748388

Armour-Thomas, E. , & Gopaul-McNicol, S-A. (1997). Bio-ecological approach to cognitive assessment. *Cultural Diversity and Mental Health, 3*(2), 131-144.

Arnold, D., & Doctoroff, G. (2003). The early education of socioeconomically disadvantaged children. *Annual Review of Psychology, 54*, 517-545. doi: 10.1146/annurev.psych.54.111301.145442

Australian Institute of Family Studies. (2011). *Growing up in Australia: The longitudinal study of Australian children annual statistical report 2010*. Canberra.

Baroody, A., & Diamond, K. (2010). Links among Home literacy environment, literacy interest, and emergent literacy skills in preschoolers at risk for reading difficulties. *Topics in Early Childhood Special Education, 32*(2), 78-87. doi: 10.1177/0271121410392803

Bates, E., Bretherton, I., & Snyder, L. (1988). *From first words to grammar - Individual differences and dissociable mechanisms*. New York: Cambridge University.

Battin-Pearson, S., Newcomb, M.D., Abbott, R.D., Hill, K.G., Catalano, R.F., & Hawkins, J.D. (2000). Predictors of early high school dropout: a test of five theories. *Journal of Educational Psychology, 92*, 568-582.

Beaver, J.M. (2006). *Teacher guide: Developmental reading assessment, grades K-3 (2nd ed).* Parsipanny, NJ.: Pearson Education, Inc.

Benítez, R., & García, G. (2010). El razonamiento analógico verbal: una habilidad cognitiva esencial de la producción escrita [Verbal analogical reasoning: an essential cognitive ability of written production]. *Onomázein, 22*(2), 165-194.

Benton, A., Hamsher, K., & Sivan, A. (1994). *Multilingual aphasia examination*. Iowa City, IA: AJA Associates.

Berninger, V. (2001). *Process assessment of the learner™ (PAL™) test battery for reading and writing*. San Antonio, TX: The Psychological Corporation.

Bishop, D. V., & Snowling, M. (2004). Developmental dyslexia and specific language impairment: same or different? *Psychological Bulletin, 130*(6), 858-886. doi: 10.1037/0033-2909.130.6.858

Blaye, A., Bernard-Peyron, V., Paour, Jean-L., & Bonthoux, F. (2006). Categorical flexibility in children: Distinguishing response flexibility from conceptual flexibility; the protracted development of taxonomic representations. *European Journal of Developmental Psychology, 3*(2), 163-188. doi: 10.1080/17405620500412267

Bloodgood, J. (1999). What's in a name? Children's name writing and literacy acquisition. *Reading Research Quarterly, 34*(3), 342–367.

Bond, G.L., & Dykstra, R. (1967). The cooperative research program in first-grade reading instruction. *Reading Research Quarterly, 2*(4), 5-142.

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. doi: 10.1177/0022219410371676

Botting, N., Powls, A., Cooke, R., & Marlow, N. (2008). Cognitive and educational outcome of very-low-birthweight children in early adolescence. *Developmental Medicine & Child Neurology, 40*(10), 652-660. doi: 10.1111/j.1469-8749.1998.tb12324.x

Bowers, G.H. (1989). Mental models in text understanding. In A. F. Bennett & K. M. McConkey (Eds.), *Cognition in individual and social contexts* (pp. 129-144). Amsterdam: Elsevier.

Bowey, J. (1986). Syntactic awareness in relation to reading skill and ongoing reading comprehension monitoring. *Journal of Experimental Child Psychology, 41*(2), 282-299.

Bowey, J. (1994). Phonological sensitivity in novice readers and nonreaders. *Journal of Experimental Child Psychology, 58*, 143-159.

Bowey, J. (1995). Socioeconomic status differences in preschool phonological sensitivity and first-grade reading achievement. *Journal of Educational Psychology, 87*(3), 476-487.

Bowyer-Crane, C., & Snowing, M. (2005). Assessing children's inference generation: What do tests of reading comprehension measure? *British Journal of Educational Psychology, 75*, 189-201.

Bracken, S., & Fischel, J. (2008). Family reading behavior and early literacy skills in preschool children from low-income backgrounds. *Early Education and Development, 19*(1), 45-67. doi: 10.1080/10409280701838835

Bradley, L., & Bryant, P. (1983). Categorizing sounds and learning to read: A causal connection. *Nature, 301*, 419-421.

Bradley, R., & Corwyn, R. (2002). Socioeconomic status and child development. *Annual Review of Psychology, 53*, 371-379.

Bradley, R., Corwyn, R., Burchinal, M., McAdoo, H., & Garcia, C. (2001). The home environments of children in the United States Part II: Relations with behavioral development through age thirteen. *Child Development, 72*(6), 1868-1886.

Brady, S., Shankweiler, D., & Mann, V. (1983). Speech perception and memory coding in relation to reading ability. *Journal of Experimental Child Psychology, 35*, 345-367.

Bravo, L. (1995). A four year follow-up study of low socioeconomic status, Latin American children with reading difficulties. *International Journal of Disability, Development and Education, 42*(3), 189-202. doi: 10.1080/0156655950420302

Bravo, L. (1997). Prueba experimental pre-lectora (PPL). *Boletín de Investigación Educacional, 12*, 79-90.

Bravo, L., Villalon, M., & Orellana, E. (2003). Predictividad del rendimiento de la lectura: el segundo año básico [Predictability of reading performance: Second grade]. *Psykhe, 12*(2), 29-36.

Bravo, L., Villalón, M., & Orellana, E. (2002). La conciencia fonológica y la lectura inicial en niños que ingresan al primer año básico [Phonological awareness and emergent reading in Children who enter first elementary grade]. *Psykhé, 11*(1), 175-182.

Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Cambridge, MA: Harvard University Press.

Bronfenbrenner, U. (1989). Ecological systems theory. In R. Vasta (Ed.), *Six theories of child development: Revised formulations and current issues* (Vol. 6, pp. 187-249). Greenwich, CT: JAI Press.

Brooks-Gunn, J., & Duncan, G.J. (1997). The effects of poverty on children. *Future Child, 7*(2), 55-71.

Buckingham, J., Beaman, R., & Wheldall, K. (2013). Why poor children are more likely to become poor readers: the early years. *Educational Review, 66*(4), 428-446. doi: 10.1080/00131911.2013.795129

Burgess, S., Hecht, S., & Lonigan, C. (2002). Relations of the Home Literacy Environment (HLE) to the development of reading-related abilities: A one-year longitudinal study. *Reading Research Quarterly, 37*(4), 408 - 426.

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

Cain, K., & Oakhill, J. (2006). Assessment matters: issues in the measurement of reading comprehension. *British Journal of Developmental Psychology, 76*(4), 697-708. doi: 10.1348/000709905X69807

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), 31-42. doi: 10.1037/0022-0663.96.1.31

Caravolas, M., Hulme, C., & Snowling, M. (2001). The foundations of spelling ability: Evidence from a 3-Year longitudinal study. *Journal of Memory and Language, 45*(4), 751-774. doi: 10.1006/jmla.2000.2785

Caravolas, M., Lervag, A., Defior, S., Seidlova Malkova, G., & Hulme, C. (2013). Different patterns, but equivalent predictors, of growth in reading in consistent and inconsistent orthographies. *Psychological Science, 24*(8), 1398-1407. doi: 10.1177/0956797612473122

Caravolas, M., Lervag, A., Mousikou, P., Efrim, C., Litavsky, M., Onochie-Quintanilla, E., . . . Hulme, C. (2012). Common patterns of prediction of literacy development in different alphabetic orthographies. *Psychological Science, 23*(6), 678-686. doi: 10.1177/0956797611434536

Carneiro, P., Crawford, P., & Goodman, A. (2007). *The impact of early cognitive and non-cognitive skills on later outcomes.* . London: London School of Economics.

Carr, T., Brown, T., Vavrus, L., & Evans, M. (1990). Cognitive skill maps and cognitive skill profiles: Componential analysis of individual differences in children's reading efficiency. In T. Carr & A. Levy (Eds.), *Reading and its development: Component skills approaches* (pp. 1-55). London: Academic Press.

Casey, B., Andrews, N., Schindler, H., Kersh, J., Samper, A., & Copley, J. (2008). The development of spatial skills through interventions involving block building activities. *Cognition and Instruction, 26*(3), 269-309. doi: 10.1080/07370000802177177

Castillo, J. C. (2011). Legitimacy of inequality in a highly unequal context: Evidence from the Chilean case. *Social Justice Research, 24*(4), 314-340. doi: 10.1007/s11211-011-0144-5

Castillo, J. C., Miranda, D., & Carrasco, D. (2012). Percepción de desigualdad económica en Chile: medición, diferencias y determinantes [Perception of Economic Inequality in Chile: Measurement, differences and determinants] *Psykhé, 21*(1), 99-114.

Castles, A., & Coltheart, M. (2004). Is there a causal link from phonological awareness to success in learning to read? *Cognition, 91*(1), 77-111. doi: 10.1016/s0010-0277(03)00164-1

Cattell, R. (1943). The measurement of adult intelligence. *Psychological Bulletin, 40*, 153–193.

Catts, H., Fey, M., Zhang, X. , & Tomblin, J. (1999). Language basis of reading and reading disabilities: Evidence from a longitudinal investigation. *Scientific Studies of Reading, 3*(4), 331-361. doi: 10.1207/s1532799xssr0304_2

Catts, H., Hogan, T. , & Adolf, S. (2005). Developmental changes in reading and reading disabilities. In H. Catts & A. Kamhi (Eds.), *Connections between language and reading disabilities* (pp. 25-40). Mahwah, NJ: Lawrence Erlbaum.

