Centre de Recherches sur la Cognition et l'Apprentissage

Centre National de la Recherche Scientifique

Rapport technique : 2010/01/E.LAM

Early Training in Oral Comprehension and Phonological Skills: Results of a Three-Year Longitudinal Study

Maryse Bianco [1]; Pascal Bressoux [1]; Anne-Lise Doyen[2]; Eric Lambert[3]; Laurent Lima [1]; Catherine Pellenq[1]; Michel Zorman[1]

[1] Laboratoire des Sciences de L'Education, Université P. Mendès France, Grenoble
[2] IUFM Centre Val de Loire, Université d'Orléans
[3] Laboratoire CeRCA, UMR CNRS 6234, Poitiers

To appear in :

Bianco, M., Bressoux, P., Doyen, A.-L., Lambert, E., Lima, L., Pellenq, C., & Zorman M.. Early training in oral comprehension and phonological skills : results of a three-year longitudinal study. *Scientific Studies in Reading*.

Address for Corresponding Author:
Eric LAMBERT,
Université de Poitiers –CNRS
Centre de Recherches sur la Cognition et l'Apprentissage (CeRCA) – CNRS UMR 6234
MSHS - Bâtiment A5 - 5 rue Théodore Lefebvre - 86000 Poitiers, France
86000 Poitiers
France
e-mail : eric.lambert@univ-poitiers.fr
Tel : 33 (0)5.49.45.48.89 ou 46.10
Fax : 33 (0)5.49.45.46.16

ABSTRACT

A sample of 1,273 4-year-old children were followed for 3 years. The children participated in 1 of 2 comprehension training programs, or in a phonological awareness training program. The comprehension programs explored the possibility of improving young children's oral comprehension in an educational setting. The first focused on the component skills of comprehension; the second involved storybook reading. Phonological awareness and oral language comprehension skills were measured repeatedly in the course of the study. The data were analyzed using multilevel growth-curve models. The results showed that it is possible to improve oral comprehension if the training focuses on its component skills and extends over 2 semesters. When these conditions were met, training effects still existed 9 months after the pro- gram had ended. Finally, phonological training improved phonological awareness but not comprehension, and comprehension-skill training improved oral comprehension but not phonological awareness.

INTRODUCTION

It has long been claimed that in order to become accomplished readers, children have to rise to a double challenge: They must acquire both efficient word-identification skills and text-comprehension skills. A large body of evidence shows that by the end of elementary school, what essentially distinguishes good readers from poor readers is their ability to interpret texts at a deeper level. In Grades 5 and 6, it is comprehension skills—more than word-identification skills—that differentiate pupils on reading achievement (Oakhill, 1994; Oakhill, Cain, & Yuill, 1998). Moreover, the relationship between language development and reading achievement has been extensively documented (NICHD, Early Child Care Research Network, 2005; Storch & Whitehurst, 2002). In addition to phonological skills, which are usually associated with early decoding skills, research has shown that higherorder language skills such as syntax, morphology, and oral comprehension are closely related to both reading comprehension and decoding skills, once vocabulary and verbal IQ have been controlled (Cain, Oakhill, & Bryant, 2004; Casalis & Louis-Alexandre, 2000; Nagy, Berninger, & Abbott, 2006).

Research on reading acquisition over the past 30 years has provided two important relatively independent bodies of evidence. The first deals with the word-identification component of reading and mainly explores the development of alphabetic skills and their relationship to phonological awareness (Bus & van Ijzendoorn, 1999; Castles & Coltheart, 2004; Ehri, Nunes, Stahl, & Willows, 2001; Ehri, Nunes, Willows, et al., 2001). The second, often referred to as "strategy instruction" or "strategy training," examines text comprehension and the way this high-level activity can be improved in teaching programs (for reviews, see Bianco, Lima, & Sylvestre, 2004; Trabasso & Bouchard, 2002). We briefly summarize the main results from these two areas of research, because they are both important for the study reported here.

