Longitudinal predictors of reading comprehension in French at first grade: Unpacking the oral comprehension component of the simple view

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Abstract

According to the simple view of reading (SVR), reading comprehension relies on "decoding" (pseudoword, word reading) and "oral comprehension" skills. Testing 556 French pupils, we aimed at unpacking these two components and tracking their longitudinal development in first grade. We have found that: (1) lower level language skills (vocabulary, syntax) and discourse skills (oral text comprehension) emerged as two dimensions of "oral comprehension"; (2) lower level language skills longitudinally predicted reading comprehension outcomes, above code-related skills; (3) decoding precursors (letter knowledge, naming speed and phonemic awareness) predicted reading comprehension directly, and indirectly, through decoding skills (pseudoword, word reading, text reading fluency); (4) Oral comprehension skills did not favour the development of decoding. Our results support the independency of the SVR components. However, we suggest that a more fine-grained conceptualisation of oral comprehension skills would help to better understand the individual and pedagogical factors influencing the early development of reading comprehension.

1. Introduction

Reading comprehension is fundamental for professional and personal achievement. Yet the level of fourth-grade French pupils is below the European one (Mullis, Martin, Foy, & Hooper, 2017), and persistent gaps between children from different socio-economic backgrounds are being reported (Georgiou, Tziraki, Manolitsis, & Fella, 2013; Hoover & Gough, 1990; Johnston & Kirby, 2006; Oakhill, Cain, & Bryant, 2003; Ouellette & Beers, 2010; Ouellette, 2006; Plaza & Cohen, 2003). Having a better understanding of the skills underlying reading comprehension from the first year of compulsory education would help to direct teaching efforts.

The simple view of reading (SVR[1]) identifies decoding and oral comprehension skills as fundamental predictors of reading comprehension. These two components would be independent enough to be specifically impaired, but both necessary to develop reading comprehension skills (Gough & Tunmer, 1986; Hoover & Gough, 1990; Hulme & Snowling, 2011; Snowling & Hulme, 2011). However, recent studies have challenged several aspects of the SVR. First, the homogeneity of oral comprehension skills has been questioned. Vocabulary and grammar, on one side, and oral text comprehension skills, on the other side, seem to emerge as dissociable dimensions of oral language in first grade, being clearly differentiated in 3rd grade (Justice et al., 2015). Secondly, oral language skills have been shown to predict decoding skills (Tunmer & Chapman, 2012a, 2012b), although this relationship is not entirely clear in young readers (Kendeou, Van den Broek, White, & Lynch, 2009; Storch & Whitehurst, 2002) and is likely to vary depending on the measures used to assess the two constructs (Kirby & Savage, 2008). Finally, cross-linguistic comparisons are warranted since the inconsistency of letter-sound mappings in English could prevent the generalization of findings on more transparent orthographies (Seymour, Aro, & Erskine, 2003; Ziegler et al., 2010). A relatively faster development of decoding skills in French, compared to English children could be associated with a greater importance of oral comprehension skills as a predictor of reading comprehension in first grade (Florit & Cain, 2011). However, French is not as transparent as other languages, such as Finish or Hungarian (Ziegler et al., 2010), and children need to learn the orthography of complex irregular words. In this process, semantic, syntactic and morphological information, stored in the mental lexicon with orthographic representations, could play a role in reading acquisition (Perfetti & Stafura, 2014). Testing the longitudinal relationships between decoding skills and oral language skills among French children could help to better understand whether orthographic consistency influences the independency of the SVR components.

Comparing studies on English and French-speaking pupils, we will first present the two traditional components of the SVR, and their development during the course of reading instruction. We will then question in more detail the homogeneity of oral language skills, and their potential longitudinal influence on decoding skills.

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[1] List of abbreviations. SVR: Simple View of Reading; SEM: Structural Equation Modeling; RAN: Rapid Automatized Naming; LLL: Lower Level Language skills.

1.1. Decoding skills

The first component of the SVR, decoding skills, has been assessed through pseudoword or word reading. Pseudoword reading measures knowledge of regular grapheme-to-phoneme correspondences: children discover that phonemes are the smallest sounds differentiating two words, and that they can be represented by specific letters, called graphemes (Ehri, 2005; Ehri et al., 2001; Observatoire national de la lecture, 1998; Ouellette & Beers, 2010). However, the frequency of irregular words in French and English (Seymour et al., 2003; Ziegler et al., 2010) makes it necessary for children to also recognize words' orthography through repeated exposure, since grapheme-to-phoneme correspondences would be misleading in their case (Ehri, 2005). Whereas the distinction between word and pseudoword reading might be less salient in fully transparent orthographies, studies on English (Ouellette & Beers, 2010) and French populations (Gentaz, Sprenger-Charolles, Theurel, & Colé, 2013) have shown that reading comprehension is better explained when pseudoword and word reading measures are both considered.

Furthermore, in the process of comparing orthographies that vary in consistency, the specific way of assessing pseudoword and word reading seems to influence the correlations between decoding and reading comprehension skills. Florit and Cain (2011) report that decoding fluency is a more powerful predictor of reading comprehension than decoding accuracy during the first two years of schooling, for transparent orthographies. This could be explained by a faster development of reading accuracy compared to irregular orthographies. English (Kendeou et al., 2009; Oakhill et al., 2003; Ouellette & Beers, 2010; Tunmer & Chapman, 2012a, 2012b) and French (Bianco et al., 2012; Gentaz et al., 2013) studies vary in their use of pseudoword, word, accuracy and fluency measures, which makes comparisons difficult. Florit and Cain (2011)'s inclusion of French in transparent orthographies is questionable: in French, the consistency of letter-sound mappings is higher than in English, yet lower than in more transparent orthographies such as Hungarian or Finish (Moll et al., 2014; Ziegler et al., 2010). Therefore, to take this ambiguity into account, a composite measure of decoding skills focused on both pseudoword and word reading accuracy, yet including a speed component, would be relevant. It would take into account the complexity of processes involved, and facilitate cross-cultural comparisons.

Finally, a faster development of reading accuracy in French compared to English pupils could influence the respective importance of decoding and oral language skills in predicting reading comprehension (Florit & Cain, 2011). Text fluency (the capacity to read effortlessly, in a fast and accurate manner), could free cognitive and attentional resources for text understanding (Dehaene, 2007). As we will see in part 1.2, text understanding is highly influenced by oral comprehension. Therefore, it is possible that oral language skills explain a greater part of variance in reading comprehension outcomes among French, compared to English pupils. Results from Hoover and Gough (1990) on English first-grade pupils indicate that reading comprehension is more correlated with pseudoword reading than listening comprehension. However, regression analyses carried out by Megherbi, Seigneuric, and Ehrlich (2006), using similar measures among French first grade students, showed that listening comprehension was the strongest predictor of reading comprehension. To our knowledge, structural equation modeling (SEM), combining factorial analysis (to create composite measures of decoding skills), and regression analysis, to predict reading comprehension, has not been applied to French pupils. This prevents a direct comparison with studies on English-speaking students (Kendeou et al., 2009; Kim, 2017; Storch

& Whitehurst, 2002; Tunmer & Chapman, 2012b), or pupils learning more transparent orthographies such as Finish (Lepola, Lynch, Kiuru, Laakkonen, & Niemi, 2016).

Furthermore, the heterogeneity of decoding factors in the existing SEM literature prevents the full generalisation of findings. Depending on pupils' year of schooling, studies focus on word and pseudoword reading (Tunmer & Chapman, 2012b), their precursors (Lepola et al., 2016), or both, either in the same composite (Kendeou et al., 2009) or in separate factors (Storch & Whitehurst, 2002). Phonological awareness, letter knowledge and naming speed are three main precursors of decoding skills, both in French, English, and languages with different levels of orthography consistency (Caravolas et al., 2012; Caravolas, Lervåg, Defior, Seidlová Málková, & Hulme, 2013). However, the exact weight of each predictor may vary depending on the language under study, and the specific decoding measures selected (Moll et al., 2014; Ziegler et al., 2010).

Phonological awareness is the ability to perceive, isolate, and manipulate units of spoken sounds, (phonemes and syllables, Araújo, Reis, Petersson, & Faísca, 2015). Measured during prekindergarten or kindergarten, it predicts English (Muter, Hulme, Snowling, & Stevenson, 2004) and French pupils' (Bianco et al., 2012) word recognition skills one or two years later. Its training among English-speaking pupils, from kindergarten to Year 8, enhances pseudoword and word reading, especially when it is associated with a training of letter knowledge (Ehri et al., 2001).

The process of matching symbolic representations to spoken sounds could be assessed by the capacity to quickly name objects, colours, digits or letters, also called rapid automatized naming (RAN). RAN is correlated with concurrent and longitudinal measures of letter, word, pseudoword and text reading as well as reading comprehension (Araújo et al., 2015; Georgiou et al., 2013; Hulme & Snowling, 2014). In first grade, its contribution to reading and writing skills seems to be in- dependent from phonological awareness, memory and syntactic knowledge (Plaza & Cohen, 2003). Alphanumeric RAN (letters and digits) is more correlated with reading comprehension than non-alphanumeric RAN (objects and colours, Araújo et al., 2015).

A fine-grained longitudinal model on French pupils, depicting relationships from decoding precursors to decoding skills, to reading comprehension, is lacking. Such model would be highly relevant, both on an educational and theoretical point of view. It would allow us to better understand how strongly decoding precursors predict decoding skills during the year of first grade, and whether they have an independent effect on reading comprehension. Indeed, the effects of phonological awareness and RAN on reading comprehension might not be fully mediated by decoding skills (these findings mostly rely on concurrent regression analyses: see Bianco et al., 2012; Johnston & Kirby, 2006; Sénéchal & LeFevre, 2002 for phonological awareness; Joshi & Aaron, 2000 for RAN; but see Catts, Herrera, Nielsen, & Bridges, 2015 for longitudinal SEM).

