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► To cite this version:

Jessica Massonnié, Maryse Bianco, Laurent Lima, Pascal Bressoux. Longitudinal predictors of reading comprehension in French at first grade: Unpacking the oral comprehension component of the simple view. *Learning and Instruction*, 2018, 10.1016/j.learninstruc.2018.01.005 . hal-01858185

HAL Id: hal-01858185

<https://hal.science/hal-01858185>

Submitted on 22 Oct 2021

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

Jessica Massonnié^{a, 1*}, Maryse Bianco^a, Laurent Lima^a, Pascal Bressoux^a

^a Laboratoire des Sciences de l'Éducation, Université Grenoble Alpes. CS 40700, 38 058 Grenoble Cedex 9, FRANCE

¹ Present address: Centre for Brain and Cognitive Development, British Medical Association Building, Birkbeck University of London, WC1E7HX, London, UNITED KINGDOM.

jessica.massonnie@gmail.com; maryse.bianco@univ-grenoble-alpes.fr; laurent.lima@univ-grenoble-alpes.fr; pascal.bressoux@univ-grenoble-alpes.fr

* Corresponding author.

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.

Keywords: reading development, reading comprehension, elementary school, simple view, structural modeling

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* (SVR¹) 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 Finnish 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.

¹ List of abbreviations. SVR: Simple View of Reading; SEM: Structural Equation Model; RAN: Rapid Automated 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 *et al.*, 2001; Ehri, 2005; 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 & 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, Pellenq, Lambert, Bressoux, Lima & Doyen, 2012; Gentaz *et al.*, 2013) studies vary in their use of pseudoword, word, accuracy and fluency measures, which makes comparisons difficult. Florit & 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; Observatoire national de la lecture, 1998). 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 & 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, & 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 models (SEM), combining factorial

analysis (to create composite measures of decoding skills), and regression analysis, to predict reading comprehension, have not been applied to French pupils. This prevents a direct comparison with studies on English-speaking students (Kendeou, Van den Broek, *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 independent 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; Johnston & Kirby, 2006; Joshi & Aaron, 2000 for RAN; but see Catts, Herrera, Nielsen, & Bridges, 2015 for a 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 information 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 representations². Moreover, Silva & 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, 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; Tunmer & Chapman, 2012a). 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 SEM 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

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

(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 prekindergarten oral language skills to kindergarten decoding skills. Using different measures, Storch & 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 & 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-Rhône 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; $M = 6$; $SD = 0.34$).

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

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 SEM 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.

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.

Letter Knowledge. Pupils had to write ten letters (maximum:10; $\alpha = .67$).

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.

Phonemic Awareness.

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 ($\alpha = .61$).

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 was used in further analyses (combined $\alpha = 0.6$).

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; $\alpha = .75$).

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; $\alpha = .68$).

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.

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 ($\text{maximum}_{\text{pseudowords}}: 100; \alpha_{\text{pseudowords}} = .95; \text{maximum}_{\text{words}}: 110; \alpha_{\text{words}} = .97$). The test of word reading is composed of 65 regular short words, 15 regular long words, 20 irregular short words, 10 irregular long words.

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.

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 minutes for the first three texts (27-28 words), and 5 minutes 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 45 minutes. The experimenter read the instructions to the child, writing his answers on an individual booklet. During collective sessions, lasting about one 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 0.89 ($p < 0.001$).

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 ($\chi^2(581) = 583.09, p > 0.05$), 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.

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.