Chan, R. , Shum, D., Toulopoulou, T., & Chen, E. (2008). Assessment of executive functions: review of instruments and identification of critical issues. *Archives of Clinical Neuropsychology, 23*(2), 201-216. doi: 10.1016/j.acn.2007.08.010

Chiat, S., & Roy, P. (2007). The preschool repetition test: An evaluation of performance in typically developing and clinically referred children. *Journal of Speech, Language, and Hearing Research, 50*(2), 429-443. doi: 10.1044/1092-4388(2007/030

Chiu, M., & McBride-Chang, C. (2006). Gender, context, and reading: A comparison of students in 43 countries. *Scientific Studies of Reading, 10*(4), 331-362. doi: 10.1207/s1532799xssr1004_1

Cho, S., Holyoak, K., & Cannon, T. (2007). Analogical reasoning in working memory: Resources shared among relational integration, interference resolution, and maintenance. *Memory & Cognition, 35*(6), 1445-1455.

Christo, C., & Davis, J. (2008). Rapid naming and phonological processing as predictors of reading and spelling. *The California school psychologist, 13*, 7-18.

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 Child Psychology: General, 141*(3), 470-488. doi: 10.1037/a0027375

Chung, K., Liu, H., McBride, C., Wong, A., & Lo, J. (2016). How socioeconomic status, executive functioning and verbal interactions contribute to early academic achievement in Chinese children. *Educational Psychology, 37*(4), 402-420. doi: 10.1080/01443410.2016.1179264

Clarke, P., Hulme, C., & Snowling, M. (2005). Individual differences in RAN and reading: a response timing analysis. *Journal of Research in Reading, 28*(2), 73-86.

Coady, J. A., & Evans, J. L. (2008). Uses and interpretations of non-word repetition tasks in children with and without specific language impairments (SLI). *International Journal of Language & Communication Disorders, 43*(1), 1-40. doi: 10.1080/13682820601116485

Cohen, J. (1977). *Statistical power analysis for the behavioral sciences*. New York: Academic Press.

Comisión Económica para América Latina y el Caribe - CEPAL. (2005). *Invertir mejor para invertir más: financiamiento y gestión de la educación en América Latina y el Caribe [Invest better to invest more: financing and management of education in Latin America and Caribbean].* Santiago: UNESCO.

Compton, D. (2003). Modeling the relationship between growth in rapid naming speed and growth in decoding skill in first-grade children. *Journal of Educational Psychology 95*(2), 225-239.

Compton, D., Fuchs, D., Fuchs, L., Bouton, B., Gilbert, J., Barquero, L., . . . Crouch, R. (2010). Selecting at-risk first-grade readers for early intervention: Eliminating false positives and exploring the promise of a two-stage gated screening process. *Journal of Educational Psychology, 102*(2), 327-340. doi: 10.1037/a0018448

Compton, D., Olson, R., DeFries, J., & Pennington, B. (2002). Comparing the relationships among two different versions of alphanumeric rapid automatized naming and word level reading skills. *Scientific Studies of Reading, 6*(4), 343-368. doi: 10.1207/S1532799XSSR0604_03

Consejo Asesor Presidencial para la Reforma de las políticas de infancia [Presidential Advisory Council about Reform Policies for Children]. (2006). El futuro de los niños es siempre hoy [The future of children is always today]. Santiago, Chile: Chilean Government.

Conti-Ramsden, G., Botting, N., & Faragher, B. (2001). Psycholinguistic markers for specific language impairment (SLI). *Journal of Child Psychology and Psychiatry, 42*(6), 741-748. doi: 10.1111/1469-7610.00770

Cornejo, R. (2006). El experimento educativo chileno 20 años después: una mirada crítica a los logros y falencias del sistema escolar [The Chilean educational experiment 20 years later: a critical look at the achievements and failures of the educational system] *REICE - Revista Electrónica Iberoamericana sobre Calidad, Eficacia y Cambio en Educación, 4*(1), 118-129.

Cowie, R., Douglas-Cowie, E. , & Wichmann, A. (2002). Prosodic characteristics of skilled reading: Fluency and expressiveness in 8- 10-year-old readers. *Language and Speech, 45*(1), 47-82.

Crain-Thoreson, C., & Dale, P. (1992). Do early talkers become early readers? Linguistic precocity, preschool language, and emergent literacy. *Developmental Psychology, 28*(3), 421-429.

Cromley, J., & Azevedo, R. (2007). Testing and refining the direct and inferential mediation model of reading comprehension. *Journal of Educational Psychology, 99*(2), 311-325. doi: 10.1037/0022-0663.99.2.311

Curtis, M., & Kruidenier, J. (2005). *A summary of scientifically based research principles teaching adults to read: Teaching adults to read*. Washington, DC: National Institute for Literacy.

Cutting, L., & Denckla, M. (2001). The relationship of rapid serial naming and word reading in normally developing readers- an exploratory model. *Reading and Writing: An Interdisciplinary Journal, 14*, 673-705.

Cutting, L., Huang, G., Zeger, S., Koth, C., Thompson, R., & Denckl, M. (2002). Growth curve analyses of neuropsychological profiles in children with neurofibromatosis type 1: specific cognitive tests remain "spared" and "impaired" over time. *Journal of International Neuropsychology Society, 8*(6), 839-846.

Cutting, L., & Scarborough, H. (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. doi: 10.1207/s1532799xssr1003_5

de Bree, E., Rispens, J., & Gerrits, E. (2007). Non-word repetition in Dutch children with (a risk of) dyslexia and SLI. *Clinical Linguistics & Phonetics, 21*(11-12), 935-944. doi: 10.1080/02699200701576892

de Bree, E., Wijnen, F., & Gerrits, E. (2010). Non-word repetition and literacy in Dutch children at-risk of dyslexia and children with SLI: results of the follow-up study. *Dyslexia, 16*(1), 36-44. doi: 10.1002/dys.395

De Cara, B., & Goswami, U. (2002). Similarity relations among spoken words: The special status of rimes in English. *Behavior Research Methods, Instruments, and Computers, 34*(3), 416-423.

de Jong, P., & Olson, R. (2004). Early predictors of letter knowledge. *Journal of Experimental Child Psychology, 88*(3), 254-273. doi: 10.1016/j.jecp.2004.03.007

de Jong, P., & van der Leij, A. (1999). Specific contributions of phonological abilities to early reading acquisition: Results from a Dutch latent variable longitudinal study. *Journal of Educational Psychology, 91*(3), 450–476.

Deacon, H. (2012). Sounds, letters and meanings: The independent influences of phonological, morphological and orthographic skills on early word reading accuracy. *Journal of Research in Reading, 35*(4), 456-475. doi: 10.1111/j.1467-9817.2011.01496.x

10.1111/j.1467-9817.2010.01496.x

Deák, G. O., Ray, S. D., & Pick, A. D. (2004). Effects of age, reminders, and task difficulty on young children's rule-switching flexibility. *Cognitive Development, 19*(3), 385-400. doi: 10.1016/j.cogdev.2004.05.002

Defior, S., Fonseca, L., Gottheil, B., Aldrey, A., Jiménez, G., Pujals, M., . . . Serrano, F. (2006). *LEE Test de Lectura y Escritura en Español [LEE test of Reading and Writing in Spanish]*. Buenos Aires: Paidos.

Defior, S., Martos, F., & Cary, L. (2002). Differences in reading acquisition development in two shallow orthographies: Portuguese and Spanish. *Applied Psycholinguistics, 23*, 135–148.

Denckla, M. (1972a). Color-Naming defects in dyslexic boys. *Cortex, 8*(2), 164-176. doi: 10.1016/s0010-9452(72)80016-9

Denckla, M. (1972b). Performance on color tasks in kindergarten children. *Cortex, 8*(2), 177-190. doi: 10.1016/s0010-9452(72)80017-0

Denckla, M., & Rudel, R. (1974). Rapid "automatized" naming of pictured objects, colors, letters and numbers by normal children. *Cortex, 10*(2), 186-202. doi: 10.1016/s0010-9452(74)80009-2

Denckla, M., & Rudel, R. (1976a). Naming of objects by dyslexic and other learning disabled children. *Brain and Language, 3*, 1-15.

Denckla, M., & Rudel, R. (1976b). Rapid automatized naming (R.A.N): dyslexia differentiated from other learning disabilities. *Neuropsychologia, 14*, 471-479.

Denton, C., Hasbrouck, J., Weaver, L., & Riccio, C. (2000). What do we know about phonological awareness in Spanish? *Reading Psychology, 21*(4), 335-352. doi: 10.1080/027027100750061958

DeThorne, L., & Schaefer, B. (2004). Guide to child nonverbal IQ measures. *American Journal of Speech-Language Pathology, 13*, 275-290.

Development, National Institute of Child Health and Human. (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. In N. P. N. 00-4769. (Ed.). Washington, DC: U.S. Government Printing Office.

Diamond, A. (2013). Executive functions. *Annual Review of Psychology, 64*, 135-168. doi: 10.1146/annurev-psych-113011-143750

Diuk, B., & Ferroni, M. (2011). Predictors of letter knowledge in children growing in poverty. *Psicologia: Reflexão e Crítica, 24*(3), 570-576.

Diuk, B., & Moras, C. (2009). Las dificultades de aprendizaje de la lectura y la escritura en niños que crecen en contextos de pobreza [Learning difficulties in reading and writing in children growing up in poverty contexts]. *Perspectivas en Psicología, 6*(1), 22-29.

Dockrell, J. E., & Messer, D. (2004). Lexical acquisition in the early school years. In R. A. Berman (Ed.), *Language development across childhood and adolescence* Amsterdam: John Benjamins Publishing Company.

Downer, J.T., & Pianta, R. (2006). Academic and cognitive functioning in first grade: Associations with earlier home and child care predictors and with concurrent home and classroom experiences. *School Psychology Review, 35*(1), 11-30.