A very large number of studies have established that phonological awareness and the acquisition of alphabetic skills are closely related. Many studies have found a strong correlation between phonological awareness and ease of learning to read (Elbro & Scarborough, 2003; Goswami & Bryant, 1990; Wagner & Torgesen, 1987). Moreover, several longitudinal studies have shown that a child's phonological skills before learning to read are important predictors of later word identification (for a review, see Castles & Coltheart, 2004). Finally, training studies have provided evidence that phonological training before learning to read helps children acquire word identification skills (Bus & van Ijzendoorn, 1999; Ehri, Nunes, Willows, et al., 2001; Torgesen, 2002). Although neither the exact phonological unit involved in facilitating reading acquisition nor the causal nature of the link between phonological skills and early reading skills has been firmly established (Castles & Coltheart, 2004), some properties of training programs can be seen as likely to favor reading acquisition. As Ehri, Nunes, Willows, et al. (2001) pointed out, the effects of training programs are enhanced when the training duration is sufficiently long (5–18 hr) and achieved with a small group of children instead of individually or with a whole class. Moreover, programs including phonemic awareness and alphabetic skills are more likely to trigger transfers to reading acquisition (Castles & Coltheart, 2004), and this seems to be especially the case for young children at risk of reading delay (Hatcher et al., 2006; Hatcher, Hulme, & Snowling, 2004). Cross-linguistic studies have mostly confirmed the results obtained for the English language but have also shown that the strength of the relationship between phonological awareness and reading depends on the regularity of the orthographic system (Mann &

Wimmer, 2002; Wimmer, Landerl, Linortner, & Hummer, 1991). For the French language, several correlational and longitudinal studies have largely confirmed the findings for English (Sprenger-Charolles, Siegel, Bechennec, & Serniclaes, 2003), but training studies are very scarce. Lecocq (1992) reported a study in which a group of about 18 French preschool children received phonological training lasting half an hour per week for 12 weeks. Phonological awareness scores immediately after the training as well as reading scores measured 1 year later were both higher in the phonologically trained group than among controls. To our knowledge, there are no other training studies involving a larger or more representative sample of French pupils, nor are there any studies designed to explore longer periods of development. The phonological training condition in our study fills this gap. Given that this condition will be compared to another kind of oral language training, namely, comprehension, its potential effects will be integrated into a larger view of language development.

For about a decade, the phonological hypothesis has overshadowed the idea that other oral language abilities might play a role in reading development. As Bus and van Ijzendoorn (1999) stated, "Phonological awareness is an important but not a sufficient condition for early reading" (p. 413). Several recent studies have emphasized the role played by other language skills. Casalis and Louis-Alexandre (2000), for example, showed that morphological awareness accounted for unique variance in word identification among beginning French readers, and many other studies have stressed that vocabulary development is also an important skill for the development of visual word recognition and reading comprehension (Dickinson, McCabe, Anastasopoulos, Peisner-Feinberg, & Poe, 2003; Nation & Snowling, 1998). The NICHD Early Child Care Research Network (2005) conducted a longitudinal study with 1,137 children followed fromage 3 to 9. They found that better oral language skills such as syntax, semantic knowledge, and narrative ability each played direct and indirect roles in early word identification, apart from vocabulary. These early skills were also found to contribute directly to text comprehension in Grade 3. Therefore early language development as a whole appears crucial to reading achievement, and the various linguistic skills interact in a complex way in process of learning to read.