1.2. Oral language skills

The second component of the SVR, oral comprehension, has been defined as “the ability to take lexical information (i.e., semantic in- formation at the word level) and derive sentence and discourse interpretations” (Hoover & Gough, 1990, p. 131).

Information processing mechanisms explaining text comprehension are common to listening and reading. There is a large consensus to consider that comprehending a text consists in building a coherent mental representation. This process relies on information explicitly stated in the text, as well as on general knowledge and inference-making allowing a reader/listener to connect explicit information with implicit knowledge, retrieved from memory or deduced from the text (Bianco, 2015; Gernsbacher, Varner, & Faust, 1990; Kendeou et al., 2009). Many longitudinal and training studies on English populations have shown that oral language skills predict reading comprehension: from kindergarten to primary school (Kendeou et al., 2009; Muter et al., 2004; NICHD Early Child Care Research Network, 2005; Snowling & Hulme, 2011; Storch & Whitehurst, 2002), from 7 to 8 years-old (Oakhill et al., 2003), and from 8 to 11 years-old (Cain, Oakhill, & Bryant, 2004). Furthermore, three French longitudinal studies have shown that oral language skills are involved in reading comprehension from first grade, even though decoding skills are not fully automatized (Bianco et al., 2012; Gentaz et al., 2013; Megherbi et al., 2006).

However, the homogeneity of oral comprehension skills, understood as a single broad factor, is questionable. To assess this component of the SVR, authors typically ask pupils to: identify the meaning of a sentence by choosing a picture (Bianco et al., 2012; Gentaz et al., 2013), complete a sentence with a missing word (Georgiou, Das, & Hayward, 2009; Johnston & Kirby, 2006; Joshi & Aaron, 2000), answer questions on narrative and/or informative texts (Bianco et al., 2012; Ouellette & Beers, 2010), recall a story (Hoover & Gough, 1990). Measures of syntactic skills (the ability to understand sentences) and oral text comprehension have sometimes been aggregated or assimilated (Bianco et al., 2012; Gentaz et al., 2013; NICHD Early Child Care Research Network, 2005). This procedure might be misleading, since interpretation and integration at the level of the sentence and at the level of an entire text might not involve similar cognitive mechanisms. In particular, Justice et al. (2015) have carried out a cross-sectional study on English-speaking children from 4 to 8 years of age. Studying the dimensional structure of oral language skills, they report a progressive differentiation between "Lower Level Language Skills" (LLL), including vocabulary and grammar, and "discourse skills". However, the two sets of skills were highly correlated in Grade 1 ($r = .85$). According to the authors, the dimensionality of oral language could reflect the evolution of schooling experiences, where greater demand is progressively placed on text integration.

Empirical and theoretical work suggest that both syntactic skills and vocabulary play a role in reading comprehension and its impairments (Hulme & Snowling, 2011; Muter et al., 2004; NICHD Early Child Care Research Network, 2005), although they are not systematically investigated within the SVR framework. The number of words known by children from 4 to 6 years-old (Muter et al., 2004; Silva & Cain, 2015), and 7 to 8 years-old (Oakhill et al., 2003) predicts their level of reading comprehension one year later. According to Ouellette (2006), having studied Grade 4 pupils, such receptive measures of receptive "vocabulary breadth" are likely to reflect the quality and extent of semantic representations[2]. Moreoever, Silva and Cain (2015) have demonstrated that the effect of vocabulary breadth on reading comprehension was mediated by inference-making and literal comprehension skills. Beyond the knowledge of individual words,

[2] Indeed, when the quality of semantic representations (or "vocabulary depth") was entered in the analyses before the measure of vocabulary breadth, it remained the main predictor of reading comprehension, with decoding and word recognition skills.

sentence comprehension relies on the understanding of active and passive grammatical structures, pronouns, negations, spatial and temporal indicators, relative clauses... In regression analyses, vocabulary breadth does not always predict reading comprehension over and above syntactic skills (Silva & Cain, 2015). However, results from Gentaz et al. (2013) on French first grade pupils suggest that both sets of skills have independent effects, and that they should both be taken into account when trying to predict reading comprehension skills.

The respective roles of vocabulary, syntax and oral text comprehension, conceived as separate constructs, in predicting reading comprehension are unclear. In particular, if two factors (LLL skills and discourse skills) are indeed extracted, it is unsure how much of the variance in reading comprehension LLL skills would predict after taking into account oral comprehension at the level of the text (Kim, 2017). A structural equation model of reading comprehension development in beginning French readers would allow us: a) to test the replicability of Justice et al. (2015)'s findings; b) to extend them by assessing the relative importance of LLL skills and discourse skills in predicting reading comprehension; c) to test whether this predictive effect is both direct and indirect. Indeed, recent work questioning the independency of the SVR components suggests that oral language skills predict reading comprehension directly, but also indirectly, through decoding skills (Dickinson, Golinkoff, & Hirsh-Pasek, 2010; Tunmer & Chapman, 2012b).

1.3. The interdependency between oral language skills and decoding skills

Since French is not a fully transparent language, children must learn to recognize complex and irregular words by sight. The Lexical Quality Hypothesis states that semantic information favours text integration, but also, in association with morphological and syntactical cues, the decoding of words which orthography is not fully mastered (Perfetti & Stafura, 2014). Ouellette (2006) has shown, testing Grade 4 pupils, that receptive vocabulary breadth, the key vocabulary measure in most of the aforementioned studies on reading development, specifically predicts pseudoword reading. Vocabulary breadth is assessed by the ability to identify a picture representing a given word, and would evaluate the number of entries in children's lexicon. In the process of learning new words, and broadening their lexicon, children would refine their phonological representations, which would in turn strengthen their "decoding skills". In Ouellette (2006)'s study, word reading is associated with receptive vocabulary breadth, but mostly predicted by expressive vocabulary breadth. This last measure would put a greater demand on lexical retrieval and would reflect "the ability to encode, organize and/ or retrieve underlying (word-specific) phonological representations" p 562. Furthermore, vocabulary depth (the quality of words' definitions) also plays a role (although to a lower extent) in word recognition. This suggests the involvement of more global orthographic, phonemic and semantic representations. Structural equation models assessing the development of reading comprehension provide contradictory findings regarding the influence of oral language skills on decoding skills. Kendeou et al. (2009) report a prediction from pre-kindergarten oral language skills (vocabulary, listening comprehension) to concurrent decoding skills (including both word recognition and its precursors). However, these effects were not significant in kindergarten or Grade 2. In this study, a model including longitudinal cross-lagged effects has not been retained, although there was a significant path from pre- kindergarten oral language skills to kindergarten decoding skills. Using different measures, Storch and Whitehurst (2002) report concurrent relationships between oral language skills and code-related skills in prekindergarten and kindergarten. They also noted indirect effects from oral language skills to reading achievement, through code-related skills, from prekindergarten to Grade 3. Finally, according to Tunmer and Chapman (2012b), among Grade 3 pupils, a factor composed of vocabulary knowledge and listening comprehension predicts reading comprehension both directly and indirectly, through word and pseudoword reading. Existing evidence within the SEM literature therefore suggests concurrent relationships between oral language and decoding skills, in prekindergarten, kindergarten or Grade 3. However, the existence of direct longitudinal relationships is uncertain, and the aforementioned results are limited to English-speaking populations (Lepola et al., 2016 did not test cross-lagged effects).

1.4. Aims of the study

This study aims at creating a longitudinal model to better understand the development of reading comprehension during the first year of reading instruction in France. In order to compare results with the existing literature, as well as to provide new insights, vocabulary, syntax and oral text comprehension skills have all been assessed at the beginning (T1) and at the end (T2) of first grade. Decoding precursors (phonological awareness, RAN and letter knowledge), measured at T1, have been fully differentiated from decoding skills (pseudoword, word reading and text fluency), assessed at T2. Reading comprehension has been measured at T2. To better understand the relationships between language skills, we aim to test the following research questions and hypotheses.

Question 1) Are the predictors of reading comprehension better represented by a two-factor structure, differentiating, in line with the SVR, decoding skills from oral language skills, or are oral language skills themselves composed of LLL skills and discourse skills?

Hypothesis 1.a) At T1, a three-factor structure would distinguish: a) decoding precursors (phonological awareness, RAN and letter knowledge); b) LLL skills (vocabulary and grammar); c) discourse skills (oral text comprehension).

Hypothesis 1.b) At T2, three factors would also be extracted: a) decoding skills (pseudoword reading, word reading, text fluency); b) LLL skills (vocabulary and grammar); c) discourse skills (oral text comprehension).

Question 2) How do decoding, LLL skills and discourse skills develop during first grade?

Hypothesis 2.a) There will be longitudinal continuity for LLL skills and discourse skills (T1 values predicting T2 values for each factor).

Hypothesis 2.b) T1 decoding precursors will be strong predictors of T2 decoding skills.

Hypothesis 2.c) T1 LLL skills and T1 discourse skills will predict T2 decoding skills.

Question 3) What is the contribution of each of the three factors in predicting reading comprehension?

Hypothesis 3.a) Each of the three factors, measured at T2, will significantly predict reading comprehension skills.

Hypothesis 3.b) T1 decoding precursors will also directly predict T2 reading comprehension outcomes. However, direct effects from T1 LLL skills and T1 discourse skills to T2 reading comprehension are not expected.

2. Methods

2.1. Participants

561 first-grade pupils, from 23 schools and 35 classrooms situated in the school district of Grenoble (Auvergne-Rhônes Alpes Region) were recruited in 2014–2015. Signed parental consent was obtained for all participants. Five children, being disabled or requiring special educational needs were excluded from the analyses. The final sample includes 556 pupils (275 girls). Children were 6 years of age on average (SD = 0.34).