Duncan, L.G., & Seymour, P. (2000). Socio-economic differences in foundation-level literacy. *British Journal of Psychology, 91*, 145-166.

Duncker, K. (1945). On problem solving. *Psychological Monographs, 58*(5), 1-113.

Dunn, L., & Dunn, D. (1981). *Peabody Picture Vocabulary Test-IV*. San Antonio, TX: Pearson.

Dunn, L., Padilla, E., Lugo, D., & Dunn, D. (1986). *Test de Vocabulario en Imágenes Peabody: Adaptación Hispano-Americano [Peabody Picture Vocabulary Test- Latin American adaptation]*. Circle Pines, MN: American Guidance Service.

Ebbels, S. H., Dockrell, J. E., & van der Lely, H. K. (2012). Non-word repetition in adolescents with specific language impairment (SLI). *International Journal of Language & Communication Disorders, 47*(3), 257-273. doi: 10.1111/j.1460-6984.2011.00099.x

Ehri, L., Nunes, S., Willows, D. , Schuster, B., Yaghoub-Zadeh, Z. , & Shanahan, T. (2001). Phonemic awareness instruction helps children learn to read: Evidence from the national reading panel's meta-analysis. *Reading Research Quarterly, 36*(3), 250-287.

Entwisle, D.R., & Astone, N.M. (1994). Some practical guidelines for measuring youth's race/ethnicity and socioeconomic status. *Child Development, 65*(6), 1521-1540.

Espínola, V., Balladares, J., Claro, J. P., & Valencia, E. (2011). *Mapa de la efectividad de la Educación Media en Chile: Factores de gestión asociados a la completación de estudios secundarios [Map of the effectiveness of high school in Chile: Management factors associated with completion of secondary]*. Santiago, Chile: Ministry of Education. Chile.

Evans, J., Floyd, R., McGrew, K., & Leforgee, M. (2001). The relations between measures of Cattell-HornCarroll (CHC) cognitive abilities and reading achievement during childhood and adolescence. *School Psychology Review, 31*(2), 246-262.

Farrington-Flint, L., Wood, C., Canobi, K., & Faulkner, D. (2004). Patterns of analogical reasoning among beginning readers. *Journal of Research in Reading, 27*(3), 226 – 247.

Farukh, A., & Vulchanova, M. (2014). Predictors of reading in Urdu: does deep orthography have an impact? *Dyslexia, 20*(2), 146-166. doi: 10.1002/dys.1474

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.

Fernald, A., Marchman, V., & Weisleder, A. (2013). SES differences in language processing skill and vocabulary are evident at 18 months. *Developmental Science, 16*(2), 234-248. doi: 10.1111/desc.12019

Fernald, L., Weber, A., Galasso, E., & Ratsifandrihamanana, L. (2011). Socioeconomic gradients and child development in a very low income population: evidence from Madagascar. *Developmental Science, 14*(4), 832-847. doi: 10.1111/j.1467-7687.2010.01032.x

Ferreiro, E. (1986). *La alfabetización en proceso. El proceso de alfabetización.* Mexico: Bibliotecas Universitarias.

Fisher, D. , & Frey, N. (2009). *Background knowledge: The overlooked factor in reading comprehension*. New York: Mc Graw Hill Education.

Fletcher, C., & Bloom, C. (1988). Causal reasoning in the comprehension of simple narrative texts. *Journal of Memory and Language, 27*, 235-244.

Fletcher, K., & Reese, E. (2005). Picture book reading with young children: A conceptual framework. *Developmental Review, 25*(1), 64-103. doi: 10.1016/j.dr.2004.08.009

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. doi: 10.1007/s10648-011-9175-6

Flynt, S.E., & Cooter, R.B. (2004). *Flynt-Cooter reading inventory for the classroom (5th ed.).* Upper Saddle Riber, NJ: Merrill.

Fossati, P., Guillaume, L., Ergis, A., & Allilairea, J. (2003). Qualitative analysis of verbal fluency in depression. *Psychiatry Research, 117*, 17-24.

Foster, M., Lambert, R., Abbott-Shim, M., McCarty, F., & Franze, S. (2005). A model of home learning environment and social risk factors in relation to children's emergent literacy and social outcomes. *Early Childhood Research Quarterly, 20*(1), 13-36. doi: 10.1016/j.ecresq.2005.01.006

Foulin, J. (2005). Why is letter-name knowledge such a good predictor of learning to read? *Reading and Writing, 18*(2), 129-155. doi: 10.1007/s11145-004-5892-2

Frith, U., Landerl, K., & Frith, C. (1995). Dyslexia and verbal fluency: More evidence for a phonological deficit. *Dyslexia, 1*, 2-11.

Frost, R. (2005). Orthographic systems and skilled word recognition processes in reading. In C. Hulme & M. Snowling (Eds.), *The science of reading: A handbook* (pp. 272-295). Oxford: Blackwell.

Fuchs, L., Fuchs, D., & Compton, D. (2004). Monitoring early reading development in first grade: Word identification fluency versus nonsense word fluency. *Exceptional Children, 71*(1), 7-21.

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

Fundación Integra [Integra foundation]. (2016). *Annual report. 2015*. Santiago, Chile: Chile's government.

Gang, M., & Siegel, L. (2002). Sound-symbol learning in children with dyslexia. *Journal of Learning Disabilities, 35*(2), 137-157.

Gardner, H., Froud, K., McClelland, A., & van der Lely, H. K. (2006). Development of the Grammar and Phonology Screening (GAPS) test to assess key markers of specific language and literacy difficulties in young children. *International Journal of Language and Communication Disorders, 41*(5), 513-540. doi: 10.1080/13682820500442644

Gathercole, S. (2006). Nonword repetition and word learning: The nature of the relationship. *Applied Psycholinguistics, 27*, 513-546.

Gelman, S. A., Star, J. R., & Flukes, J. (2002). Children's use of generics in inductive inferences. *Journal of Cognition and Development, 3*(2), 179-199. doi: 10.1207/s15327647jcd0302_3

Georgiou, G., Papadopoulos, T., Fella, A., & Parrila, R. (2012). Rapid naming speed components and reading development in a consistent orthography. *Journal of Experimental Child Psychology, 112*(1), 1-17. doi: 10.1016/j.jecp.2011.11.006

Georgiou, G., Parrila, R., & Kirby, J. (2006). Rapid naming speed components and early reading acquisition. *Scientific Studies of Reading, 10*(2), 199-220. doi: 10.1207/s1532799xssr1002_4

Geschwind, N. (1965). Disconnexion syndromes in animals and man. *Brain, 27*, 237-294.

Geschwind, N., & Fusillo, M. (1966). Color-naming defects in association with alexia. *Archives of Neurology, 15*, 137-146.

Geva, E., & Farnia, F. (2011). Developmental changes in the nature of language proficiency and reading fluency paint a more complex view of reading comprehension in ELL and EL1. *Reading and Writing, 25*(8), 1819-1845. doi: 10.1007/s11145-011-9333-8

Gick, M., & Holyoak, K. (1980). Analogical problem solving. *Cognitive Psychology, 12*, 306-355.

Givón, T. (1995). *Functionalism and Grammar.* . Amsterdam: John Benjamins Publishing Company.

Goikoetxea, E. (2006). Reading errors in first- and second-grade readers of a shallow orthography: evidence from Spanish. *British Journal of Educational Psychology, 76*, 333-350. doi: 10.1348/000709905X52490

Gómez-Palacio, M., Rangel, E., & Padilla, E. (1985). *Kaufman batería de evaluación intelectual. Manual de aplicación y calificación [Kaufman intellectual assessment battery. Application and qualification handbook]*. Ciudad de México: Dirección General de Educación Especial.

Gómez, P., Valero, J., Buades, R., & Pérez, A. (1995). *Test de habilidades metalingüísticas [Metalinguistic skills test]*. Madrid: EOS. .

Good, R., & Kaminski, R. . (2007). *Dynamic inventory of basic early literacy skills — Sixth Edition (DIBELS)*. Eugene, OR: Dynamic Measurement Group.

Gopnik, A., & Sobel, D. (2000). Detecting blickets: How young children use information about novel causal powers in categorization and induction. *Child Development, 71*(5), 1205-1222.

Goswami, U. (1991). Analogical reasoning: what develops? A review of research and theory. *Child Development, 62*(1), 1-22.

Goswami, U. (1999). Causal connections in beggining reading: The importance of rhyme. *Journal of Research in Reading, 22*(3), 217-240.

Goswami, U. (2002). Phonology, reading development, and dyslexia: A cross-linguistic perspective. *Annals of Dyslexia, 52*(1), 139–163.

Gough, P., Hoover, W., & Peterson, C. . (1996). Some observations on a simple view on reading. In C. Cornoldi & J. Oakhill (Eds.), *Reading comprehension difficulties* (pp. 1-13). New Jersey: LEA.

Gough, P., & Tunmer, W. (1986). Decoding, reading, and reading disability *Remedial and Special Education, 7*(1), 6-10.

Graesser, A.C., Singer, M., & Trabasso, T. (1994). Constructing inferences during narrative text comprehension. *Psychological Review, 101*(3), 371-395.

Graves, M.F. (1986). Vocabulary learning and instruction In E. Z. Rothkopf (Ed.), *Review of Research in Education* (pp. 49-89). Washington, DC: American Educational Research Association.

Guardia, P. (2003). Relaciones entre habilidades de alfabetizacion emergente y la lectura, desde nivel transicion mayor a Primero basico. *Psykhe, 12*(2), 63 - 79.

Guardia, P. (2010). *The effect of linguistic, phonetic and lexical factors on phonological skills and reading acquisition in Spanish: A longitudinal study.* (PhD), Cambridge.

Guarino, R., & Perkins, K. (1986). Awareness of form class as a factorin ESL reading comprehension. *Language Learning, 36*, 77–82.