Table 1. Descriptive statistics

| | <i>n</i> | <i>M</i> | <i>SD</i> | <i>Skewness</i> | <i>Kurtosis</i> |
|----------------------------------|----------|----------|-----------|-----------------|-----------------|
| <i>T1</i> | | | | | |
| Letter Knowledge | 536 | 8.63 | 1.64 | -1.84 | 4.03 |
| Alphanumeric RAN | 538 | 82.01 | 24.82 | .395 | -.135 |
| Phonemic Awareness | 538 | 5.26 | 1.94 | -.56 | -.41 |
| Vocabulary Breadth | 536 | 37.09 | 4.25 | -1.86 | 5.7 |
| Syntactic skills | 539 | 15.65 | 2.55 | -1.28 | 2.45 |
| Oral Text Comprehension (Text 1) | 547 | 3.99 | 1.46 | -.25 | -.1 |
| Oral Text Comprehension (Text 2) | 547 | 3.35 | 1.29 | -.36 | -.71 |
| Oral Text Comprehension (Text 3) | 541 | 3.78 | 1.48 | -.51 | -.3 |
| Oral Text Comprehension (Text 4) | 541 | 2.11 | 1.62 | .46 | -.56 |
| <i>T2</i> | | | | | |
| Pseudoword reading | 539 | 27.62 | 10.99 | .232 | .195 |
| Word reading | 539 | 37.42 | 15.99 | .322 | -.245 |
| 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 | 1.188 |
| Oral Text Comprehension (Text 1) | 539 | 3.97 | 1.94 | -.421 | -.761 |
| Oral Text Comprehension (Text 2) | 539 | 4.42 | 2.28 | -.094 | -.96 |
| Oral Text Comprehension (Text 3) | 539 | 2.96 | 1.82 | -.047 | -.78 |
| Oral Text Comprehension (Text 4) | 539 | 4.43 | 1.42 | -.946 | .49 |
| Reading comprehension (Text 1) | 527 | 2.92 | 1.18 | -.95 | .06 |
| Reading comprehension (Text 1) | 527 | 2.88 | 1.32 | -.9 | -.42 |
| Reading comprehension (Text 1) | 525 | 3.11 | 1.21 | -1.26 | .515 |
| Reading comprehension (Text 1) | 525 | 3.82 | 2.66 | .035 | -1.29 |

The number of classrooms in our sample is 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 are 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 *Figure 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]).

Following the procedure for T1, two models were compared to assess the factorial structure of T2 variables. Model C (see *Figure 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, $p < .001$). *Lower level language skills* and *discourse skills* correlated strongly with each other (.73, $p < 0.001$). 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]).

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 Model 1, *Figure 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*, reading 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* ($\beta = .58$ and $\beta = .46$, respectively). The model explained 81% of its variance.

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 ($\beta = .31$; for the overall model: $\chi^2(272) = 651.26, p < .0001, CFI = .94, TLI = .93, SRMR = .07, RMSEA = .06$, 90% confidence interval [.05, .06]; $\Delta\chi^2(1) = 4.79, p < 0.05$). This new model (Model 2, see *Figure 4*) accounted for 82% of the variance in reading comprehension skills, which were predicted by T2 *decoding skills* ($\beta = .33$), T1 *decoding precursors* ($\beta = .31$), T2 *LLL skills* ($\beta = .39$), and marginally by T2 *discourse skills* ($\beta = .11$). Table 2 reports the correlations between latent variables.

Table 2: Correlations between latent variables in the SEM Model 2 (*Figure 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 Model 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 Model 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 ($\chi^2(279) = 806.86, p < .0001, CFI = .91, TLI = .90, SRMR = .07, RMSEA = .06, 90\%$ 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 inferior to .25, and several of them had values close to 0.

In order to better understand our final Model 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 is 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.

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 Automated naming; PA: Phonemic Awareness; LK: Letter Knowledge

*** $p < .001$; ** $p < .001$; * $p < .05$

We can note that, for every combination of precursors, there is 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 holds when phonemic awareness and letter knowledge are both included in the latent variable. Furthermore, when these two precursors are included, without RAN, we note a less strong prediction from T1 *decoding precursors* to T2 *decoding skills* ($\beta = .49$), compared to the model with RAN and letter knowledge ($\beta = .9$), RAN and phonemic awareness ($\beta = .91$) or the three precursors ($\beta = .85$). To sum up, computing these alternative models gives 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 strengthens 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 SEM models, which prevent a direct comparison with the full Model 2. Furthermore, latent variables, by definition, extract the variance that is common between the precursors. The shared variance between the three decoding precursors seems to be the strongest predictor of decoding and reading comprehension skills. The sum of its direct and indirect effects on reading comprehension reaches .59.

4. Discussion

This study aims 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 interdependency between decoding, LLL and discourse skills. Finally, we assessed the extent to which each of these three factors predicted reading comprehension, 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 the complex processes involved in reading (in our sample, the mean 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, Joët, Lima, Nardi, Colé & Megherbi, 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 distinction 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 hypothesis, classroom observations, and especially comparisons of pedagogical materials over the school year would be necessary. Alternatively, the two oral language factors could be hierarchically organised, and represent different levels of text integration when ones try 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 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, report 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 & 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 ($\beta = .85$). Note the especially 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 pseudoword 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 & 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 & 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* ($\beta = .31$), T2 *decoding skills* ($\beta = .33$), T2 *LLL skills* ($\beta = .39$), but only marginally by T2 *discourse skills* ($\beta = .11$). We can note the similar magnitude of the coefficients for decoding and lower level language skills.