There is less research on the development of reading comprehension (but see Gaonac'h & Fayol, 2003; Oakhill & Cain, 2003). Text comprehension is generally regarded as a general capacity that is not specific to reading, and reading and listening comprehension are highly correlated, both in adults (Gernsbacher, Varner, & Faust, 1990) and in children (Carpenter & Just, 1986; Perfetti, 1985). There is also evidence that reading comprehension among children in the third to fifth grades can be improved solely by reinforcing word-identification skills (Chardon, 2000; Stanovich, West, Cunningham, Cipielewski, & Siddiqui, 1996). These findings have led many researchers to consider that comprehension during reading will follow naturally from the acquisition of good word-identification skills and extensive practice. However, text comprehension requires integrating information across sentences so that an overall, coherent representation can be built of what is going on in a passage of text, that is, a "situation model" (Van Dijk & Kintsch, 1983). To achieve this goal, readers must often rely on high-level language skills such as inference making and comprehension monitoring. These mechanisms have been studied extensively within the past 25 years (e.g., Baker, 1985; Gernsbacher, 1990; Gombert, 1990; Van den Broek, 1994; Van Dijk & Kintsch, 1983). Oakhill and her collaborators have demonstrated that, by the end of elementary school, the capacity to mobilize inferential and monitoring skills strongly differentiates skilled and less-skilled comprehenders (Cain & Oakhill, 1998). The relationship between comprehending and monitoring seems to develop very early during first grade, as evidenced by Kinnunen, Vauras, and Niemi (1998). Relying on this widely accepted conception of text comprehension, Cain et al. (2004) conducted a longitudinal study and showed that in children ages 8 to 11, inference-making and comprehension-monitoring skills, along with text-structure knowledge, each explained a unique part of the variance in comprehension level, independently of verbal ability, code-related skills, and working-memory capacity.

Assuming that oral and written comprehension rely on essentially the same linguistic skills, one can hypothesize that oral language development, both before and during reading acquisition, is a crucial factor in reading comprehension. However, the spontaneous development of oral language comprehension may prove insufficient for written comprehension, because the language used in written texts differs from everyday speech. Briefly, the written language generally involves more complex vocabulary and syntactic structures, in addition to providing no deictic cues to the comprehender. Written language also requires integrating an extended piece of discourse, which is rarely the case with everyday oral exchanges. So children have to learn the “language of books” and the question that arises is whether the complex skills involved in written comprehension—if not practiced enough in everyday oral interactions—can be improved by teaching.

A long tradition of research, referred to as “comprehension monitoring” or “comprehension strategy training” (reviewed by Trabasso & Bouchard, 2002) has shown that this is indeed possible, at least in second grade and beyond. A large number of comprehension strategies have been used. They can be classified as follows: specific inference training (Baumann, 1986; Yuill & Oakhill, 1991); knowledge development, that is, vocabulary and use of prior knowledge (Baumann et al., 2002; McKeown, Beck, Omanson, & Perfetti, 1983; Spires & Donley, 1998); organization of information: story structure, summarizing information, and graphic organizers (Thiede & Anderson, 2003); detailed text analysis: asking and answering questions (Rosenshine, Meister, & Chapman, 1996); and comprehension monitoring: thinking aloud and inconsistency checking and resolving (Baker & Zimlin, 1989; Trabasso & Magliano, 1996).

All of these studies concern children older than 8 years of age. So far, there are few training studies that have attempted to improve the oral language comprehension skills of prereaders. The existing research involving early oral comprehension training is mostly directed at preventing academic underachievement in at-risk children (Bowyer-Crane et al., 2008; Torgesen et al., 1999), and oral comprehension is often part of larger language intervention programs such as Head Start (Whitehurst et al., 1994; Whitehurst & Lonigan, 1998). Aside from a study by Morrow (1985), who showed that training kindergartners to listen to stories improved their comprehension performance, other studies involving young children have mostly been based on shared reading of storybooks, with oral comprehension skills remaining mostly an implicit focus (Crain-Thoreson & Dale, 1999) or serving to measure the improvement of other linguistic skills like vocabulary (Robbins & Ehri, 1994).

At present therefore, we do not know whether the complex skills required for language comprehension can be taught and improved at an early age or whether an explicit component-targeted approach will prove effective with normally developing prereaders. In other words, will explicit “meaning-focused” activities improve preschool children’ s oral comprehension as it seems to do for vocabulary growth (McDonald Connor, Morrison, & Slominski, 2006; Robbins & Ehri, 1994). Finding an answer to this question is crucial, given the major role that high-level language skills play in literacy development. The comprehension-skill training described next was designed to provide an answer to this issue.