2.2. Measures

Assessments were carried out by trained and periodically supervised experimenters at the beginning (from September to November 2014, T1) and at the end (May and June 2015, T2) of first grade. This time frame was selected because it corresponds to the academic year in which children develop fundamental reading skills. Testing before September was avoided since the long summer holidays are likely to be associated with familial rather than school influences on reading.

2.2.1. T1 measures

2.2.1.1. Socio-economic status. Information about parental profession was obtained for 87% of the fathers and 86% of the mothers. Professions were coded following French official classifications (Institut National de la Statistique et des Etudes Economiques, 2012a). The proportion of children from middle or high socio-economic background is higher in our sample than in the Department, Region and Country (Institut National de la Statistique et des Etudes Economiques, 2012b). However, some schools did not return the parents' questionnaires, which ended up in 20.9% of missing data. In order to control for this in our structural equation models, we have recoded the father's profession into three categories, distinguishing: a) the two professions indicating the higher socio-economic status (executives, middle-level professions, 49.8%), b) other professions (29.2%), c) missing data. These variables were dummy coded.

2.2.1.2. Language spoken at home. Parents were asked to list the languages spoken at home. Only four families did not mention French. Since all the tested children spoke and understood French, it was not clear whether it was an omission or an indication that French was not spoken at all at home. Twenty-two families mentioned speaking French and at least another language. Three categories have therefore been created: a) families only speaking French (76.6%), b) bilingual families and families not mentioning French (4.2%), c) missing data (19.2%). Dummy variables were created and used in SEM analyses.

2.2.1.3. Letter knowledge. Pupils had to write ten letters (maximum:10; α = .67).

2.2.1.4. Rapid automatized naming (RAN). Following the Comprehensive test of phonological processing (Lennon & Slesinski, 2001), participants named five letters (O, A, U, I, E) and five digits (1, 2, 3, 4, 5), organized in ten rows of eight, as fast as possible. Familiarity with the stimuli was ensured before the test began. We scored the number of symbols correctly named, divided by the reading time (in seconds), multiplied by one hundred. Test-retest reliability is above .70 (Lennon & Slesinski, 2001). Letter and digits RAN scores were highly correlated ($r = .79, p < .001$) and averaged to create a score of alphanumeric RAN.

2.2.1.5. Phonemic awareness

2.2.1.5.1. Phoneme identification. Four phonemes were tested. For each of them, children were shown five pictures representing words. They had to select the words including a specific phoneme, pronounced aloud by the experimenter. One point was given when children correctly identified all the target words, and avoided all the distractors for a given phoneme (maximum: 4). The mean result of the four phonemes was used ($\alpha = .61$).

2.2.1.5.2. Initial phoneme elision. Children had to delete the first phoneme of a word (*e.g*: bras), read aloud by the experimenter. The newly created word had to be identified among three pictures (*e.g*: rat, pas, tas; maximum: 4; $\alpha = .48$).

The sum of the two tests of phonemic awareness was used in further analyses (combined $\alpha = 0.6$).

2.2.1.6. Vocabulary breadth. Following the Echelle de Vocabulaire en Images Peabody (Thériault-Whalen, Dunn, & Dunn, 1993), children selected a picture, among four, that best represented a word read aloud by the experimenter. Items corresponding to the children's age range were selected (maximum: 44; $\alpha = .75$).

2.2.1.7. Syntactic skills. Following the Epreuve de Compréhension Syntaxico-Sémantique (Lecocq, 1996), participants chose a picture, among four, that best represented the situation depicted in a sentence read aloud by the experimenter (maximum: 19; $\alpha = .68$).

2.2.1.8. Oral text comprehension. Children listened to four informative and narrative texts, and answered questions assessing inference-making and literal comprehension ($\alpha = .76$). The texts have been used in a previous study on reading development among French pupils from kindergarten to first grade (Bianco et al., 2012). A scoring sheet with acceptable answers for each question was established (see Appendix A).

2.2.2. T2 measures

The same tests as T1 were used for: *vocabulary breadth* (maximum: 32; $\alpha = .73$); *syntactic skills* (maximum: 17; $\alpha = .66$); oral text comprehension ($\alpha = .85$). For these three assessments, the most sensitive items used at T1 were kept at T2, and more complex items were added. For oral text comprehension, two texts were removed, the distributions of scores at T1 indicating that they might be too simple and not sensitive enough at T2. Two texts were added, requiring children to make more inferences to understand the characters' mental states, or to connect the different events mentioned in the text. So, two texts were common to T1 and T2 and two were specific.

2.2.2.1. Pseudoword and word reading. The number of pseudowords and common words (from RTI International, 2009) that children could correctly read in one minute was scored ($maximum_{pseudowords}$: 100; $\alpha_{pseudowords} = .95$; $maximum_{words}$: 110; $\alpha_{words} = .97$). The test of word reading was composed of 65 regular short words, 15 regular long words, 20 irregular short words, 10 irregular long words.

2.2.2.2. Text reading fluency. Children had to read a text aloud (Monsieur Petit) during one minute (Lequette, Pouget, & Zorman, 2008). The number of words correctly read was calculated.

2.2.2.3. Reading comprehension. Children silently read four narrative texts, and wrote their answers to questions assessing inference-making and literal comprehension ($\alpha = .91$). Reading time was limited to 3 min for the first three texts (27–28 words), and 5 min for the last one (63 words). Questions were asked orally by the experimenter. Orthography was ignored for scoring. A scoring sheet with acceptable answers for each question was established (see Appendix A).

2.3. Procedure

Testing was carried out in individual or collective sessions (see Appendix B). Individual sessions were led in a quiet room during approximately 45min. The experimenter read the instructions to the child, writing his answers on an individual booklet. During collective sessions, lasting about an hour, instructions were read to all children. Test order in each session was fixed, alternating between longer and faster tests. To better fit with classroom schedules, the order between individual and collective sessions was randomized.

3. Results

3.1. Descriptive and correlational analyses

Table 1 presents the descriptive statistics of raw scores.

Due to school holidays and organizational constraints, the T1 period lasted nine weeks. To control for this effect, we conducted a regression analysis for each test. The week number and its squared value were the independent variables, allowing to control for linear and quadratic ("U-shaped") temporal effects. Residuals were stored and used for further analysis. Correlations between raw and corrected data were all above .89 ($p < .001$).

3.94% of data points were missing, due to children's absence or mistakes in writing in the booklets. Little's (1988) MCAR test was nonsignificant (χ^2 (581) = 583.09, $p > .05$), indicating that data were missing completely at random. We used the maximum likelihood estimation to deal with missing data (Schreiber, Nora, Stage, Barlow, & King, 2006), and the so-called "robust" estimator in Mplus 6.12, which does not assume normal multivariate distributions.

Table 1. Descriptive statistics

	n	*M*	*SD*	*Skewness*	*Kurtosis*
T1					
Letter Knowledge	536	8.63	1.64	-1.84	4.03
Alphanumeric RAN	538	82.01	24.82	0.40	-0.14
Phonemic Awareness	538	5.26	1.94	-0.56	-0.41
Vocabulary Breadth	536	37.09	4.25	-1.86	5.70
Syntactic skills	539	15.65	2.55	-1.28	2.45
Oral Text Comprehension (Text 1)	547	3.99	1.46	-0.25	-0.10
Oral Text Comprehension (Text 2)	547	3.35	1.29	-0.36	-0.71
Oral Text Comprehension (Text 3)	541	3.78	1.48	-0.51	-0.30
Oral Text Comprehension (Text 4)	541	2.11	1.62	0.46	-0.56
T2					
Pseudoword reading	539	27.62	10.99	0.23	0.20
Word reading	539	37.42	15.99	0.32	-0.25
Text fluency	539	38.67	25.38	1.12	2.03
Vocabulary Breadth	528	27.99	3.27	-1.65	3.79
Syntactic skills	526	12.78	2.64	-1.00	1.19
Oral Text Comprehension (Text 1)	539	3.97	1.94	-0.42	-0.76
Oral Text Comprehension (Text 2)	539	4.42	2.28	-0.09	-0.96
Oral Text Comprehension (Text 3)	539	2.96	1.82	-0.05	-0.78
Oral Text Comprehension (Text 4)	539	4.43	1.42	-0.95	0.49
Reading comprehension (Text 1)	527	2.92	1.18	-0.95	0.06
Reading comprehension (Text 2)	527	2.88	1.32	-0.90	-0.42
Reading comprehension (Text 3)	525	3.11	1.21	-1.26	0.52
Reading comprehension (Text 4)	525	3.82	2.66	0.04	-1.29

Correlations between variables are reported in Appendix C.

Performance at the four reading comprehension texts correlated moderately or strongly with all the other language skills. The strongest correlations were noted between pseudoword, word reading and text fluency at T2.

Measures assessing the same construct at T1 and T2 (vocabulary breadth, syntactic knowledge, oral text comprehension) were moderately or strongly correlated.

At T1, alphanumeric naming speed correlated moderately with letter knowledge and phonemic awareness, as precursors of decoding skills. However, the last two skills were also correlated with vocabulary breadth and syntax.

At T2, decoding skills (pseudoword, word reading and text fluency) were strongly correlated and had weak associations with most of the oral language abilities. The four texts assessing reading comprehension were strongly correlated.

At both time points, vocabulary and syntax were strongly correlated, but both of them also showed moderate associations with oral comprehension texts. Scores at the four oral comprehension texts were moderately to strongly correlated.