SEM models on English-speaking children have mostly distinguished two factors to assess the *simple view of reading*: decoding, and oral language skills. They 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 (2006) suggested that the same phenomenon occurs among French first grade pupils, since French is a more transparent orthography than English. However, this author has 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 SEM longitudinal models, 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 general involvement in school tasks. Furthermore, Georgiou *et al.* (2013) have shown that naming speed, 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 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 modelling 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 completed with studies investigating the impact of teaching practices on LLL skills, discourse skills and code-related abilities.

References

- Araújo, S., Reis, A., Petersson, K. M., & Faísca, L. (2015). Rapid automatized naming and reading performance: A meta-analysis. *Journal of Educational Psychology, 107*(3), 868-883.
- Bianco, M. (2015). *Du langage oral à la compréhension de l'écrit*. Presses Universitaires de Grenoble.
- Bianco, M., Joët, G., Lima, L., Nardy, A., Colé, P., & Megherbi, H. (2013). Text reading fluency and reading comprehension in 8 to 11 years old French children. *20th annual conference of the society for scientific studies of reading*. Hong Kong.
- Bianco, M., Pellenq, C., Lambert, E., Bressoux, P., Lima, L., & Doyen, A.-L. (2012). Impact of early code-skill and oral-comprehension training on reading achievement in first grade. *Journal of Research in Reading, 35*(4), 427–455.
- Bressoux, P., Massonnié, J., Bianco, M., Lima, L., Joët, G., Cosnefroy, O., & Dessus, P. (2016). Teacher effectiveness and reading comprehension at first grade. *Fifth Biennial Meeting of the EARLI Special Interest Groups 18 (Educational Effectiveness) and 23 (Educational Evaluation, Accountability and School Improvement)*. “Closing the Gaps? Differential Accountability and Effectiveness as a Road to School Improvement”. Oslo (Norvège) : 28-30 Septembre 2016.
- 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.
- Caravolas, M., Lervåg, A., Defior, S., Seidlová Málková, G., & Hulme, C. (2013). Different patterns, but equivalent predictors, of growth in reading in consistent and inconsistent orthographies. *Psychological Science, 24*(8), 1398–1407.
- Caravolas, M., Lervåg, A., Mousikou, P., Efrim, C., Litavský, M., Onochie-Quintanilla, E., ... others. (2012). Common patterns of prediction of literacy development in different alphabetic orthographies. *Psychological Science, 23*(6), 678–686.
- Catts, H. W., Herrera, S., Nielsen, D. C., & Bridges, M. S. (2015). Early prediction of reading comprehension within the simple view framework. *Reading and Writing, 28*(9), 1407–1425.
- Cheslock, J. J., & Rios-Aguilar, C. (2011). Multilevel analysis in higher education research: A multidisciplinary approach. In *Higher education: Handbook of theory and research* (pp. 85–123). Springer.
- Dehaene, S. (2007). *Neurones de la lecture (Les): La nouvelle science de la lecture et de son apprentissage*. Odile jacob.
- Dickinson, D. K., Golinkoff, R. M., & Hirsh-Pasek, K. (2010). Speaking out for language: Why language is central to reading development. *Educational Researcher, 39*(4), 305–310.
- Ehri, L. C. (2005). Development of sight word reading: Phases and findings. In *The science of reading: A handbook* (Oxford, United Kingdom: Blackwell, pp. 135–154). M. J. Snowling & C. Hulme.