Haastr, K., & Henriksen, B. (2000). Vocabulary knowledge: Acquiring depth of knowledge. *International Journal of Applied Linguistics, 10*(2), 221-240.

Hamilton, L. G., Hayiou-Thomas, M., Hulme, C., & Snowling, M. (2016). The Home Literacy Environment as a Predictor of the Early Literacy Development of Children at Family-Risk of Dyslexia. *Scientific Studies of Reading, 20*(5), 401-419. doi: 10.1080/10888438.2016.1213266

Hanline, M., Milton, S., & Phelps, P. (2010). The relationship between preschool block play and reading and maths abilities in early elementary school: a longitudinal study of children with and without disabilities. *Early Child Development and Care, 180*(8), 1005-1017. doi: 10.1080/03004430802671171

Harlaar, N., Hayiou-Thomas, M., & Plomin, R. (2005). Reading and general cognitive ability: A multivariate analysis of 7-year-old twins. *Scientific Studies of Reading, 9*(3), 197-218. doi: 10.1207/s1532799xssr0903_2

Hart, B., & Risley, T. (1995). *Meaningful differences in the everyday experience of young American children*. Baltimore: Paul H. Brookes Publishing. .

Hayes, D., & Tierney, R. (1982). Developing readers' knowledge through analogy. *Reading research quarterly, 17*(2), 256-280.

Henriksen, B. (1999). Three dimensions of vocabulary development. *Studies in Second Language Acquisition, 21*(2), 303-317.

Hernández, M., & Raczynski, D. (2015). Elección de escuela en Chile: De las dinámicas de distinción y exclusión a la segregación socioeconómica del sistema escolar [School choice in Chile: From distinction and exclusion to the social segregation of the school system]. *Estudios pedagógicos (Valdivia), 41*(2), 127-141.

Hoff, E. (2003). The specificity of environmental influence: Socioeconomic status affects early vocabulary development via maternal speech. *Child Development, 74*(5), 1368 - 1378.

Hoff, E., & Naigles, L. (2002). How children use input to acquire a lexicon. *Child Development, 73*(2), 418-433. doi: 10.1111/1467-8624.00415

Hoien, T., Lundberg, I., Stanovich, K. , & Bjaalid, I. . (1995). Components of phonological awareness. *Reading and Writing: An Interdisciplinary Journal, 7*, 171-188.

Hollich, G., Hirsh-Pasek, K., Golinkoff, R., Brand, R., Brown, E., Chung, H., . . . Bloom, L. (2000). Breaking the language barrier: An emergentist coalition model for the origins of word learning. *65, 3*, 1-135.

Holyoak, K. J., Junn, E. N. , & Billman, D. O. (1984). Development of analogical problem-solving skill. *Child Development, 55*(6), 2042-2055.

Hoover, W., & Gough, P. (1990). The simple view of reading *Reading and Writing: An Interdisciplinary Journal, 2*, 127-160.

Hu, L., & Bentler, P. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1-55. doi: 10.1080/10705519909540118

Hulme, C., Bowyer-Crane, C., Carroll, J. M., Duff, F. J., & Snowling, M. J. (2012). The causal role of phoneme awareness and letter-sound knowledge in learning to read: combining intervention studies with mediation analyses. *Psychological Science, 23*(6), 572-577. doi: 10.1177/0956797611435921

Hulme, C., Caravolas, M., Malkova, G., & Brigstocke, S. (2005). Phoneme isolation ability is not simply a consequence of letter-sound knowledge. *Cognition, 97*(1), B1-11. doi: 10.1016/j.cognition.2005.01.002

Hulme, C., Hatcher, P., Nation, K., Brown, A., Adams, J., & Stuart, G. (2002). Phoneme awareness is a better predictor of early reading skill than onset-rime awareness. *Journal of Experimental Child Psychology, 82*(1), 2-28. doi: 10.1006/jecp.2002.2670

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

Hulme, C., Snowling, M. , & Clarke, P. (2005). Individual differences in RAN and reading: a response timing analysis. *Journal of Research in Reading, 28*(2), 73–86.

Hulme, C., Snowling, M., Caravolas, M., & Carroll, J. (2005). Phonological skills are (probably) one cause of success in learning to read: A comment on Castles and Coltheart. *Scientific Studies of Reading, 9*(4), 351-365. doi: 10.1207/s1532799xssr0904_2

Humes, G.E. (1997). Towers of Hanoi and London: Reliability of two executive function tasks. *Assessment, 4*(3), 249-257.

Jenkins, J., Fuchs, L., Espin, C., Van den Broek, P., & Deno, S. (2000). Effects of task format and performance dimension on word reading measures: Criterion validity, sensitivity to impairment, and context facilitation. . *Manuscript submitted for publication*.

Jenkins, J., Fuchs, L., van den Broek, P., Espin, C., & Deno, S. (2003). Sources of individual differences in reading comprehension and reading fluency. *Journal of Educational Psychology, 95*(4), 719-729. doi: 10.1037/0022-0663.95.4.719

Jones, M., & Mewhort, D. (2004). Case-sensitive letter and bigram frequency counts from large-scale English corpora. *Behavior Research Methods, Instruments, and Computers, 36*(3), 388-396.

Jong, P., & Vrielink, L. (2004). Rapid Automatic Naming: Easy to measure, hard to improve (quickly). *Annals of Dyslexia, 54*(1), 65-88.

Juel, C., Griffith, P., & Gough, P. (1986). Acquisition of literacy: A longitudinal study of children in first and second grade. *Journal of Educational Psychology, 78*(4), 243-255.

Junta Nacional de Jardines Infantiles [National Nurseries' Board]. (2015). *Cuenta publica [Public account]*. Santiago, Chile: Ministry of Education.

Justice, L., Pence, K., Bowles, R., & Wiggins, A. (2006). An investigation of four hypotheses concerning the order by which 4-year-old children learn the alphabet letters. *Early Childhood Research Quarterly, 21*(3), 374-389. doi: 10.1016/j.ecresq.2006.07.010

Juul, H., Poulsen, M., & Elbro, C. (2014). Separating speed from accuracy in beginning reading development. *Journal of Educational Psychology, 106*(4), 1096-1106. doi: 10.1037/a0037100

Kamhi, A., & Catts, H. (1986). Toward an understanding of developmental language and reading disorders. *Journal of Speech and Hearing Research, 51*, 337-347.

Kamii, C., Miyakawa, Y., & Kato, Y. (2004). The development of logico-mathematical knowledge in a block-building activity at ages 1–4. *Journal of Research in Childhood Education, 19*(1), 44-57. doi: 10.1080/02568540409595053

Kamil, M., & Hiebert, E. H. (2005). Teaching and learning vocabulary: Perspectives and persistent issues. In E. H. Hiebert & M. Kamil (Eds.), *Teaching and learning vocabulary: Bringing research to practice* (pp. 1-23). Mahwah, New Jersey: Lawrence Erlbaum.

Katzir, T., Kim, Y., Wolf, M., O'Brien, B., Kennedy, B., Lovett, M., & Morris, R. (2006). Reading fluency: the whole is more than the parts. *Annals of Dyslexia, 56*, 51-82.

Kaufman, A., & Kaufman, N. (1983). *Kaufman Assessment Battery for Children. Interpretive Manual*. Circle Pines, MN: American Guidance Service.

Kendeou, P., Savage, R., & van den Broek, P. (2009). Revisiting the simple view of reading. *British Journal of Educational Psychology, 79*, 353-370.

Kieffer, M. (2011). Before and after third grade: Longitudinal evidence for the shifting role of socioeconomic status in reading growth. *Reading and Writing, 25*(7), 1725-1746. doi: 10.1007/s11145-011-9339-2

Kim, Y., & Pallante, D. (2012). Predictors of reading skills for kindergartners and first grade students in Spanish: a longitudinal study. *Reading and Writing, 25*(1), 1-22. doi: 10.1007/s11145-010-9244-0

Kirby, J., Deacon, H., Bowers, P., Izenberg, L., Wade-Woolley, L., & Parrila, R. (2011). Children's morphological awareness and reading ability. *Reading and Writing, 25*(2), 389-410. doi: 10.1007/s11145-010-9276-5

Kirby, J., Parrila, R., & Pfeiffer, S. (2003). Naming speed and phonological awareness as predictors of reading development. *Journal of Educational Psychology, 95*(3), 453-464. doi: 10.1037/0022-0663.95.3.453

Klauda, S., & Guthrie, J. (2008). Relationships of three components of reading fluency to reading comprehension. *Journal of Educational Psychology, 100*(2), 310-321. doi: 10.1037/0022-0663.100.2.310

Klein, R. B. (1998). *Principles and practice of structural equation modeling.* New York: Guilford Press.

Kloo, D., Perner, J., Kerschhuber, A., Dabernig, S., & Aichhorn, M. (2008). Sorting between dimensions: conditions of cognitive flexibility in preschoolers. *Journal of Experimental Child Psychology, 100*(2), 115-134. doi: 10.1016/j.jecp.2007.12.003

Kosmidis, M., Bozikas, V., Vlahou, C., Kiosseoglou, G., Giaglis, G., & Karavatos, A. (2005). Verbal fluency in institutionalized patients with schizophrenia: Age-related performance decline. *Psychiatry Research, 134*, 233-240.

Kuhn, M., Schwanenflugel, P., Meisinger, E., Levy, B., & Rasinski, T. (2010). Aligning theory and assessment of reading fluency: Automaticity, prosody, and definitions of fluency. *Reading Research Quarterly, 45*(2), 230-251. doi: 10.1598/rrq.45.2.4

Kuhn, M., Schwanenflugel, P., Morris, R., Morrow, L.M., Woo, D., Meisinger, E., . . . Stahl, S. (2006). Teaching children to become fluent. *Journal of literacy research, 38*(4), 357-387.