The number of classrooms in our sample was not big enough to allow us to estimate SEM parameters at both the intra-group and inter-group levels. Therefore, since individual cognitive and linguistic factors were the focus of our study, we centred every child's score on the classroom's mean to remove between-classrooms variance and obtain unbiased estimates at the individual level (Cheslock & Rios-Aguilar, 2011; Heck & Thomas, 2015).

3.2. Are the predictors of reading comprehension better represented by a two-factor, or a three-factor structure, differentiating LLL skills and discourse skills?

The maximum likelihood estimation procedure was used for confirmatory factorial analyses (CFA). Model fit was assessed with the following indicators (Schreiber et al., 2006): a low and nonsignificant χ^2 value (however, a big sample size often leads to a significant value), Standardized Root Mean Square Residual (SRMR) under .08, Comparative Fit Index (CFI) above .9, Tucker-Lewis Index (TLI) above .9, Root Mean Square Error of Approximation (RMSEA) under .08, ideally .05. Correlations between factors were expected and assessed (Lepola et al., 2016; Protopapas, Simos, Sideridis, & Mouzaki, 2012; Tunmer & Chapman, 2012b). To facilitate the reading process, factors are referred to in italic.

At T1, two alternative models were compared. Model A (see Fig. 1) distinguished three factors: *decoding precursors* (RAN, letter knowledge, phonemic awareness), *lower level language skills* (vocabulary breadth and syntax), *discourse skills* (oral text comprehension). This model yielded a good fit to the data ($\chi^2(24) = 67.64$, $p < .001$; CFI = .95; TLI = .93, SRMR = .04; RMSEA = .06, 90% confidence interval [.04, .07]). *Decoding precursors* correlated strongly with *lower level language skills* (.72, $p < .001$) and moderately with *discourse skills* (.52, $p < .001$). *Lower level language skills* and *discourse skills* correlated strongly with each other (.81, $p < .001$). Model A had a significantly better fit ($\Delta \chi^2(2) = 46.6$, $p < .001$) than a model grouping *lower level language skills* and *discourse skills* in a common oral language factor (see Model B in Appendix D, $\chi^2(26) = 98.86$, $p < .001$; CFI = .92; TLI = .89, SRMR = .05; RMSEA = .07, 90% confidence interval [.06, .09]).

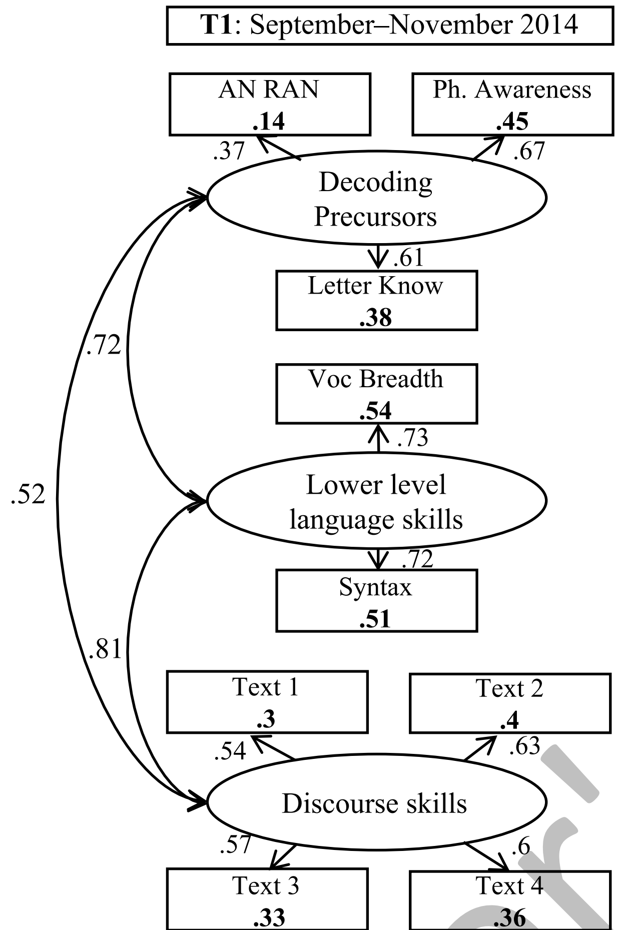

Fig. 1. Confirmatory factorial analysis with 3 factors at T1 (Model A).

Following the procedure for T1, two models were compared to assess the factorial structure of T2 variables. Model C (see Fig. 2) distinguished three factors: *decoding skills* (pseudoword, word reading and text fluency), *lower level language skills* (vocabulary breadth and syntax), *discourse skills* (oral text comprehension). This model yielded a good fit to the data ($\chi^2(24) = 41.12$, $p < .05$; CFI = .99; TLI = .99, SRMR=.03; RMSEA=.04, 90% confidence interval [.02, .05]). *Decoding skills* correlated weakly with *lower level language skills* (.28, $p < .001$) and *discourse skills* (.15, $p < .01$). *Lower level language skills* and *discourse skills* correlated strongly with each other (.73, $p < .001$). This model had significantly better fit ($\Delta\ \chi^2(2) = 48.33$, $p < .001$) than a two-factor model only dissociating *decoding skills* from *oral language skills* (see Model D in Appendix E, $\chi^2(26) = 94.67$, $p < .001$; CFI = .97; TLI = .96, SRMR = .05; RMSEA = .07, 90% confidence interval [.06, .09]).

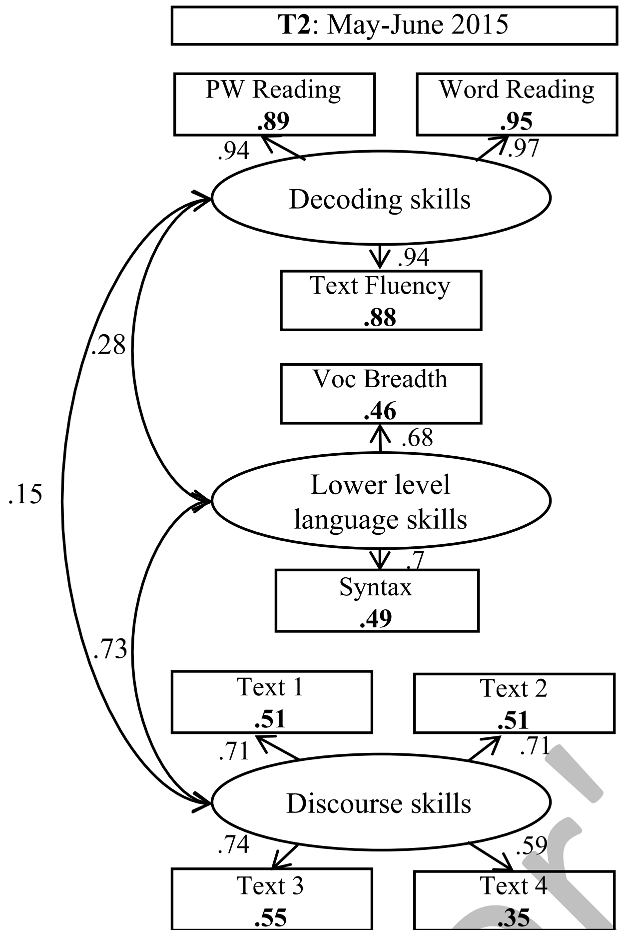

Fig. 2. Confirmatory factorial analysis with 3 factors at T2 (Model C).

3.3. How do decoding, LLL skills and discourse skills develop during first grade, and how do they predict reading comprehension?

To better understand how language skills at T1 predict reading comprehension at T2 through language skills at T2, we built structural equation models. Latent factors were created following the results of confirmatory factorial analyses. Correlations between concurrent factors were allowed. The father's socio-economic status and the language spoken at home were entered as covariates.

Our first structural model (SEM 1, Fig. 3) predicted reading comprehension at T2 by T2 *decoding skills*, T2 *lower level language skills* and T2 *discourse skills*. It assumed longitudinal independency between the three types of skills. That is to say, T2 *decoding skills* were only predicted by T1 *decoding precursors*, and T2 *lower level language skills* and *discourse skills* were predicted by their respective values at T1. This model would correspond to a "strict" interpretation of the *simple view of reading*, decoding and oral skills not influencing each other during first grade. In order to prevent estimation difficulties due to the strong interdependency between T1 and T2 *lower level language skills*, the residual variance of T2 *lower level language skills* was fixed at zero. The model yielded a good fit to the data: $\chi^2(273) = 656.05$, $p < .001$, CFI = .94, TLI = .93, SRMR = .07, RMSEA = .05, 90% confidence interval [.05, .06]. It accounted for 74% of the variance of T2 *decoding skills*, 99% of the variance of T2 *lower level language skills*, and 91% of the variance in T2 *discourse skills*. T2 *decoding skills* and T2 *lower level language skills*, but not T2 *discourse skills* predicted T2 *reading comprehension* (β = .58 and β = .46, respectively). The model explained 81% of its variance.