- Ehri, L. C., Nunes, S. R., Willows, D. M., Schuster, B. V., 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.
- 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.
- Foulin, J. N. (2005). Why is letter-name knowledge such a good predictor of learning to read? *Reading and Writing*, 18(2), 129–155.
- Geiser, C. (2012). *Data analysis with Mplus*. Guilford Press.
- Gentaz, E., Sprenger-Charolles, L., Theurel, A., & Colé, P. (2013). Reading comprehension in a large cohort of French first graders from low socio-economic status families: A 7-month longitudinal study. *PloS One*, 8(11), e78608.
- Georgiou, G. K., Das, J. P., & Hayward, D. (2009). Revisiting the “simple view of reading” in a group of children with poor reading comprehension. *Journal of Learning Disabilities*, 42(1), 76–84.
- Georgiou, G. K., Tziraki, N., Manolitsis, G., & Fella, A. (2013). Is rapid automatized naming related to reading and mathematics for the same reason(s)? A follow-up study from kindergarten to Grade 1. *Journal of Experimental Child Psychology*, 115(3), 481–496.
- Gernsbacher, M. A., Varner, K. R., & Faust, M. E. (1990). Investigating differences in general comprehension skill. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 16(3), 430–445.
- Goigoux, R. (2016). Lire et écrire. Etude de l'influence des pratiques d'enseignement de la lecture et de l'écriture sur la qualité des premiers apprentissages. Repéré à <http://ife.ens-lyon.fr/ife/recherche/lire-ecrire/rapport/rapport-lire-et-ecrire>
- Gottardo, A., Mirza, A., Koh, P. W., Ferreira, A., & Javier, C. (2017). Unpacking listening comprehension: the role of vocabulary, morphological awareness, and syntactic knowledge in reading comprehension. *Reading and Writing*, 1–24.
- Gough, P. B., & Tunmer, W. E. (1986). Decoding, reading, and reading disability. *Remedial and Special Education*, 7(1), 6–10.
- Heck, R. H., & Thomas, S. L. (2015). *An introduction to multilevel modeling techniques: MLM and SEM approaches using Mplus*. Routledge.
- Hoover, W. A., & Gough, P. B. (1990). The simple view of reading. *Reading and Writing*, 2(2), 127–160.
- Hulme, C., & Snowling, M. J. (2011). Children's reading comprehension difficulties nature, causes, and treatments. *Current Directions in Psychological Science*, 20(3), 139–142.
- Hulme, C., & Snowling, M. J. (2014). The interface between spoken and written language: developmental disorders. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 369(1634), 20120395.
- Institut National de la Statistique et des Etudes Economiques. (2012a). Nomenclature des Professions et Catégories Socioprofessionnelles (PCS). Retrieved October 22, 2016, from <http://www.insee.fr/fr/methodes/default.asp?page=nomenclatures/pcs2003/pcs2003.htm>

- Institut National de la Statistique et des Etudes Economiques. (2012b). Population active (15 à 64 ans) selon la catégorie socioprofessionnelle en 2013 : comparaisons régionales et départementales. Retrieved October 22, 2016, from http://www.insee.fr/fr/themes/tableau.asp?reg_id=99&ref_id=TCRD_014
- Jeantheau, J.-P., Johnson, S., Garbe, C., Géron, S., Lafontaine, D., Mallows, D., ... Valtin, R. (2016). *Literacy in France. Country Report. Short Version*. Elinet. Retrieved from http://orbi.ulg.ac.be/bitstream/2268/203615/1/France_Short_Report1.pdf
- Johnston, T. C., & Kirby, J. R. (2006). The contribution of naming speed to the simple view of reading. *Reading and Writing, 19*(4), 339–361.
- Joshi, R. M., & Aaron, P. G. (2000). The component model of reading: Simple view of reading made a little more complex. *Reading Psychology, 21*(2), 85–97.
- Justice, L. M., Lomax, R., O'Connell, A., Pentimonti, J., Petrill, S. A., Piasta, S. B., ... others. (2015). The dimensionality of language ability in young children. *Child Development, 86*(6), 1948–1965.
- Kendeou, P., Van den Broek, P., White, M. J., & Lynch, J. S. (2009). Predicting reading comprehension in early elementary school: The independent contributions of oral language and decoding skills. *Journal of Educational Psychology, 101*(4), 765–778.
- Kim, Y.-S. G. (2017). Why the Simple View of Reading Is Not Simplistic: Unpacking Component Skills of Reading Using a Direct and Indirect Effect Model of Reading (DIER). *Scientific Studies of Reading, 21*(4), 310–333.
- Kirby, J. R., & Savage, R. S. (2008). Can the simple view deal with the complexities of reading? *Literacy, 42*(2), 75–82.
- Lecocq, P. (1996). *L'É.CO.S.SE: une épreuve de compréhension syntaxico-sémantique*. Presses Universitaires du Septentrion.
- Lennon, J., & Slesinski, C. (2001). Comprehensive test of phonological processing (CTOPP): Cognitive linguistic assessment of severe reading problems. *NASP Communique, 29*(9).
- Lepola, J., Lynch, J., Kiuru, N., Laakkonen, E., & Niemi, P. (2016). Early Oral Language Comprehension, Task Orientation, and Foundational Reading Skills as Predictors of Grade 3 Reading Comprehension. *Reading Research Quarterly, 51*(4), 373–390.
- Lequette, C., Pouget, G., & Zorman, M. (2008). *ELFE. Évaluation de la Lecture en Fluence*.
- Little, R. J. (1988). A test of missing completely at random for multivariate data with missing values. *Journal of the American Statistical Association, 83*(404), 1198–1202.
- Megherbi, H., Seigneuric, A., & Ehrlich, M.-F. (2006). Reading comprehension in French 1st and 2nd grade children: Contribution of decoding and language comprehension. *European Journal of Psychology of Education, 21*(2), 135–147.
- Moll, K., Ramus, F., Bartling, J., Bruder, J., Kunze, S., Neuhoff, N., ... others. (2014). Cognitive mechanisms underlying reading and spelling development in five European orthographies. *Learning and Instruction, 29*, 65–77.
- Mullis, I. V. S., Martin, M. O., Foy, P., & Hooper, M. (2017). *PIRLS 2016 International Results in Reading*.
- 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.