LaBerge, D., & Samuels, S. (1974). Toward a theory of automatic information proce. *Cognitive psychology 6*, 293-323.

Landerl, K., & Wimmer, H. (2008). Development of word reading fluency and spelling in a consistent orthography: An 8-year follow-up. *Journal of Educational Psychology, 100*(1), 150-161. doi: 10.1037/0022-0663.100.1.150

Laplante, D. P., Barr, R. G., Brunet, A., Galbaud du Fort, G., Meaney, M. L., Saucier, J. F., . . . King, S. (2004). Stress during pregnancy affects general intellectual and language functioning in human toddlers. *Pediatric Research, 56*(3), 400-410. doi: 10.1203/01.PDR.0000136281.34035.44

Leinonen, S., Müller, K., Leppänen, P., Aro, M., Ahonen, T., & Lyytinen, H. (2001). Heterogeneity in adult dyslexic readers: Relating processing skills to the speed and accuracy of oral text reading. *Reading and Writing, 14*, 265-296.

Lervag, A., & Hulme, C. (2009). Rapid automatized naming (RAN) taps a mechanism that places constraints on the development of early reading fluency. *Psychological Science, 20*(8), 1040-1048.

Leslie, L., & Caldwell, J.S. (2011). *Qualitative Reading Inventory – 5.* Boston, MA: Pearson.

Lezak, M.D. (1995). *Neuropsychological assessment*. Oxford: Oxford University Press.

Liberatos, P., Link, B.G., & Kelsey, J.I. (1988). The measurement of social class in epidemiology. *Epidemiologic Reviews, 10*, 87-121.

Loftus, S.M., Coyne, M.D., McCoach, D.B., Zipoli, R., & Pullen, P.C. (2010). Effects of a supplemental vocabulary intervention on the word knowledge of kindergarten students at risk for language and literacy difficulties. *Learning Disabilities Research & Practice, 25*(3), 124-136.

Logan, G. D. (1997). Automaticity and reading: Perspectives from the instance theory of automatization. *Reading & Writing Quarterly, 13*(2), 123-146. doi: 10.1080/1057356970130203

Lyon, G., & Krasnegor, N. (1996). *Attention, memory, and executive function*. Baltimore, MD: Brookes.

Magliano, J., Trabasso, T., & Graesser, A. (1999). Strategic processing during comprehension. *Journal of Educational Psychology, 91*(4), 615-629. doi: 10.1037/0022-0663.91.4.615

Mancilla-Martinez, J., & Lesaux, N. K. (2010). Predictors of reading comprehension for struggling readers: The case of spanish-speaking language minority learners. *Journal of Educational Psychology, 102*(3), 701-711. doi: 10.1037/a0019135

Manis, F., Seidenberg, M.S., & Doi, L. (1999). See Dick RAN: Rapid naming and the longitudinal prediction of reading subskills in first and second graders. *Scientific Studies of Reading, 3*(2), 129-157. doi: 10.1207/s1532799xssr0302_3

Mann, V. (1986). Phonological awareness: The role of reading experience. *Cognition, 24*, 65 - 92.

Marcel, M. M., Ridgeway, M. M., Sewell, D. H., & Whelan, M. L. (1995). Sentence imitation by adolescents and young adults with Down Syndrome and other intellectual disabilities. *Journal of Intellectual Disability Research, 39*, 215-232.

Mareschal, D., & Quinn, P. (2001). Categorization in infancy. *TRENDS in Cognitive Sciences, 5*(10), 443-450.

Marsh, H., & Hau, K. (2014). Assessing goodness of fit. *The Journal of Experimental Education, 64*(4), 364-390. doi: 10.1080/00220973.1996.10806604

Marshall, C. R., & van der Lely, H. K. (2009). Effects of word position and stress on onset cluster production: Evidence from typical development, SLI and dyslexia. *Language, 85*(1), 39–57.

Martínez, L., Herrera, C., Valle, J., & Vásquez, M. . (2002). Razonamiento analógico verbal y no verbal en niños con trastorno específico del lenguaje. *Revista Chilena de Fonoaudiología, 3*(1), 5-24.

Matute, E., Rosselli, M., Ardila, A., & Morales, G. (2004). Verbal and nonverbal fluency in Spanish-speaking children. *Developmental Neuropsychology, 26*(2), 647-660. doi: 10.1207/s15326942dn2602_7

McCormack, T., Butterfill, S., Hoerl, C., & Burns, P. (2009). Cue competition effects and young children's causal and counterfactual inferences. *Developmental Psychology, 45*(6), 1563-1575. doi: 10.1037/a0017408

McDaniel, M., & Banks, G. (2010). General cognitive ability. In J. Scott & D. Reynolds (Eds.), *The handbook of workplace assessment: Selecting and developing organizational talent* (pp. 61-80). Hoboken, NJ: Wiley.

McKean, C., Mensah, F. K., Eadie, P., Bavin, E. L., Bretherton, L., Cini, E., & Reilly, S. (2015). Levers for language growth: Characteristics and predictors of language trajectories between 4 and 7 years. *PLoS One, 10*(8), e0134251. doi: 10.1371/journal.pone.0134251

Mecartty, F.H. (2000). Lexical and grammatical knowledge in reading and listening comprehension by foreign language learners of Spanish. *Applied Language Learning, 11*(2), 323-348.

Meckes, L., & Carrasco, R. (2010). Two decades of SIMCE: An overview of the National Assessment System in Chile. *Assessment in Education: Principles, Policy & Practice, 17*(2), 233-248. doi: 10.1080/09695941003696214

Meisinger, E., Bloom, J., & Hynd, G. (2010). Reading fluency: implications for the assessment of children with reading disabilities. *Annals of Dyslexia, 60*(1), 1-17.

Melby-Lervag, M., Lyster, S. A., & Hulme, C. (2012). Phonological skills and their role in learning to read: A meta-analytic review. *Psychological Bulletin, 138*(2), 322-352. doi: 10.1037/a0026744.supp

Mellard, D. F., Fall, E., & Woods, K. L. (2010). A path analysis of reading comprehension for adults with low literacy. *Journal of Learning Disabilities, 43*(2), 154-165. doi: 10.1177/0022219409359345

Mendive, S., Lissi, M. R., Bakeman, R., & Reyes, A. (2016). Beyond mother education: Maternal practices as predictors of early literacy development in Chilean children from low-SES households. *Early Education and Development*, 1-15. doi: 10.1080/10409289.2016.1197014

Mendive, S., Weiland, C. , Yoshikawa, H., & Snow, C. (2016). Opening the black box: Intervention fidelity in a randomized trial of a preschool teacher professional development program. *Journal of Education Policy, 108*(1), 130-145. doi: 10.1037/edu0000047

Metsala, J.L. (1999). Young children's phonological awareness and nonword repetition as a function of vocabulary development. *Journal of Educational Psychology, 91*(1), 3-19.

Miller, J., & Schwanenflugel, P. J. (2008). A longitudinal study of the development of reading prosody as a dimension of oral reading fluency in early elementary school children. *Reading Research Quarterly, 43*(4), 336-354. doi: 10.1598/RRQ.43.4.2

MINEDUC. (2007). SIMCE 2006. Summary of results. In M. o. Education (Ed.).

MINEDUC. (2013). SIMCE 2012. Summary of results. In M. o. E. o. Chile (Ed.).

MINEDUC. (2014). SIMCE 2013. Summary of results. In M. o. Education (Ed.).

Ministry of Education. (2008). *Educational guidelines. Prekindergarten*. Santiago, Chile: Ministry of Education.

Mistry, R. S., White, E. S., Benner, A. D., & Huynh, V. W. (2009). A longitudinal study of the simultaneous influence of mothers' and teachers' educational expectations on low-income youth's academic achievement. *Journal of Youth and Adolescence, 38*(6), 826-838. doi: 10.1007/s10964-008-9300-0

Mizala, A., Romaguera, P., & Urquiola, M. (2007). Socioeconomic status or noise? Tradeoffs in the generation of school quality information. *Journal of Development Economics, 84*(1), 61-75. doi: 10.1016/j.jdeveco.2006.09.003

Mizala, A., & Torche, F. (2012). Bringing the schools back in: the stratification of educational achievement in the Chilean voucher system. *International Journal of Educational Development, 32*(1), 132-144. doi: 10.1016/j.ijedudev.2010.09.004

Moghadam, S., Zainal, Z., & Ghaderpour, M. (2012). A review on the important role of vocabulary knowledge in reading comprehension performance. *Procedia - Social and Behavioral Sciences, 66*, 555-563. doi: 10.1016/j.sbspro.2012.11.300

Molfese, V., Modglin, A., & Molfese, D.L. (2003). The role of environment in the development of reading skills: A longitudinal study of preschool and school-age measures. *Journal of Learning Disabilities, 36*(1), 59-67.

Morere, D., & Koo, D. (2012). Measures of receptive language. In D. Morere & A. T. (Eds.), *Assessing literacy in deaf individuals: neurocognitive measurements and predictors* (pp. 159–178). New York: Springer.

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), 665-681. doi: 10.1037/0012-1649.40.5.665

Nag, S., & Snowling, M. (2012). *School underachievement and specific learning difficulties. IACAPAP e-Textbook of Child and Adolescent Mental Health*

Naglieri, J. (2001). Do ability and reading achievement correlate. *Journal of Learning Disabilities, 34*(4), 304-305.

Nation, K., Clarke, P., & Snowling, M. (2002). General cognitive ability in children with reading comprehension difficulties. *British Journal of Educational Psychology, 72*, 549-560.

Nation, K., & Cocksey, J. (2009). The relationship between knowing a word and reading it aloud in children's word reading development. *Journal of Experimental Child Psychology, 103*(3), 296-308. doi: 10.1016/j.jecp.2009.03.004

Nettelbeck, T., & Wilson, C. (2004). The Flynn effect: smarter not faster. *Intelligence 32*, 85-93.