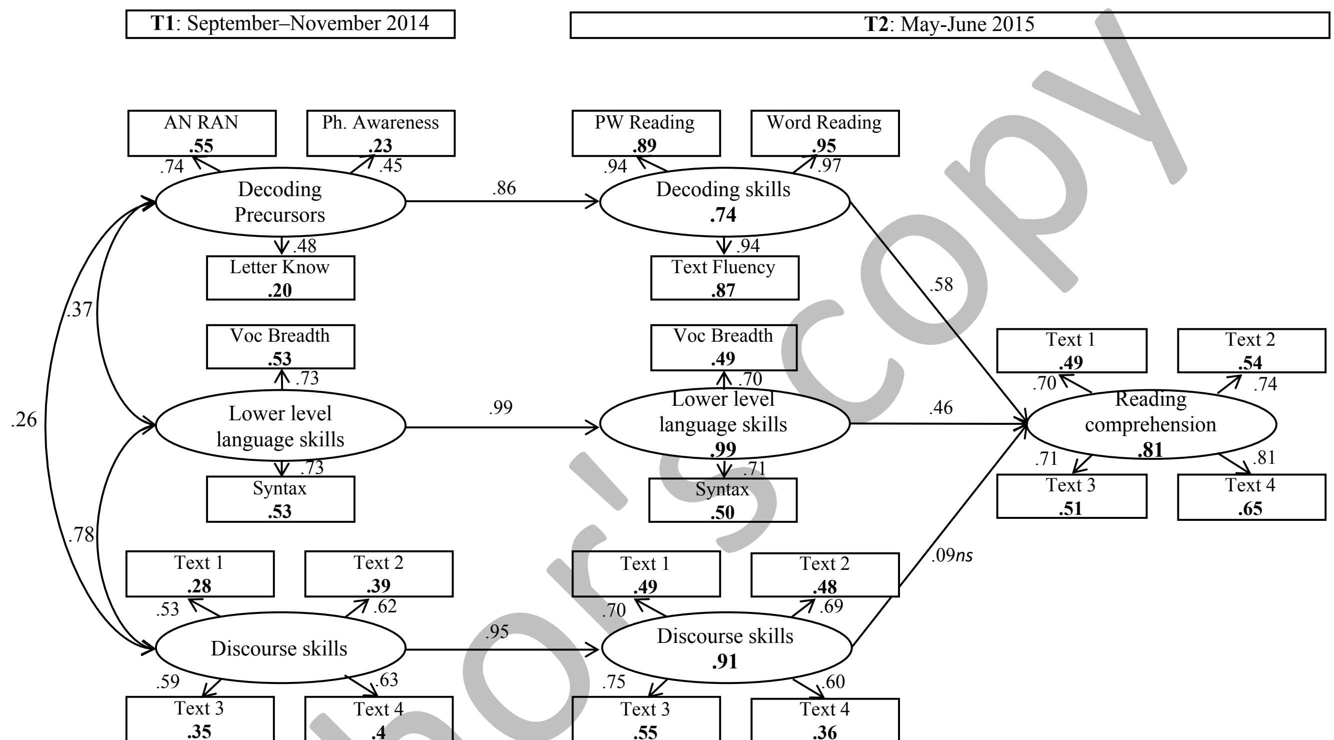

Fig. 3. SEM 1 depicting the development of reading comprehension in first grade through decoding skills, lower level language skills and discourse skills.
ns: $p > .1$. All the other paths are significant at the .001 level.

Although phonological awareness, letter knowledge, and alphanumeric naming speed strongly predicted T2 *decoding skills*, it is possible that they also directly predict T2 *reading comprehension*. That is to say, *decoding skills* might not entirely mediate the effect of *decoding precursors* on *reading comprehension*. When added, the direct path from T1 *decoding precursors* to T2 *reading comprehension* proved to be significant (β = .31; for the overall model: $\chi^2(272) = 651.26$, $p < .001$, CFI = .94, TLI = .93, SRMR = .07, RMSEA = .06, 90% confidence interval [.05, .06]; $\Delta\ \chi^2(1) = 4.79$, $p < .05$). This new model (SEM 2, see Fig. 4) accounted for 82% of the variance in reading comprehension skills, which were predicted by T2 *decoding skills* (β = .33), T1 *decoding precursors* (β = .31), T2 *LLL skills* (β = .39), and marginally by T2 *discourse skills* (β = .11). Table 2 reports the correlations between latent variables.

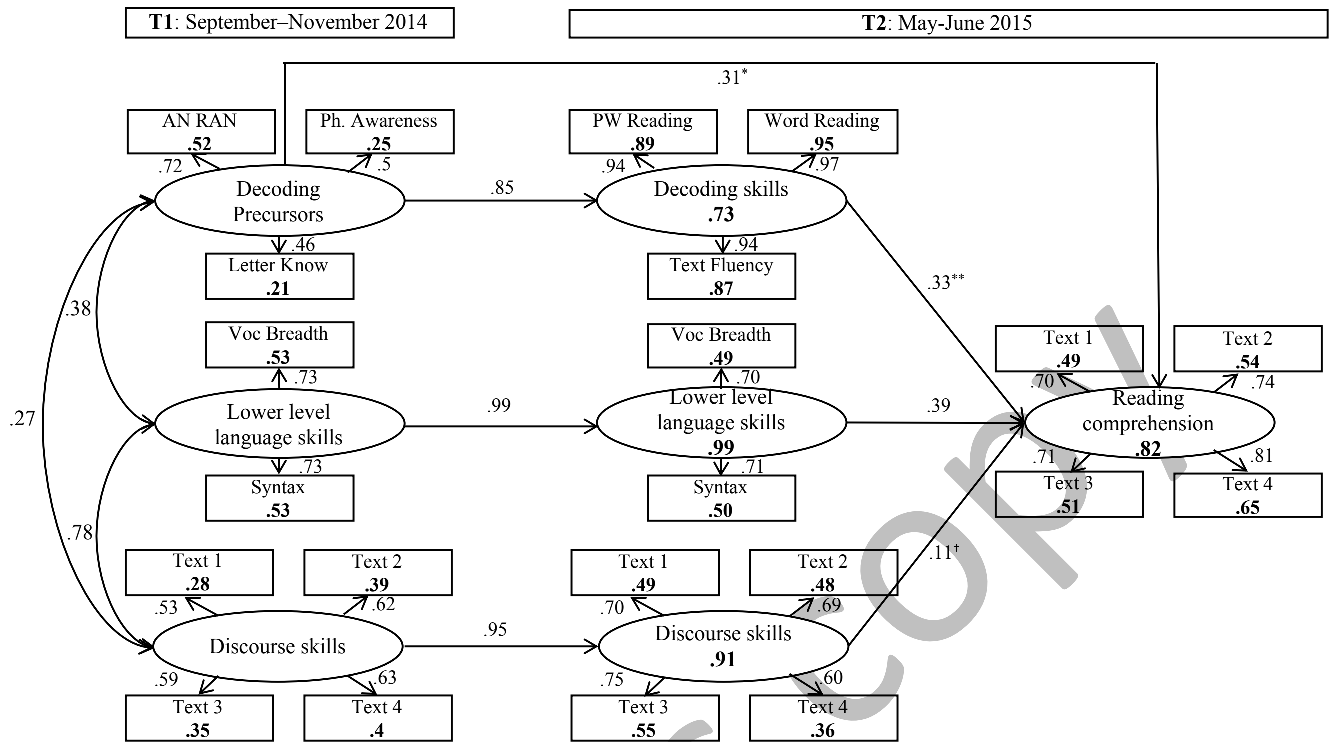

Fig. 4. SEM 2 depicting the development of reading comprehension in first grade through decoding precursors, decoding skills, lower level language skills and discourse skills.
$^{**} p < .01$; $^{*} p < .05$; $^{\dagger} p < .1$ All the other paths are significant at the .001 level.

Table 2: Correlations between latent variables (SEM 2, Fig. 4)

	2	**3**	**4**	**5**	**6**	**Reading comprehension**
1. T1 Decoding precursors	.38	.27	.85	.38	.26	.77
2. T1 Lower Level Language skills		.78	.32	.99	.74	.70
3. T1 Discourse skills			.23	.78	.95	.57
4. T2 Decoding skills				.32	.22	.75
5. T2 Lower Level Language skills					.74	.69
6. T2 Discourse skills						.55

Based on the structural equation model depicted in Fig. 4 (SEM 2), adding a direct path from T1 *LLL skills* and *T1 discourse skills* to T2 *reading comprehension* did not reach convergence.

Furthermore, theoretical and empirical work suggests that reading and oral language skills are not totally independent (Dickinson et al., 2010; NICHD Early Child Care Research Network, 2005). Specifically, T1 oral language skills could predict T2 *decoding skills*. Based on the model depicted in Fig. 4 (SEM 2), adding a prediction from T1 *LLL skills* and T1 *discourse skills* to T2 *decoding skills* resulted in no convergence. However, the high correlation between *LLL skills* and *discourse skills* could cause multicollinearity, and, therefore, convergence problems. In order to overcome this potential difficulty, an alternative model including a single oral language factor at T1 and T2 has been used to test for the effect of T1 *oral language skills* to T2 *decoding skills*. This model had lower fit indices, compared to the models with three factors ($\chi^2(279) = 806.86$, $p < .001$, CFI = .91, TLI = .90, SRMR = .07, RMSEA=.06, 90% confidence interval [.05, .06]). Furthermore, it revealed a negative prediction from T1 *oral language skills* to T2 *decoding skills*. Since the model estimation did not seem optimal, these results should be interpreted with caution (correlation coefficients greater than one were noted between T1 *decoding precursors* and T2 *decoding skills*, as well as between T1 and T2 *oral language skills*). However, they indicate that, in the present data, there was no significant and positive prediction from oral language skills to decoding skills, during the course of first grade, for French pupils. This observation is strengthened by the small correlation coefficients between T1 *oral language skills* (vocabulary breadth, syntactic skills and oral text comprehension) and T2 *decoding skills* (pseudoword and word reading, text reading fluency). These correlation coefficients were all below .25, and several of them had values close to 0.