- 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.
- NICHD Early Child Care Research Network. (2005). Pathways to reading: The role of oral language in the transition to reading. *Developmental Psychology*, *41*, 428–442.
- Oakhill, J. V., Cain, K., & Bryant, P. E. (2003). The dissociation of word reading and text comprehension: Evidence from component skills. *Language and Cognitive Processes*, *18*(4), 443–468.
- Observatoire national de la lecture. (1998). *Apprendre à lire* (Odile Jacob).
- Ouellette, G., & Beers, A. (2010). A not-so-simple view of reading: How oral vocabulary and visual-word recognition complicate the story. *Reading and Writing*, *23*(2), 189–208.
- Ouellette, G. P. (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.
- Perfetti, C., & Stafura, J. (2014). Word knowledge in a theory of reading comprehension. *Scientific Studies of Reading*, *18*(1), 22–37.
- Plaza, M., & Cohen, H. (2003). The interaction between phonological processing, syntactic awareness, and naming speed in the reading and spelling performance of first-grade children. *Brain and Cognition*, *53*(2), 287–292.
- Protopapas, A., Simos, P. G., Sideridis, G. D., & Mouzaki, A. (2012). The components of the simple view of reading: A confirmatory factor analysis. *Reading Psychology*, *33*(3), 217–240.
- RTI International. (2009). *Manuel pour l'évaluation des compétences fondamentales en lecture*. Retrieved from <https://www.eddataglobal.org/documents/index.cfm?fuseaction=pubDetail&ID=175>
- Schreiber, J. B., Nora, A., Stage, F. K., Barlow, E. A., & King, J. (2006). Reporting structural equation modeling and confirmatory factor analysis results: A review. *The Journal of Educational Research*, *99*(6), 323–338.
- Sénéchal, M., & LeFevre, J.-A. (2002). Parental involvement in the development of children's reading skill: A five-year longitudinal study. *Child Development*, *73*(2), 445–460.
- Seymour, P. H., Aro, M., & Erskine, J. M. (2003). Foundation literacy acquisition in European orthographies. *British Journal of Psychology*, *94*(2), 143–174.
- Silva, M., & Cain, K. (2015). The relations between lower and higher level comprehension skills and their role in prediction of early reading comprehension. *Journal of Educational Psychology*, *107*(2), 321–331.
- Snowling, M. J., & Hulme, C. (2011). Evidence-based interventions for reading and language difficulties: Creating a virtuous circle. *British Journal of Educational Psychology*, *81*(1), 1–23.
- Storch, S. A., & Whitehurst, G. J. (2002). Oral language and code-related precursors to reading: evidence from a longitudinal structural model. *Developmental Psychology*, *38*(6), 934–947.
- Thériault-Whalen, C. M., Dunn, L. M., & Dunn, L. M. (1993). Echelle de vocabulaire en images Peabody. *Psycan Corporation*.