The study presented here was conducted during the first 3 years of a 5-year longitudinal research project on children’s transition to elementary school. It involved 1,273 French preschool pupils. During this period, three training programs (a phonological training program and two comprehension training programs) were given to prekindergartners and kindergartners[1] in an attempt to answer the following questions: (a) Can high-level language comprehension skills such as inferencemaking, syntactic analysis, situation modeling, and comprehension monitoring be improved by instruction at an early age (4 to 6 years)? If so, then, what didactic setting is the most effective? When should it be implemented and how long should it last? (b) Are language comprehension and phonological skills independent or are they expressions of a general verbal ability? If they are independent, then training oral comprehension should improve comprehension skills but not phonological skills, and conversely, training in phonological skills should improve phonological awareness but not comprehension.

[1] In France, children enter school at age 3. According to the National Institute of Statistics (Insee, 2007), 99.7% to 100% of 3-year-olds were attending preschool during the period 1999–2006. Preschool lasts for 3 years, with classes organized according to age. In our study, the children were 4 and 5 years old, so they were attending the second and third years of preschool, respectively. We refer to our 4-year-old pupils in their second year of preschool as “prekindergartners” and our 5-year-old pupils in their last year of preschool as “kindergartners.”

METHOD

Three training programs were administered to independent groups of children. Two of the programs revolved around comprehension and were very different from today's main teaching approaches. The first, called comprehension-skill training (CS), focused specifically on the components of comprehension, and each lesson targeted one of these components. This program was an explicit, analytic, meaning-focused program designed to promote a specific outcome (McDonald Connor et al., 2006). The second comprehension-skill program, called story-analysis training (SA), involved the repeated reading of a storybook with small groups of children. This training, although language focused, was implicit both in its teaching format and in the way it drew the children' s attention to comprehension skills. The third program, called phonological training (PHO), was an explicitly code-focused program (again, in the terms proposed by McDonald Connor et al., 2006).

PARTICIPANTS

The study began in prekindergarten with 1,273 pupils and ended 3 years later with 857 pupils who had participated in each evaluation[2]. All of the children were born in 1997 and ranged in age from 3 years 11 months to 4 years 11 months at the beginning of the study (*M* age =4 years 5 months). Regarding socioeconomic status (SES), 30.54% of the children came from middle- to high-status homes, 52.46% came from low-status homes, and the remaining 17% were from very low-status homes. The socioeconomic backgrounds of the experimental groups were not strictly equivalent, however, as revealed by a chi-square test, $\chi^2(12) = 41.05$, $p < .0001$, which showed that group CS2, and to a lesser extent group PHO1 (see Table 1), were composed of slightly more socioeconomically advantaged children. Forty-four urban and suburban schools were enrolled in the program; half of the schools were located in areas with special educational needs. Each school was assigned to one training program, and a single class and its regular teacher followed this program. So, in all, 88 teachers were involved in the experiment over the 2 training years. Every teacher had the certification required for teaching in France. Out of this sample, no teacher was a beginner, 8% had less than 5 years of experience at preschool teaching and 92% had more than 5 years of experience. Consequently, one can argue that the participating teachers were overall experienced professionals. Table 1 gives the pupil and school distribution across experimental groups and the evolution of the sample structure over the 3-year period.

[2] The distributions obtained for each score at the onset of the study were analyzed to look fora potential attrition effect. No difference was observed between the distributions of the total sample and the reduced sample, so subsequent analyses were run on the total sample, as it is allowed with multilevel growth curve models. In the analysis to follow, the overall attrition resulting from the growth curve modelling amounts to 2%.