In order to better understand our final SEM 2, further analyses have been carried out to explain the direct effect of T1 *decoding precursors* to T2 *reading comprehension*. This direct effect is in line with previous findings, showing that decoding skills do not fully mediate the impact of phonological awareness and RAN on reading comprehension (Bianco et al., 2012; Catts et al., 2015; Johnston & Kirby, 2006; Joshi & Aaron, 2000; Sénéchal & LeFevre, 2002). To assess which precursor was more likely to drive this direct effect in our study, alternative models, containing every possible combination of two precursors, have been computed. The direct effect of the T1 *decoding precursors* factor on T2 *reading comprehension*, as well as its indirect effect through T2 *decoding skills*, have been calculated for each model. Fit indices, direct and indirect effects are reported in Table 3. We can note that, for every combination of precursors, there was an indirect effect from T1 *decoding precursors* to T2 *reading comprehension*, through T2 *decoding skills*. However, the direct effect from T1 *decoding precursors* to T2 *reading comprehension* only held when phonemic awareness and letter knowledge were both included in the latent variable. Furthermore, when these two precursors were included, without RAN, there was a weaker prediction from T1 *decoding precursors* to T2 *decoding skills* (β = .49), compared to the model with RAN and letter knowledge (β = .9), RAN and phonemic awareness (β = .91) or the three precursors (β = .85). To sum up, computing these alternative models gave two indications. First, the unique combination of phonemic awareness and letter knowledge seemed to explain the direct effect from T1 *decoding precursors* to T2 *reading comprehension*. Secondly, the inclusion of RAN in the *decoding precursor* factor strengthened the prediction of T2 *decoding skills*.

Finally, the effect of each precursor has been assessed by calculating the total effect in the alternative model removing this precursor, and subtracting it from the model including all three precursors. Following this procedure, the following unique effects could be estimated: .06 for RAN, .04 for phonemic awareness, .01 for letter knowledge. It should be noted that these estimations involve a change in the factorial structure of our models, which prevent a direct comparison with the full SEM 2. Furthermore, latent variables, by definition, extract the variance that is common between precursors. The shared variance between the three decoding precursors seemed to be the strongest predictor of decoding and reading comprehension skills. The sum of its direct and indirect effects on reading comprehension reached .59.

Table 3: Direct and indirect effects of *T1 decoding precursors* on T2 *reading comprehension*, depending on the precursors taken into account.

Precursors	***Df***	χ^2	**CFI**	**TLI**	**RMSEA**	**SRMR**	**Direct effect**	**Indirect effect**
1. RAN, PA, LK	272	651.26	.94	.93	.06	.07	$.31^{*}$	$.28^{**}$
2. RAN, LK	248	534.63	.95	.94	.05	.06	$.15_{ns}$	$.41^{**}$
3. PA, LK	248	470.18	.96	.95	.04	.05	$.31^{***}$	$.23^{***}$
4. PA, RAN	248	553.73	.95	.94	.05	.06	$.24_{ns}$	$.35^{*}$

RAN: Rapid Automatized naming; PA: Phonemic Awareness; LK: Letter Knowledge
$^{***}p < .001$; $^{**}p < .001$; $^{*}p < .05$

4. Discussion

This study aimed at better understanding the development of reading comprehension in French first grade pupils, providing comparisons with prevalent English-speaking samples. First, we aimed to assess the factorial structure of the *simple view of reading* components, specifically the dimensionality of oral language skills. Secondly, we investigated the longitudinal development of, and the interdependency between decoding, LLL and discourse skills. Finally, we assessed the extent to which each of these three factors predicted reading compre- hension, and whether decoding precursors had an effect above their contribution to decoding skills.

4.1. Are the predictors of reading comprehension better represented by a two-factor, or a three-factor structure, differentiating LLL skills and discourse skills?

Confirmatory factorial analyses have confirmed our hypotheses 1.a) and 1.b), showing that a three-factor structure better fitted the data than a two-factor structure, both at the beginning and at the end of first grade.

At T1, a *decoding precursors* factor was composed of phonemic awareness, letter knowledge, and RAN, three core skills favouring the development of word reading (Caravolas et al., 2013). It should be noted that RAN's factor loading was lower (.37) than the loadings for phonemic awareness (.67) and letter knowledge (.61). Moderate or small correlations between RAN and phonological awareness have been reported on English samples (Caravolas et al., 2012; Catts et al., 2015; Georgiou et al., 2013; Plaza & Cohen, 2003). This might be because RAN can assess the fast access to phonological and orthographic representations, but also more fundamental neurological processing, or attentional skills (Catts et al., 2015; Foulin, 2005; Georgiou et al., 2013; Kirby & Savage, 2008). However, contrary to other studies (Catts et al., 2015; Georgiou et al., 2013) we have focused on alphanumeric RAN, to assess the fast access to symbolic representations (letter and digits). This is because we wanted to select measures as close as possible to reading processes (in comparison with RAN of objects and colours). At the beginning of first grade, since children are expected to have a good knowledge of the alphabet, taking into account the speed of access to letter representations, beyond accuracy, seems to better discriminate children and tap into the complex processes involved in reading (in our sample, the mean score for letter knowledge was 8.63 out of 10). This, along with the complex interactions between letter knowledge, phonological awareness and RAN during the development of word reading (Foulin, 2005; Hulme & Snowling, 2014), justifies their association in a common factor.

At T2, *decoding skills* grouped pseudoword reading, word reading and text reading fluency. Factor loadings were especially high (all above .9). This could be explained by the speed component of the three measures. However, different reading processes might be involved: beyond grapheme-to-phoneme correspondences, word reading assesses knowledge of irregular words. Beyond word reading, text reading fluency requires the integration of words into sentences. However, in our sample, the means for word reading and text fluency were really close to each other (M = 37.42 and M = 38.67 respectively). We might therefore wonder whether children were reading the text word by word, without relying on a broader integration of meaning that could involve oral comprehension skills (Bianco et al., 2013).

One main interest of the study was to investigate the structure of oral language skills (vocabulary, syntactic knowledge and oral text comprehension). Our confirmatory factorial analyses showed a dis- tinction between *lower level language skills* (vocabulary, grammar) and *discourse skills* (oral text comprehension). However, these two factors were highly correlated (.81 at T1, .73 at T2). This is in line with Justice et al. (2015)'s results on English first grade students, showing an emergent dimensionality of language, potentially due to children's literacy experiences and progressive confrontation to complex texts. However, to confirm this explanation, classroom observations, and especially comparisons of pedagogical materials over the school year would be necessary. Alternatively, the two oral language factors could be hierarchically organized, and represent different levels of text integration when a reader tries to understand a text. According to Kim (2017), vocabulary and grammatical knowledge are necessary to extract initial propositions, or idea units, from a text. However, these skills would not be sufficient to integrate propositions across the entire text, and to associate them with personal background knowledge in the process of inference-making. Note that Protopapas et al. (2012), testing Grade 3 to Grade 5 Greek-speaking pupils, reported a single-factor structure of oral language skills. This factor was composed of: oral text comprehension, receptive, expressive vocabulary, and the capacity to answer verbal instructions (a measure likely to involve the understanding of short sentences, implicitly assessing syntactic knowledge). Crucially, the two-factor structure tested by the authors grouped the test of verbal instructions with oral text comprehension and not vocabulary.

Concurrent correlations between code-related skills (*decoding precursors* at T1, *decoding skills* at T2) and our two oral language factors were stronger at T1 than at T2. According to the *Lexical Quality Hypothesis* (Perfetti & Stafura, 2014), there are complex and mutually reinforced relationships between phonological, semantic, syntactical and orthographic representations stored in the lexicon. These relationships might be more salient when subcomponents of word reading (phonological awareness, RAN, letter knowledge) are taken into account. For example, Tunmer and Chapman (2012a) suggest that vocabulary breadth and phonological awareness both impact the capacity to try alternative pronunciations of words and to find the correct one.

Crucially, our study is the first longitudinal SEM study on a French sample assessing the respective contributions of lower level language skills, discourse skills and code-related skills in predicting reading comprehension.

4.2. How do decoding, LLL skills and discourse skills develop during first grade?

First, in line with our hypothesis 2. a), there was a very strong longitudinal stability for *LLL skills* and *discourse skills*. Although the same assessment tools were used at both time points, items were carefully selected to track the development of language skills. The most sensitive items used at T1 were kept at T2, and more complex items were added. It is therefore possible that school instruction in first grade principally targets word and text reading, and put less emphasis on oral language development. Observations of literacy instruction in the classroom would help to shed light on this issue (Goigoux, 2016).

Confirming our hypothesis 2. b), and results from the literature (Catts et al., 2015; Hulme & Snowling, 2014), T1 *decoding precursors* strongly predicted T2 *decoding skills*, explaining 75% of their variance (β = .85). Note the strong predictive power, compared to Moll et al. (2014) and Ziegler et al. (2010).

In the process of evaluating the interdependency of the *simple view of reading* components, our models did not reveal a significant longitudinal prediction from T1 *LLL skills* and T1 *discourse skills* to T2 *decoding skills*. Hence, our hypothesis 2.c) was not confirmed. This result should be interpreted with caution, since the model's estimation did not seem optimal. It should also be considered in light of the specific population and measures used in this study. Although complex interactions between semantic, syntactic, morphological and phonological representations exist in the mental lexicon, vocabulary might be the main oral language variable influencing the development of pseudo-word and word reading (Ouellette, 2006). According to the *Lexical Restructuring Model* (Walley, Metsala, & Garlock, 2003), vocabulary breadth, and the age at which children learn words meaning, determine how fine-grained their phonological representations are. Furthermore, Nation and Cocksey (2009), suggest that measures of vocabulary breadth assess semantic but also phonological representations. Longitudinal models on 5 to 9 years-old have also shown that vocabulary breadth and phonological awareness, but not syntactic awareness, impacted the capacity to try alternative pronunciations of words and to find the correct one. This capacity predicts pseudoword and word reading skills two years later (Tunmer & Chapman, 2012a). Note that Storch and Whitehurst (2002), who have reported concurrent relationships and indirect effects from oral language skills to code-related and reading skills, have mostly assessed oral language by vocabulary or measures requiring understanding at the word level.