Neuberg, S. L., & Newsom, J. T. (1993). Personal need for structure: Individual differences in the desire for simpler structure. *Journal of Personality and Social Psychology, 65*(1), 113-131. doi: 10.1037/0022-3514.65.1.113

Noble, K. G., Farah, M. J., & McCandliss, B. D. (2006). Socioeconomic background modulates cognition-achievement relationships in reading. *Cognitive Development, 21*(3), 349-368. doi: 10.1016/j.cogdev.2006.01.007

Norton, E. S., & Wolf, M. (2012). Rapid automatized naming (RAN) and reading fluency: implications for understanding and treatment of reading disabilities. *Annual Review of Psychology, 63*, 427-452. doi: 10.1146/annurev-psych-120710-100431

Oakhill, J., & Cain, K. (2007). Issues of causality in children’s reading comprehension. In D. S. McNamara (Ed.), *Reading comprehension strategies: theories, interventions, and technologies* (pp. 47-72). Mahwah, NJ: Lawrence Erlbaum Associates.

Oakhill, J., & 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. doi: 10.1080/10888438.2010.529219

OECD. (2007). PISA 2006: Science competencies for tomorrow’s world executive summary.

OECD. (2010). PISA 2009 results: What students know and can do. Student performance in reading mathematic and science.

OECD. (2013). PISA 2012. Results in focus: What 15-year-olds know and what they can do with what they know.

OECD. (2016). PISA 2015 results: Executive summary. In OECD (Ed.).

Oliva, M. A. (2010). Política educativa chilena 1965-2009. ¿Qué oculta esa trama? [Chilean Education Policy from 1965 to 2009. What are there behind this plot?]. *Revista Brasileira de Educação, 15*(44), 311-328.

Opfer, J. E., & Bulloch, M. J. (2007). Causal relations drive young children's induction, naming, and categorization. *Cognition, 105*(1), 206-217. doi: 10.1016/j.cognition.2006.08.006

Ortiz, I. (2012). En torno a la validez del Sistema de Medición de la Calidad de la Educación en Chile [About the validity of the Quality Measuring System of Education in Chile]. *Estudios pedagógicos, 38*, 355-373.

Ortiz, S., Lella, S., & Canter, A. (2010). Intellectual ability and assessment: A primer for parents and educators. *Helping Children at Home and School, III*, 1-4.

Ostrosky-Solis, F., Gutierrez, A. L., Flores, M. R., & Ardila, A. (2007). Same or different? Semantic verbal fluency across Spanish-speakers from different countries. *Archives of Clinical Neuropsychology 22*(3), 367-377. doi: 10.1016/j.acn.2007.01.011

Ostrove, J.M., Feldman, P. , & Adler, N. (1999). Relations among socioeconomic indicators and health for African-Americans and whites. *Journal of Health Psychology, 4*(4), 451-463.

Ouellette, G. (2006). What's meaning got to do with it: The role of vocabulary in word reading and reading comprehension. *Journal of Educational Psychology, 98*(3), 554-566. doi: 10.1037/0022-0663.98.3.554

Pallante, D., & Kim, Y. (2013). The effect of a multicomponent literacy instruction model on literacy growth for kindergartners and first-grade students in Chile. *International Journal of Psychology, 48*(5), 747-761. doi: 10.1080/00207594.2012.719628

Paredes, R., & Pinto, J. I. . (2009). ¿El fin de la educación pública en Chile? [Is this the end of public education in Chile?] *Estudios de Economía, 36*(1), 47-66.

Park, H. (2008). Home literacy environments and children's reading performance: a comparative study of 25 countries. *Educational Research and Evaluation, 14*(6), 489-505. doi: 10.1080/13803610802576734

Pasquarella, A., Chen, X., Gottardo, A., & Geva, E. (2015). Cross-Language transfer of word reading accuracy and word reading fluency in Spanish–English and Chinese–English bilinguals: Script-Universal and Script-Specific processes. *Journal of Educational Psychology, 107*(1), 96-110. doi: 10.1037/a0036966.supp

Pennington, B., & Lefly, D. (2001). Early reading development in children at family risk for dyslexia. *Child Development, 72*(3), 816-833.

Perfetti, C.A. (1985). *Reading ability*. New York: Oxford University Press.

Phillips, B., & Lonigan, C. (2009). Variations in the Home Literacy Environment of preschool children: A cluster analytic approach. *Scientific Studies of Reading, 13*(2), 146-174. doi: 10.1080/10888430902769533

Phillips, B., Piasta, S. , Anthony, J., Lonigan, C. , & Francis, D. . (2012). IRTs of the ABCs: children's letter name acquisition. *Journal of School Psychology, 50*(4), 461-481. doi: 10.1016/j.jsp.2012.05.002

Pinnell, G. , Pikulski, J., Wixson, K., Campbell, J., Gough, P., & Beatty, A. (1995). *Listening to children read aloud*. Washington, DC.: National Center for Education Statistics.

Posner, P. (2012). Targeted assistance and social capital: Housing policy in Chile's neoliberal democracy. *International Journal of Urban and Regional Research, 36*(1), 49-70. doi: 10.1111/j.1468-2427.2011.01059.x

Pruden, S.M., Hirsh-Pasek, K. , Golinkoff, R. M., & Hennon, E.A. (2006). The birth of words: Ten-month-olds learn words through perceptual salience. *Child Development, 77*(2), 266-280.

Quilis, A. (1993). *Tratado de fonética y fonología españolas [Spanish phonology and phonology handbook]*. Madrid: Editorial Gredos.

Quinn, P.C., & Eimas, P. D. (2000). The emergence of category representations during infancy: Are separate perceptual and conceptual processes required? *Journal of Cognition and Development, 1*(1), 55-61. doi: 10.1207/s15327647jcd0101n_6

Rambla, X., Valiente, Ó., & Frías, C. (2011). The politics of school choice in two countries with large private-dependent sectors (Spain and Chile): family strategies, collective action and lobbying. *Journal of Education Policy, 26*(3), 431-447. doi: 10.1080/02680939.2010.540675

Ramsey, J. L., Langlois, J. H., & Marti, N. C. (2005). Infant categorization of faces: Ladies first. *Developmental Review, 25*(2), 212-246. doi: 10.1016/j.dr.2005.01.001

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

Rasinski, T. , Padak, N., McKeon, C., Wilfong, L., Friedauer, J., & Heim, P. (2005). Is reading fluency a key for successful high school reading? *Journal of Adolescent & Adult Literacy, 49*(1), 22-27.

Ratteman, M., & Genter, D. . (1998). More evidence for a relational shift in the development of analogy: Children's performance on a causal-mapping task. *Cognitive Development, 13*(4), 453-478.

Reese, E., Leyva, D., Sparks, A., & Grolnick, W. (2010). Maternal elaborative reminiscing increases low-income children's narrative skills relative to dialogic reading. *Early Education & Development, 21*(3), 318-342. doi: 10.1080/10409289.2010.481552

Reese, E., Sparks, A., & Leyva, D. (2010). A review of parent interventions for preschool children's language and emergent literacy. *Journal of Early Childhood Literacy, 10*(1), 97-117. doi: 10.1177/1468798409356987

Reiter, A., Tucha, O., & Lange, K. W. (2005). Executive functions in children with dyslexia. *Dyslexia, 11*(2), 116-131. doi: 10.1002/dys.289

Reznick, J. S. (2000). Interpreting Infant conceptual categorization. *Journal of Cognition and Development, 1*(1), 63-66. doi: 10.1207/s15327647jcd0101n_7

Ricciuti, H., Thomas, M., & Ricciuti, A. (2006). Availability and spontaneous use of verbal labels in sorting categorization by 16–23-month olds. *Early Childhood Research Quarterly, 21*(3), 360-373. doi: 10.1016/j.ecresq.2006.07.003

Richland, L. E., Chan, T. K., Morrison, R. G., & Au, T. K. (2010). Young children's analogical reasoning across cultures: similarities and differences. *Journal of Experimental Child Psychology, 105*, 146-153. doi: 10.1016/j.jecp.2009.08.003

Richland, L. E., Morrison, R. G., & Holyoak, K. J. (2006). Children's development of analogical reasoning: insights from scene analogy problems. *Journal of Experimental Child Psychology, 94*(3), 249-273. doi: 10.1016/j.jecp.2006.02.002

Rimmer, W. (2006). Measuring grammatical complexity: The Gordian knot. *Language testing, 23*(4), 497–519.

Ritchie, S. J., & Bates, T. C. (2013). Enduring links from childhood mathematics and reading achievement to adult socioeconomic status. *Psychological Science, 24*(7), 1301-1308. doi: 10.1177/0956797612466268

Roberts, J., Jurgens, J., & Burchina, M. (2005). The role of home literacy practices in preschool children's language and emergent literacy skills. *Journal of Speech, Language, and Hearing Research, 48*(2), 345-359.

Robertson, I., Manly, T., Andrade, J., Baddeley, B., & Yiend, J. (1997). 'Oops!': Performance correlates of everyday attentional failures in traumatic brain injured and normal subjects. *Neuropsychologia, 24*(5), 747-758.

Roid, G.H. (2003). *Stanford–Binet Intelligence Scales. 5th ed.* Itasca, IL: Riverside Publishing.

Romero-Contreras, S. (2006). *Measuring language - and literacy- related practices in low SES Costa Rican families: Research instruments and results.* (PhD), Harvard.

Rowe, M. L., Raudenbush, S. W., & Goldin-Meadow, S. (2012). The pace of vocabulary growth helps predict later vocabulary skill. *Child Development, 83*(2), 508-525. doi: 10.1111/j.1467-8624.2011.01710.x

Santostefano, S., Rutledge, L., & Randall, D. (1965). Cognitive styles and reading disability. *Psychology in the Schools, 2*, 57-62.