Table 1 - Experimental Protocol and Structure of the Sample

Training	*Group 1 (2 Semesters of Training)*			*Group 2 (1 Semester of Training)*			*Control Group*	*Total*
	CS1	*SA1*	*PHO1*	*CS2*	*SA2*	*PHO2*		
Evaluation time								
T1	162	124	174	150	97	212	354	1,273
T2	162	124	174	150	97	212	354	1,273
T3	130	84	135	133	96	181	257	1,195
T4	110	73	129	113	83	178	224	910
No. of schools	8	5	5	5	3	7	12	44
No. of special education schools	5	4	2	2	2	2	5	22
Middle/high SES	20.92%	24.79%	36.77%	42.36%	30.77%	27.18%	30.94%	30.54%
Low SES	57.52%	53.85%	55.48%	45.14%	56.04%	47.09%	52.08%	52.46%
Very low SES	21.57%	21.37%	7.74%	12.50%	13.19%	25.73%	16.98%	17.00%

Note. The cells contain the number of students in each group at each evaluation time, the number of schools and schools located in areas with special educational needs, and the socioeconomic status (SES) of thechildren'shomes. CS =comprehension-skill training ; SA = story-analysis training;PHO = phonological training.

To obtain data regarding the potential effects of training duration and the school level at which training takes place, the children were divided into three groups. The first group (Group 1) was trained in prekindergarten and kindergarten. The training period lasted one semester each year. The second group (Group 2) was trained only in kindergarten. The third group served as the control group. Control schools were chosen from the same educational district as experimental schools and were comparable in terms of sociodemographic characteristics and school level achievement as evaluated by the French Ministry of Education. The children in the two trained groups were further divided into three groups, depending on their assignment to a training program: CS, SA, and PHO. As indicated in Table 1, there were seven groups in all, six experimental and one control.

The design was a quasi-experimental one. We failed to obtain a strictly randomized protocol, because the participating schools were allowed to choose which pro- gram they would teach. At the risk of limiting the potential generalizability, this procedure was chosen for two main reasons: (a) The challenge was to implement the training programs in natural settings and consequently the regular teachers of ordinary French schools had to insert the program in their everyday schooling; we wanted to make sure that each teacher would really become involved in the pro- gram because they had to apply it and sustain their motivation throughout the training period. (b) At the onset of the study, partnership between university research and elementary schools was unusual in France (and still is), and this made a strict randomization difficult. It can be stressed, however, that with respect to the deliberate participation of teachers, the treatment was equivalent across each experimental group.

ASSESSMENTS

Pupils were assessed four times: twice in prekindergarten, once at the beginning of the school year (in November) before any training had begun (T1) and once at the end of the same year (in May and June) after the first three experimental groups had received their first training semester (T2). The third evaluation (T3) took place at the end the kindergarten year (in May and June). At that time all training sessions had been completed: The first three experimental groups had received their two training semesters and the last three had received their kindergarten training semester. At T1, T2, and T3, the children's performance was evaluated for phonological awareness and oral language comprehension.

To assess potential long-term effects, the pupils were evaluated once again in the first grade (T4), 9 months after all training programs had ended. Among the elementary school data, only the first-grade oral-comprehension scores were considered here because they could be fed into the growth-curve models we used to analyze the data[3]. These analyses gave us a first estimation of any long-term training effects. In short, a 27-month interval separated assessment T 1 from assessment T4, T2 took place 6 months after T1, and T3 occurred 18 months after T1.

The children were tested individually at each evaluation time. All tests were administered by the authors or by graduate students who were trained and periodically supervised on site. Testing took place in a quiet room in the schools and was completed in two sessions lasting approximately 30 min each. Parental consent was obtained prior to testing.

PHONOLOGICAL AWARENESS

At T1 and T2 (prekindergarten), phonological awareness was assessed with three types of items: (a) syllabic segmentation (segmentation of words such as *pyjama* [pyjamas]), (b) rhyme recognition (I say */suri/* [mouse] to you, and you tell me which word has the same ending, */mari/* [husband] or */mãto/* [coat]), and (c) phonological discrimination (*vi/ki*: Do they sound the same or not?).

At T3 (kindergarten), the phonological items were as follows: syllable deletion (say */torty/* [turtle] without the */tor/*→ */ty/*), rhyme extraction (*/valiz//s?riz/*→ */iz/*), and pick the odd initial phoneme (*/tabl/, /tyb/, /va?/*).

The phonological tests had 34 to 40 items, depending on the assessment time. The internal consistency of each test was very satisfactory, as Cronbach's alpha coefficients ranged between .87 and .90.