4.3. What is the contribution of decoding, LLL skills and discourse skills in predicting reading comprehension?

In line with our hypotheses 3. a) and 3. b), reading comprehension at the end of first grade was predicted by T1 *decoding precursors* (β = .31), T2 *decoding skills* (β = .33), T2 *LLL skills* (β = .39), but only marginally by T2 *discourse skills* (β = .11). We can note the similar magnitude of the coefficients for decoding and lower level language skills.

SEM on English-speaking children principally distinguished two factors to assess the *simple view of reading*: decoding, and oral language skills. Studies report a higher prediction of reading comprehension by decoding skills in Grade 2 (Kim, 2017), 3 and 4 (Storch & Whitehurst, 2002), or an equivalent prediction by the two factors (Tunmer & Chapman, 2012b). An exception is Kendeou et al. (2009), reporting that Grade 2 listening comprehension was a stronger predictor of concurrent reading comprehension than word reading. However, the use of a composite measure for decoding skills, instead of a single one, could have led to different results. Crucially, Lepola et al. (2016)'s study on Grade 3 Finish-speaking pupils reveals a stronger prediction of reading comprehension by oral language comprehension skills, compared to reading fluency. Megherbi et al. (2006) suggested that the same phenomenon would occur among French first grade pupils, since French is a more transparent orthography than English. However, this author used a single measure for each component of the *simple view of reading*, pseudoword reading being retained to assess decoding skills. We can assume that our composite measure, including pseudoword, as well as word reading and text fluency explains more variance in reading comprehension outcomes because it better takes into account the diversity of processes involved in reading, especially the mastery of irregular words.

With the exception of Kim (2017), the aforementioned models don't assess the separate contribution of LLL and discourse skills. Instead, they select and mix measures corresponding to one, or both constructs and include them in a broad oral language factor. Our results suggest that differentiating LLL and discourse skills would help to better understand the language processes involved in reading comprehension over the course of reading development. In our sample, both factors played a role in explaining reading comprehension outcomes, although the effect of T2 *discourse skills* was only marginal. As suggested by Kim (2017), vocabulary and grammatical knowledge may act as foundational language skills, allowing the reader to extract words and sentences meaning, and to understand initial propositions. In first grade, these skills might be especially important to start understanding texts. However, building a complete situation model might require, over the course of development, a broader and more complex range of skills, such as inference-making, theory of mind, or comprehension monitoring (Cain et al. 2004; Kim, 2017; Oakhill et al., 2003). In our study, these processes are likely to be encompassed in the assessment of oral text comprehension. Over the course of reading instruction, it is likely that discourse skills will play a greater role in reading comprehension, children building situation models of increasing complexity. Contrary to the full mediation reported by Kim (2017), our models identify vocabulary and syntax as unique predictors of reading comprehension, even after taking into account oral text comprehension. Kim (2017)'s results could be due to the fact that they have tested Grade 2 pupils, and to their heterogeneous listening comprehension measures. In particular, one test required pupils to "point to one of four pictures that corresponded to [...] heard sentences" p.10. This corresponds to measures of syntactic knowledge in other studies (Bianco et al., 2012; Silva & Cain, 2015) and could have confounded the effect of grammatical knowledge with their measure of listening comprehension.

Finally, confirming our Hypothesis 3.b, T1 *decoding precursors* directly predicted T2 reading comprehension above their contribution to T2 *decoding skills*.

Results from the literature suggest that this effect might be due to RAN, or phonemic awareness. Using longitudinal SEM, Catts et al. (2015) also reported a direct effect from kindergarten measures of RAN (but not letter knowledge, or phonological awareness), to Grade 3 reading comprehension, above their contribution to Grade 2 word reading. If, as the authors suggest, RAN measures broader attentional skills, it could favour performance at reading tests as well as a general involvement in school tasks. Furthermore, Georgiou et al. (2013) have shown that RAN, measured in kindergarten, significantly predicted reading fluency at first grade, but 43% of its predictive variance was shared with measures of speed of processing, and 19% with a measure of verbal short-term memory. It was therefore suggested that RAN could act as a proxy for general cognitive skills, such as attentional resources, speed of processing or working memory, beyond the fast retrieval of phonological and orthographical representations. Additional analyses carried out on our sample don't support this interpretation. Indeed, the direct effect from T1 *decoding precursors* to T2 *reading comprehension* seemed to be driven by the specific combination of phonemic awareness and letter knowledge.

This is in line with another set of studies showing, using regression analyses, a unique effect of phonological awareness on reading comprehension, after accounting for listening comprehension and word reading (Bianco et al., 2012; Johnston & Kirby, 2006; Sénéchal & LeFevre, 2002), or listening comprehension and pseudoword reading (Johnston & Kirby, 2006). Phonological awareness seems to have complex relationships with morphological, semantic and syntactic representations stored in the mental lexicon (Perfetti & Stafura, 2014). Since our model includes vocabulary and syntactic measures at T2, we might wonder whether the unique effect of phonemic awareness, in combination with letter knowledge, is related to morphological processes. Generally speaking, our results highlight the need to carefully select code-related variables in models of reading comprehension development. Indeed, if pseudoword or word reading are likely to be the main measures used among children who have passed the first steps of reading instruction, they might not entirely subsume the effect of early-developed skills such as phonological awareness and letter knowledge.

In the process of unpacking the components of the simple view of reading, it is worth keeping in mind some limitations of our study. First, our evaluation of oral language skills has not included components such as morphological awareness (Gottardo, Mirza, Koh, Ferreira, & Javier, 2017). Inference-making and literal comprehension are expected to play a role in the understanding of oral texts, but have not been formally assessed. This prevents a fine-grained understanding of the cognitive processes involved in oral comprehension, and of the complex interactions between oral language skills (Kim, 2017). In order to enhance the practical impact of our research, and to better infer causal relationships, interventions, in line with Bianco et al. (2012), but tapping the two oral language components, could be investigated (Snowling & Hulme, 2011). In particular, a recent report has pointed out weaknesses in reading comprehension training in the French educational system (Jeantheau et al., 2016). Teaching practices influencing reading comprehension should therefore be carefully studied (Bressoux et al., 2016), in light of their impact on LLL skills, discourse skills and/ or decoding skills.

5. Conclusion

To sum up, our study brings new insight into the development of reading comprehension in first grade. First, applying structural equation modeling on a French sample, we have replicated English findings showing a dissociation between Lower Level Language skills (vocabulary, syntax) and discourse skills (oral text comprehension; Justice et al., 2015). Secondly, we have shown that LLL skills significantly, and discourse skills marginally predicted reading comprehension outcomes during the year of first grade, above code-related skills. Finally, we have been able to understand in a more refined way the components and longitudinal development of decoding skills during the first year of reading instruction. In particular, decoding precursors have been shown to predict pseudoword, word reading and text fluency, but also to directly predict reading comprehension outcomes. Our results could be supplemented with studies investigating the impact of teaching practices on LLL skills, discourse skills and code-related abilities.

Acknowledgments

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Appendix A: Assessment tools used for the oral and reading comprehension measures

Oral text comprehension

La tortue égarée

Cette nuit, la porte du jardin était restée ouverte et la petite tortue s'est sauvée. Alors ce matin, Sophie est partie à sa recherche. Elle appelle: « Marguerite ! Marguerite ! », mais Marguerite est introuvable. Sophie est prête à pleurer quand elle aperçoit son voisin. Elle s'arrête et l'interroge: « Bonjour, Monsieur, vous n'avez pas vu ma petite tortue ? » « Mais oui dit-il ! Je me demandais bien d'où elle venait ! Je l'ai trouvée tout à l'heure près des rosiers et je l'ai rentrée dans la maison. Viens, je vais te la donner ». Sophie est très heureuse d'avoir retrouvé si vite Marguerite.

1) Qui est Marguerite ? (1 point: la tortue/la petite tortue)
2) Pourquoi s'est-elle sauvée ? (1 point: car le portail/la porte/la porte du jardin était ouvert(e))
3) Que fait Sophie quand elle s'aperçoit que la tortue s'est sauvée? (1 point: elle part à sa cherche/elle l'appelle/elle dit ou crie: « Marguerite »)
4) Qui a trouvé la tortue ? (1 point: le voisin/le Monsieur)
5) Où le voisin l'a-t-il trouvée ? (1 point: près des rosiers/dans les roses/dans les fleurs)
6) Qu'a-t-il fait de la tortue ? (1 point: il l'a rentrée/il l'a ramenée dans la maison/il l'a ramenée chez lui)

The lost turtle

Last night, the garden gate was left open, and the little turtle ran away. So this morning, Sophie has gone to look for her. She calls, "Marguerite! Marguerite!", but Marguerite is nowhere to be found. Sophie is about to cry when she comes across her neighbour. She stops and says to him, "Good morning Sir, have you seen my little turtle?". "Oh, yes!" He answers. "I was wondering where she came from! I found her a bit earlier near the rose bushes and took her back to the house. Come with me, I will give her back to you". Sophie is so happy to have found Marguerite so quickly.

1) Who is Marguerite? (1 point: the turtle/the little turtle)
2) Why did she run away? (1 point: because the door/the door of the garden/the garden gate was open)
3) What does Sophie do when she realises that the turtle has run away? (1 point: she looks for her/she calls her/she says or shouts "Marguerite ! ")
4) Who found the turtle? (1 point: the neighbour/the gentleman)
5) Where did the neighbour find her? (1 point: near the rose bushes/in the roses/in the flowers)
6) What did he do with the turtle? (1 point: he took her back to his home/he took her back to the house/he brought her inside)

Reading comprehension

Le pêcheur

Anne et Jean cherchaient des têtards. Soudain, ils ont entendu un grand plouf. Un pêcheur était tombé dans le lac. Il ne pouvait pas nager car il s'était blessé. Les enfants ont essayé de le tirer vers le bord mais il était trop lourd. Alors, Anne a tenu la tête de l'homme hors de l'eau pendant que Jean a couru chercher de l'aide.