- Tunmer, W. E., & Chapman, J. W. (2012a). Does set for variability mediate the influence of vocabulary knowledge on the development of word recognition skills? *Scientific Studies of Reading, 16*(2), 122–140.
- Tunmer, W. E., & Chapman, J. W. (2012b). The simple view of reading redux vocabulary knowledge and the independent components hypothesis. *Journal of Learning Disabilities, 45*(5), 453–466.
- Walley, A. C., Metsala, J. L., & Garlock, V. M. (2003). Spoken vocabulary growth: Its role in the development of phoneme awareness and early reading ability. *Reading and Writing, 16*(1–2), 5–20.
- Ziegler, J. C., Bertrand, D., Tóth, D., Csépe, V., Reis, A., Faísca, L., ... Blomert, L. (2010). Orthographic depth and its impact on universal predictors of reading a cross-language investigation. *Psychological Science, 21*(4), 551–559.

Figure 1: Confirmatory factorial analysis with 3 factors at T1 (Model A)

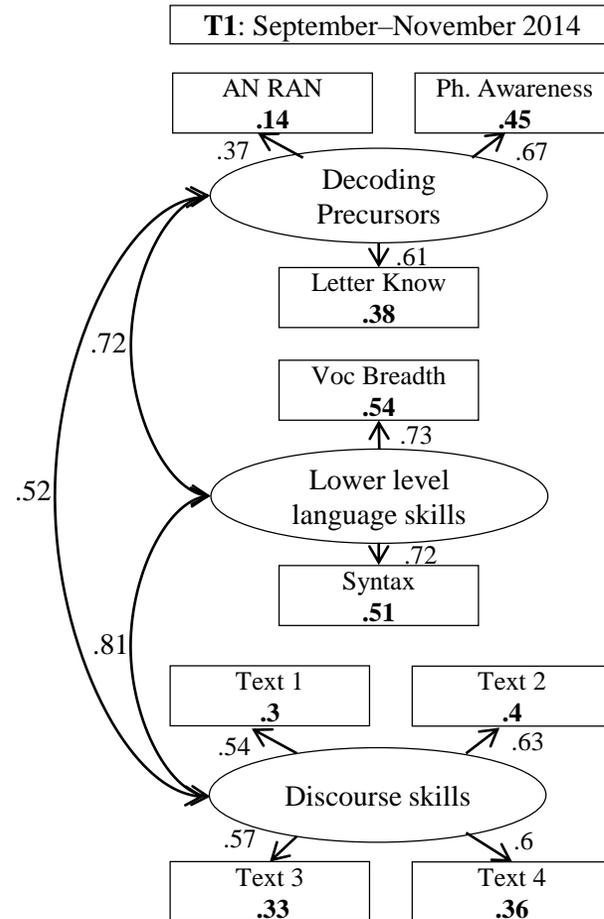
Figure 2: Confirmatory factorial analysis with 3 factors at T2 (Model C)

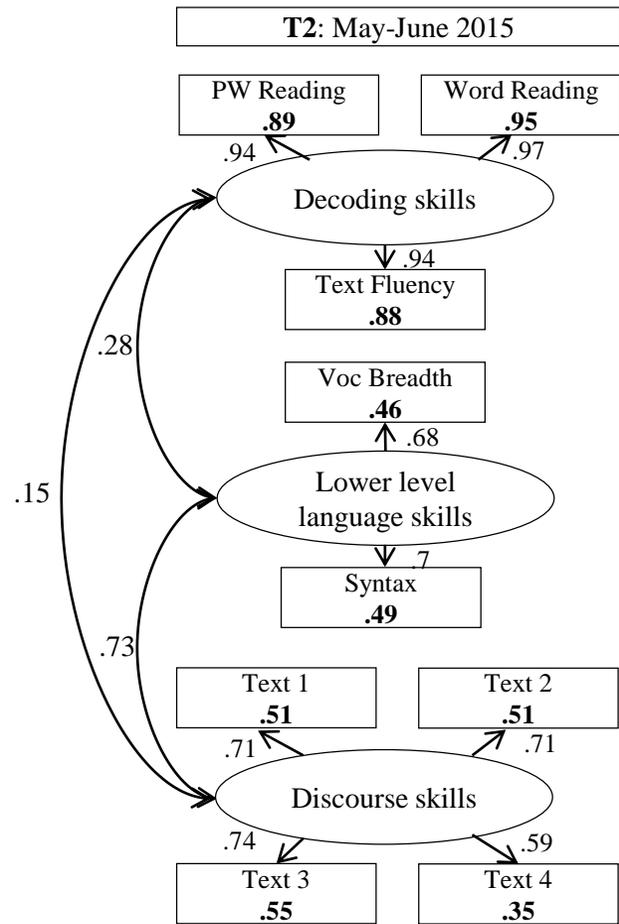
Figure 3: SEM Model 1 depicting the development of reading comprehension in first grade through decoding skills, lower level language skills and discourse skills.

ns : $p > .1$. All the other paths are significant at the .0001 level.