Savage, R., Deault, L., Daki, J., & Aouad, J. (2011). Orthographic analogies and early reading: Evidence from a multiple clue word paradigm. *Journal of Educational Psychology, 103*(1), 190-205. doi: 10.1037/a0021621

Savage, R., & Frederickson, N. (2005). Evidence of a highly specific relationship between rapid automatic naming of digits and text-reading speed. *Brain and Language, 93*(2), 152-159. doi: 10.1016/j.bandl.2004.09.005

Schmitt, N. . (2014). Size and depth of vocabulary knowledge: what the research shows. *Language learning, 64*(4), 913-951.

Schneider, M., Elacqua, G., & Buckley, J. (2006). School choice in Chile: Is it class or the classroom? *Journal of Policy Analysis and Management, 25*(3), 577-601. doi: 10.1002/pam.20192

Schulz, L. E., & Gopnik, A. (2004). Causal learning across domains. *Developmental Psychology, 40*(2), 162-176. doi: 10.1037/0012-1649.40.2.162

Schwanenflugel, P., & Ruston, H. (2008). Becoming a fluent reader: From theory to practice. In M. Kuhn (Ed.), *Fluency in the classroom*. New York: Guilford Press.

Schwartz, M., Segal, M., Veramonti, T., Ferraro, M., & Buxbaum, L. (2002). The naturalistic action test: A standardised assessment for everyday action impairment. *Neuropsychological Rehabilitation, 12*(4), 311-339. doi: 10.1080/09602010244000084

Seidenberg, M.S. (2006). Connectionist models of reading. In G. Gaskell (Ed.), *The Oxford handbook of psycholinguistics* (Vol. 235– 250). Oxford: UK: Oxford University Press.

Seidenberg, M.S., & McClelland, J.L. (1989). A distributed developmental model of word recognition and naming. *Psychological Review, 96*(4), 523-568.

Senechal, M., & LeFevre, J. (2002). Parental involvement in the development of children's reading skill: A five-year longitudinal study. *Child Development, 73*(2), 445-460.

Serafica, F., & Sigel, I. (1970). Styles of categorization and reading disability. *Journal of Reading Behavior, 2*, 105-115.

Seymour, P. (1997). Foundations of orthographic development. In C. A. Perfetti, L. Rieben & M. Fayol (Eds.), *Learning to spell* (pp. 59-73). Hillsdale, NJ: Erlbaum.

Seymour, P., Aro, M., & Erskine, J. (2003). Foundation literacy acquisition in European orthographies. *British Journal of Psychology, 94*, 143–174.

Seymour, P., & Evans, H. (1999). Foundation-level dyslexias: Assessment and treatment. *Journal of Learning Disabilities, 32*, 394-405.

Shanker, J., & Ekwall, E. (2009). *Ekwall Shanker Reading Inventory Fifth Edition (ESRI-5).* . Needham Heights: Pearson.

Shany, M., & Share, D. L. (2011). Subtypes of reading disability in a shallow orthography: a double dissociation between accuracy-disabled and rate-disabled readers of Hebrew. *Annals of dyslexia, 61*(1), 64-84. doi: 10.1007/s11881-010-0047-4

Shao, Z., Janse, E., Visser, K., & Meyer, A. S. (2014). What do verbal fluency tasks measure? Predictors of verbal fluency performance in older adults. *Frontiers in Psychology, 5*, 1-10. doi: 10.3389/fpsyg.2014.00772

Share, D. L., Jorm, A., Maclean, R., & Matthews, R. . (1984). Sources of individual differences in reading acquisition. *Journal of Educational Psychology, 76*(6), 1309-1324.

Share, D. L., & Stanovich, K. (1995). Cognitive processes in early reading development. Accommodating individual differences into a model of acquisition. *Issues in education, 1*(1), 1-57.

Simpson, E., Oliver, W., & Fragaszy, D. (2008). Super-expressive voices: Music to my ears? *Behavioral and Brain Sciences, 31*(05). doi: 10.1017/s0140525x08005517

Slotte, C., & Lanka, K. (1999). Review of process effects of spontaneous note-taking on text comprhension. *Contemporary Educational Psychology, 24*, 1-20.

Snow, C., Burns, M., & Griffin, P. (1998). *Preventing reading difficulties in young children.* Washington, DC: National Research Council.

Sobel, D. , Yoachim, C. M., Gopnik, A., Meltzoff, A. , & Blumenthal, E. J. (2007). The blicket within: Preschoolers' inferences about insides and causes. *Journal of Cognition and Development, 8*(2), 159-182. doi: 10.1080/15248370701202356

Son, S.H., & Morrison, F. J. (2010). The nature and impact of changes in home learning environment on development of language and academic skills in preschool children. *Developmental Psychology, 46*(5), 1103-1118. doi: 10.1037/a0020065

Spearman, C. (1920). Manifold sub-theories of "the two factors" *Psychological Review, 27*, 159–172.

Spellman, B. A., & Mandel, D. R. (2003). Causal reasoning, psychology of. In N. L. (Ed.), *Encyclopedia of cognitive science* (Vol. 1, pp. 461-466). London: Nature Publishing Group.

Stage, F., Carter, H., & Nora, A. (2004). Path analysis: An introduction and analysis of a decade of research. *The Journal of Educational Research, 98*(1), 5-13. doi: 10.3200/joer.98.1.5-13

Stahl, S. (2003). Vocabulary and readability: How knowing word meanings affects comprehension. *Topics in Language Disorders, 23*(3), 241-247.

Stahl, S., & Bravo, M. (2010). Contemporary classroom vocabulary assessment for content areas. *The Reading Teacher, 63*(7), 566-578. doi: 10.1598/rt.63.7.4

Stahl, S., & Fairbanks, M. (1986). The effects of vocabulary instruction: A model-based meta-analysis. *Review of Educational Research, 56*(1), 72-110.

Stahl, S., Hare, V., Sinatra, R., & Gregory, J. (1991). Defining the role of prior knowledge and vocabulary in reading comprehension: The retiring of number 41. *Journal of Reading Behavior, 23*, 487-508.

Stahl, S., & Murray, B. (1994). Defining phonological awareness and its relationship to early reading. *Journal of Educational Psychology, 86*(2), 221-234. doi: 10.1037/0022-0663.86.2.221

Stannard, L., Wolfgang, C., Jones, I., & Phelps, P. (2001). A longitudinal study of the predictive relations among construction play and mathematical achievement. *Early Child Development and Care, 167*(1), 115-125. doi: 10.1080/0300443011670110

Stanovich, K. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. *Reading Research Quarterly, 21*(4), 360-407.

Storch, S., & Whitehurst, G.J. (2001). The role of family and home in the literacy development of children from low-income backgrounds. *New Directions for Child and Adolescent Development, 92*, 53-71.

Stothard, S., & Hulme, C. (1992). Reading comprehension difficulties in children. The role of language comprehension and working memory skills. *Reading and writing: An interdisciplinary journal, 4*, 245-256.

Stovall, J. (2008). *Writing for the mass media (7th ed.)*. Boston: Allyn & Bacon.

Strasser, K., Larraín, A., López de Lérida, S., & Lissi, M. R. (2010). La comprensión narrativa en edad preescolar: Un instrumento para su medición [Narrative comprehension in the preschool age: An assessment instrument]. *Psykhe, 19*(1), 75-87.

Strasser, K., & Lissi, M. R. (2009). Home and instruction effects on emergent literacy in a sample of Chilean kindergarten children. *Scientific Studies of Reading, 13*(2), 175-204. doi: 10.1080/10888430902769525

Strasser, K., Lissi, M. R., & Silva, M. (2009). Gestión del tiempo en 12 salas chilenas de kindergarten: Recreo, colación y algo de instrucción [Time management in 12 Chilean kindergarten classrooms: Recess, snack and a little teaching]. *Psykhe, 18*(1), 85-96.

Strasser, K., Mendive, S., Vergara, D., & Darricades, M. (2017). Efficacy of a self-monitoring tool for improving the quality of the language environment in the preschool classroom. *Early Education and Development, 28*(1), 1-21. doi: 10.1080/10409289.2017.1287992

Strong, R., Sulver, H., Perini, M., & Tuculescu, G. (2002). *Reading for academic success: Powerful strategies for struggling, average, and advanced readers, Grades 7-12*. Thousand Oaks, CA: Corwin.

Sullivan, S., Oakhill, J., Arfé, B., & Boureux, M. (2014). Temporal and causal reasoning in deaf and hearing novice readers. *Discourse Processes, 51*(5-6), 426-444. doi: 10.1080/0163853x.2014.910341

Swanson, H., Trainin, G., Necoechea, D., & Hammil, D. (2003). Rapid naming, phonological awareness, and reading: A meta-analysis of the correlation evidence. *Review of Educational Research, 73*(4), 407-440.

Szpunar, K. , & McDermott, K. (2008). Episodic future thought: Remembering the past to imagine the future In K. D. Markman, W. M. P. Klein & J. A. Suhr (Eds.), *The handbook of imagination and mental simulation* (pp. 119-129). New York: NY: Psychology Press.

Tattersall, P. J., Nelson, N. W., & Tyler, A. A. (2014). Associations among nonword repetition and phonemic and vocabulary awareness: Implications for intervention. *Child Language Teaching and Therapy, 31*(2), 159-171. doi: 10.1177/0265659014554719

Thaler, V., Ebner, E.M., Wimmer, H., & Landerl, K. (2004). Training reading fluency in dysfluent readers with high reading accuracy: Word specific effects but low transfer to untrained words. *Annals of Dyslexia, 54*(1), 89-113.