1) Que faisaient Jean et Anne près du lac ? (1 point: ils cherchaient des têtards)
2) Quel bruit ont-ils entendu ? (1 point: un (grand) plouf)
3) Pourquoi Jean et Anne ont-ils entendu un grand plouf ? (1 point: un pêcheur est tombé dans le lac/dans l'eau)
4) Pourquoi le pêcheur ne peut-il pas nager ? (1 point: il s'était blessé)
5) Qu'essayent de faire les enfants ? (1 point: ils essayent de le tirer vers le bord)
6) Pourquoi sont-ils incapables de tirer le pêcheur vers le bord ? (1 point: il est trop lourd)
7) Comment Anne aide-t-elle le pêcheur ? (1 point: elle tient sa tête hors de l'eau)
8) Comment Jean l'aide-t-il ? (1 point: il court/va chercher de l'aide)

The fisherman

Anne and Jean were looking for tadpoles. Suddenly, they heard a big "Splash!" A fisherman had fallen into the lake. He could not swim because he was injured. The children tried to pull him up onto the bank, but he was too heavy. So Anne held the fisherman's head above the water, while Jean ran to look for help.

1) What were Jean and Anne doing near the lake? (1 point: they were looking for tadpoles)
2) What sound did they hear? (1 point: a big "splash!")
3) Why did Jean and Anne hear a big "splash!"? (1 point: a fishman fell into the lake/into the water)
4) Why can't the fisherman swim? (1 point: he got injured)
5) What do the children try to do? (1 point: to pull him on the bank)
6) Why can't they pull the fisherman on the bank ? (1 point: because he is too heavy)
7) How does Anne help the fisherman? (1 point: she is holding his head outside of water)
8) How does Jean help the fisherman? (1 point: he runs/goes to look for help)

Appendix B: Experimental sessions

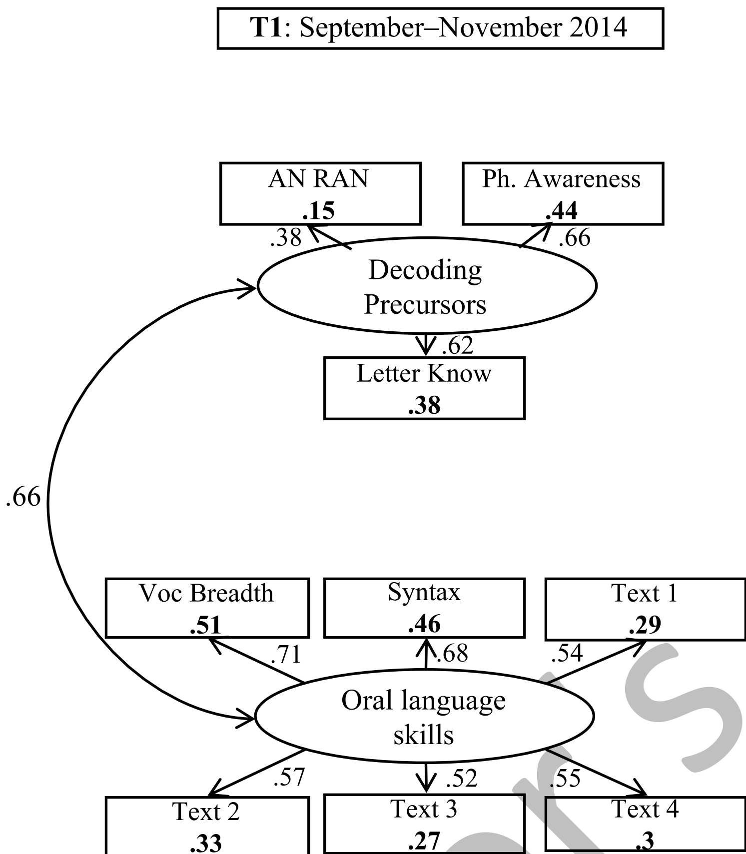
	T1	T2
Individual 1	Oral comprehension (2 texts)	Word reading Pseudoword reading Text reading fluency Oral comprehension
Individual 2	Alphanumeric RAN Oral comprehension (2 texts)	
Collective 1	Vocabulary breadth Letter knowledge	Vocabulary breadth Reading comprehension (2 texts)
Collective 2	Phoneme identification Initial phoneme elision Syntactic skills	Syntactic skills Reading comprehension (2 texts)

Individual sessions were carried out few days apart.
Collective sessions were led the same day.

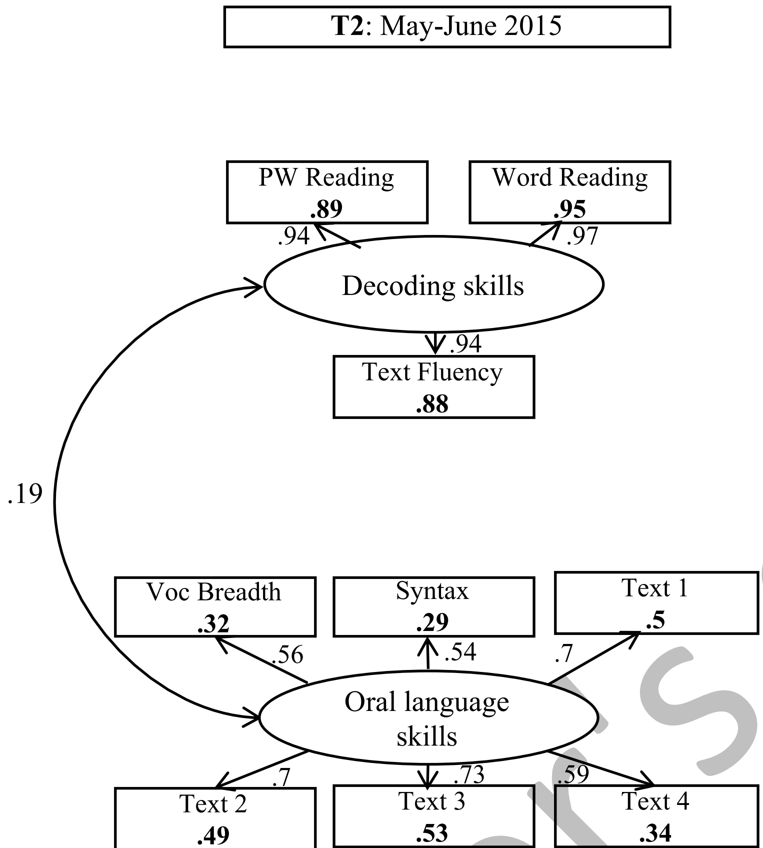
Appendix C: Correlations between all the variables

Variable	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
T1																						
1. Age	.07	.06	.06	.07	-.05	.04	.04	-.06	.01	.01	.02	.01	.06	.01	.02	-.01	.03	-.01	.09	.06	.06	.04
2. Letter Knowledge		.27	.37	.35	.33	.28	.23	.15	.15	.31	.34	.33	.33	.33	.27	.22	.15	.21	.37	.37	.37	.37
3. Alphanumeric RAN			.29	.06	.17	.1	.09	-.01	.1	.64	.65	.65	.1	.16	.11	.04	.06	.05	.35	.28	.31	.47
4. Phonemic awareness				.33	.4	.22	.24	.17	.19	.34	.37	.38	.32	.36	.2	.16	.21	.18	.39	.4	.38	.46
5. Vocabulary Breath					.53	.36	.39	.34	.37	.06	.08	.1	.59	.46	.43	.41	.41	.35	.3	.31	.32	.3
6. Syntactic skills						.37	.29	.32	.33	.25	.25	.25	.47	.56	.35	.38	.36	.37	.34	.4	.42	.46
7. Oral text comp. (Txt 1)							.35	.29	.25	.21	.22	.21	.36	.39	.34	.37	.32	.34	.32	.34	.29	.29
8. Oral text comp. (Txt 2)								.36	.41	.17	.18	.17	.29	.36	.44	.38	.44	.36	.3	.32	.28	.29
9. Oral text comp. (Txt 3)									.38	.02	.05	.05	.35	.37	.39	.38	.4	.41	.22	.3	.19	.21
10. Oral text comp. (Txt 4)										.15	.16	.16	.33	.29	.38	.42	.57	.34	.26	.31	.24	.3
T2																						
11. Pseudoword reading											.92	.88	.11	.23	.13	.12	.07	.02	.45	.45	.47	.63
12. Word reading												.91	.13	.26	.15	.12	.09	.05	.47	.47	.5	.64
13. Text Reading Fluency													.12	.27	.18	.15	.09	.05	.42	.43	.44	.62
14. Vocabulary Breadth														.48	.37	.35	.38	.33	.35	.36	.31	.3
15. Syntactic skills															.33	.37	.34	.32	.42	.38	.38	.45
16. Oral text comp. (Txt 1)																.51	.53	.41	.36	.34	.25	.32
17. Oral text comp. (Txt 2)																	.53	.4	.33	.29	.25	.24
18. Oral text comp. (Txt 3)																		.45	.29	.27	.24	.23
19. Oral text comp. (Txt 4)																			.2	.21	.22	.2
20. Reading comp. (Txt 1)																				.57	.49	.52
21. Reading comp. (Txt 2)																					.59	.56
22. Reading comp. (Txt 3)																						.55
23. Reading comp. (Txt 4)																						

Appendix D: Confirmatory factorial analysis with 2 factors at T1 (Model B)



Appendix E: Confirmatory factorial analysis with 2 factors at T2 (Model D)



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