Figure 4: SEM Model 2 depicting the development of reading comprehension in first grade, through decoding precursors, decoding skills, lower level language skills and discourse skills.

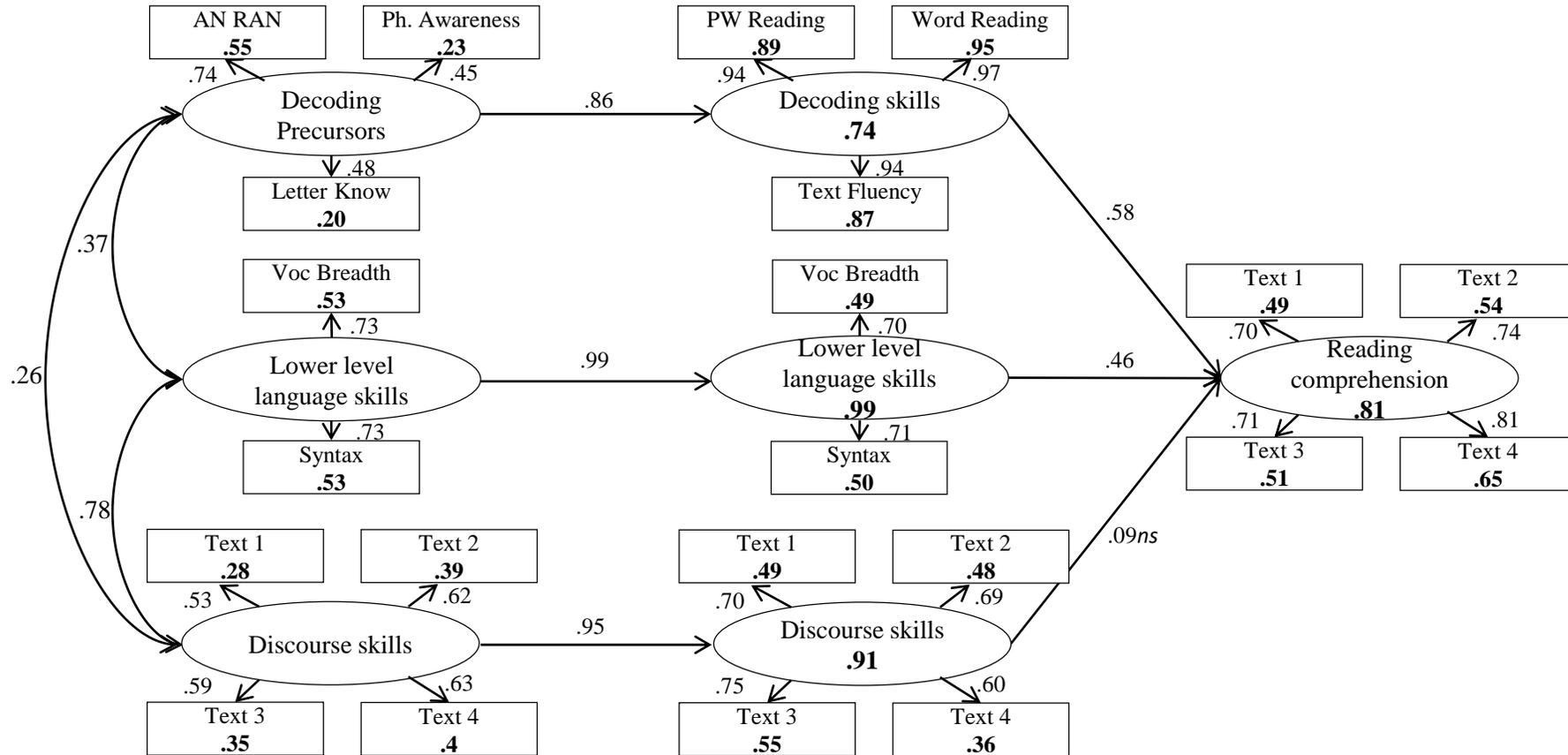
*** $p < .001$; * $p < .05$, † $p < .1$. All the other paths are significant at the .0001 level.*





T1: September–November 2014

T2: May–June 2015



T1: September–November 2014

T2: May–June 2015