The Psychological Corporation. (2003). *The Early Reading Diagnostic Assessment (2nd ed.)*. San Antonio, TX: Psychological Corporation, Harcourt Assessment Company.

Thibaut, J. P., French, R., & Vezneva, M. (2010). The development of analogy making in children: cognitive load and executive functions. *Journal of Experimental Child Psychology, 106*(1), 1-19. doi: 10.1016/j.jecp.2010.01.001

Thornbury, S. (2002). *How to teach vocabulary*. Edinburgh: Pearson Education Limited.

Thorndike, E.L. . (1917). *The thorndike arithmetics books (1-3)*. Chicago: Rand-McNally.

Thorndike, R., Hagen, E., & Sattler, J. (1986). *Stanford–Binet Intelligence Scales. 4th ed.* Chicago, IL: Riverside Publishing.

Tobia, V., & Marzocchi, G.M. (2014). Predictors of reading fluency in Italian orthography: Evidence from a cross-sectional study of primary school students. *Child Neuropsychology, 20*(4), 449-469. doi: 10.1080/09297049.2013.814768

Tong, X., Deacon, H., & Cain, K. (2013). Morphological and syntactic awareness in poor comprehenders: Another piece of the puzzle. *Journal of Learning Disabilities, 47*(1), 22-33. doi: 10.1177/0022219413509971

Torche, F. (2005). Privatization reform and inequality of educational opportunity: The case of Chile. *Sociology of Education, 78*(4), 316-343. doi: 10.1177/003804070507800403

Torgesen, J., Wagner, R. , Rashotte, C., Burgess, S., & Hecht, S. (1997). Contributions of phonological awareness and rapid automatic naming ability to the growth of word-reading skills in second-to fifth-grade children. *Scientific Studies of Reading, 1*(2), 161-185. doi: 10.1207/s1532799xssr0102_4

Treiman, R., & Kessler, B. (2006). Spelling as statistical learning: Using consonantal context to spell vowels. *Journal of Educational Psychology, 98*(3), 642-652. doi: 10.1037/0022-0663.98.3.642

Treiman, R., Kessler, B., Zevin, J. D., Bick, S., & Davis, M. (2006). Influence of consonantal context on the reading of vowels: evidence from children. *Journal of Experimental Child Psychology, 93*(1), 1-24. doi: 10.1016/j.jecp.2005.06.008

Treiman, R., Tincoff, R., & Richmond-Welty, E.D. . (1996). Letter names help children to connect print and speech. *Developmental Psychology, 32*(3), 505-514.

Tunteler, E., & Resing, W. (2002). Spontaneous analogical transfer in 4-year-olds: A microgenetic study. *Journal of Experimental Child Psychology, 83*, 149–166.

Vaessen, A., Bertrand, D., Tóth, D., Csépe, V., Faísca, L., Reis, A., & Blomert, L. (2010). Cognitive development of fluent word reading does not qualitatively differ between transparent and opaque orthographies. *Journal of Educational Psychology, 102*(4), 827-842. doi: 10.1037/a0019465

van den Broek, P. (1989). Causal reasoning and inference making in judging the importance of story statements. *Child Development, 60*(2), 286-297.

Vosniadou, S., & Ortony, A. (1983). The emergence of the literal-metaphoricalanomalous distinction in young children. *Child Development, 5*, 154-161.

Wagner, R., & Meros, D. (2010). Vocabulary and reading comprehension: Direct, indirect, and reciprocal influences. *Focus on Exceptional Children, 43*, 1-17.

Wagner, R., Muse, A., & Tannenbaum, K. (2007). *Vocabulary acquision: Implications for reading comprehension.* . New York: The Guilford Press.

Wagner, R., & Torgesen, J. (1987). The nature of phonological processing and its causal role in the acquisition of reading skills. *Psychological Bulletin, 101*(2), 192-212.

Wagner, R., Torgesen, J., & Rashotte, C. (1994). Development of reading-related phonological processing abilities: New evidence of bidirectional causality from a latent variable longitudinal study. *Developmental Psychology, 30*(1), 73-87.

Wagner, R., Torgesen, J., & Rashotte, C. (1999). *Comprehensive test of phonological processing (CTOPP)*. Austin, TX: Pro-Ed.

Walpole, M. (2003). Socioeconomic status and college: How SES affects college experiences and outcomes. *The Review of Higher Education, 27*(1), 45-73. doi: 10.1353/rhe.2003.0044

Walton, P. D., Walton, L. M., & Felton, K. (2001). Teaching rime analogy or letter recoding reading strategies to pre-readers: Effects on prereading skills and word reading. *Journal of Educational Psychology, 93*, 160-180.

Walton, P., & Walton, L. (2002). Beginning reading by teaching in rime analogy: Effects on phonological skills, letter-sound knowledge, working memory, and word-reading strategies. *Scientific Studies of Reading, 6*(1), 79-115. doi: 10.1207/s1532799xssr0601_04

Wechsler, D. (2002). *Wechsler Preschool and Primary Scale of Intelligence — Third Edition*. San Antonio, TX: The Psychological Corporation.

Wechsler, D. (2003). *Wechsler Intelligence Scale for Children — Fourth Edition*. San Antonio, TX: The Psychological Corporation.

Weigel, D. J., Martin, S., & Bennet, K. (2006). Mothers' literacy beliefs: Connections with the home literacy environment and pre-school children's literacy development. *Journal of Early Childhood Literacy, 6*(2), 191-211. doi: 10.1177/1468798406066444

Welsh, J. A., Nix, R. L., Blair, C., Bierman, K. L., & Nelson, K. E. (2010). The development of cognitive skills and gains in academic school readiness for children from low-income families. *Journal of Educational Psychology, 102*(1), 43-53. doi: 10.1037/a0016738

Westermann, G., & Mareschal, D. (2012). Mechanisms of developmental change in infant categorization. *Cognitive Development, 27*(4), 367-382. doi: 10.1016/j.cogdev.2012.08.004

White, K.R. (1982). The relation between socioeconomic status and academic achievement. *Psychological Bulletin, 91*(3), 461-481. doi: 10.1037/0033-2909.91.3.461

Whitehurst, G., & Lonigan, C. (1998). Child development and emergent literacy. *Child Development, 69*, 848-872.

Wiederholt, J.L., & Bryant, B.R. (2001). *Gray Oral Reading Tests—Fourth Edition.* . Austin, TX: PRO-ED.

Williams, D.R., & Collins, C. (1995). U. S. socioeconomic and racial differentials in health: patterns and explanations. *Annual Review of Sociology, 21*.

Williams, K. (2001). *GRADE: Group reading assessment and diagnostic evaluation.* . Circle Pines, MN: American Guidance Service, Inc.

Wimmer, H. . (1993). Characteristics of developmental dyslexia in a regular writing system. *Applied Psycholinguistics, 14*(1), 1-33. doi: 10.1017/s0142716400010122

Wixson, K., & Lipson, M. (1996). *Reading disability*. New York: Harper-Collins.

Wolf, M., & Bowers, P. (1999). The double-deficit hypothesis for the developmental dyslexias. *Journal of Educational Psychology, 91*(3), 415-438. doi: 10.1037/0022-0663.91.3.415

Wolf, M., Bowers, P. G., & Biddle, K. (2000). Naming-Speed processes, timing, and reading: A conceptual review. *Journal of Learning Disabilities, 33*(4), 387-407. doi: 10.1177/002221940003300409

Wolf, M., & Denckla, M. (2005). *RAN/RAS: Rapid automatized naming and rapid alternating stimulus tests*. Austin, TX: Pro-Ed.

Wolf, M., & Katzir-Cohen, T. (2001). Reading fluency and its intervention. *Scientific studies of reading, 5*(3), 211-239. doi: 10.1207/s1532799xssr0503_2

Wolfgang, C., Stannard, L., & Jones, I. (2001). Block play performance among preschoolers as a predictor of later school achievement in mathematics. *Journal of Research in Childhood Education, 15*(2), 173-180. doi: 10.1080/02568540109594958

Wolfgang, C., Stannard, L., & Jones, I. (2003). Advanced constructional play with LEGOs among preschoolers as a predictor of later school achievement in mathematics. *Early Child Development and Care, 173*(5), 467-475. doi: 10.1080/0300443032000088212

Woodcock, R., McGrew, K., & Mather, N. (2001). *Woodcock-Johnson III*. Itasca, IL.: Riverside Publishing.

Woodward, A., Markman, E., & Fitzsimmons, C. (1994). Rapid word learning in 13- and 18-month-olds. *Developmental Psychology, 30*(4), 553-566.

Yoshikawa, H., Snow, C., Barata, C., Gomez, C., Leyva, D., Treviño, E., . . . Arbour, M. (2015). Supplemental material for experimental impacts of a teacher professional development program in Chile on preschool classroom quality and child outcomes. *Developmental Psychology, 51*(3), 309-322. doi: 10.1037/a0038785.supp

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

Zelazo, P., & Müller, U. (2002). Executive function in typical and atypical development. In U. Goswami (Ed.), *Handbook of childhood cognitive development* (pp. 445-469). Oxford, UK: Blackwell.

Zelazo, P., Muller, U., Frye, D., & Marcovitch, S. . (2003). The development of executive function in early childhood. *Monographs of the Society for Research in Child Development, 68*(3), Serial No. 274.

Zhang, D. (2012). Vocabulary and grammar knowledge in second language reading comprehension: A structural equation modeling study. *The Modern Language Journal, 96*(4), 558-575. doi: 10.1111/j.1540-4781.2012.01398.x

Ziegler, J. C., & Goswami, U. (2005). Reading acquisition, developmental dyslexia, and skilled reading across languages: a psycholinguistic grain size theory. *Psychological Bulletin, 131*(1), 3-29. doi: 10.1037/0033-2909.131.1.3