ORAL LANGUAGE COMPREHENSION

To evaluate the multiple high-level components of comprehension, oral language comprehension was assessed using a composite test that combined sentence comprehension and text comprehension. All the comprehension items (sentences, texts and questions about texts) were read aloud to the children who gave their answers orally.

Sentence comprehension evaluated children's syntactic skills. The test was composed of 20 items taken from a standardized French test (L'ECOSSE: Lecocq, 1996). The children were shown four pictures and had to choose the one that exactly depicted the situation described in a sentence read by the examiner.

Text comprehension was evaluated by having the children answer questions about narrative and informative texts. Three types of items were used to measure deductive reasoning, surface understanding, and inferential understanding, respectively: (a) paragraphs 3 or 4 sentences long containing a short riddle were read aloud and the children had to solve the riddle using deductive reasoning, (b) short stories 5 to 10 sentences long were read aloud and the children were asked some questions about the main characters and the temporal and spatial setting and events, and (c) short expository texts depicting the life of an animal. As previously for the stories, the children had to answer some surface or inference-based questions after hearing the texts.

For the first-grade assessment, oral language comprehension was evaluated using a similar composite test, but the texts were longer (approximately 30 sentences) and were taken from second-grade schoolbooks.

The comprehension items were selected to ensure that both proximal and distal measures would be represented in relation to the two comprehension training programs. As the CS program was more analytic in nature, sentence comprehension and riddle resolution can be considered as proximal measures, whereas story comprehension items, involving surface and inferential questions as well as children' s ability to deal with story structure, represent more

[3] As formal reading instruction begins at first grade in France, the purpose of the follow-up study during first grade was to assess the potential effects of the training programs on reading acquisition on top of the long-term effect on oral comprehension skills. Consequently, evaluation at first grade concentrated on reading and writing skills besides oral and reading comprehension. Owing to the time needed to test each child individually, follow-up assessment of phonological skills was given up.

distal measures; this is especially true for T4 text items, where questions followed listening to long complex paragraphs chosen to make use of integrated comprehension skills. The reverse pattern holds for the SA program. The weight of each item type was equivalent at assessments T 1 and T2, whereas the weight of text comprehension items increased at T3 and T4. Preliminary analysis using raw scores and weighted scores demonstrated an identical pattern of results. So the raw scores were retained for the final analysis.

In all, there were 20 to 38 items in the language comprehension tests, depending on the time of evaluation. The internal consistency of each test was satisfactory, with Cronbach's alpha coefficients ranging from .76 to .85.

Control Measures

Four control measures were included in the data analyses. *Vocabulary* was assessed at T1 using a receptive subtest taken from a standardized vocabulary test (T.V.A.P., Deltour & Hupkens, 1980). Three levels for the *socioeconomic status of the children's homes* were defined on the basis of the parents' occupations: SES1 included children whose parents had middle- to high-status jobs, SES2 included children whose parents had low-status jobs, and SES3 included children from "at-risk" homes. The children's sex and month of birth also served as control variables.

Training Programs

CS

Based on the theoretical view outlined earlier, each lesson was designed to practice a particular component of the comprehension process. Lessons were produced and pretested during the 2 years preceding the training experiment with a group of experienced prekindergarten and kindergarten teachers supervised by the first author and a pedagogical adviser. As far as possible, the exercises were expressly made to contain ambiguities and/or several plausible answers to elicit different responses that would encourage discussion among pupils. Twenty-one prekindergarten lessons and 19 kindergarten lessons were created (Bianco, Coda, & Gourgue, 2002,2006; Bianco, Pellenq, & Coda, 2004). Lessons for the CS pro- gram were extracted from these tools. Some sample exercises and the organization of the training sessions are given in Appendix A. Teachers were instructed to follow this organization. The lessons were designed to help children work on the following points.

Detection of inconsistencies. These lessons were designed to help very young children learn comprehension monitoring. The aim was to make children aware that comprehension difficulties do exist and that one must think about this problem. Activities ranged from introductory les sons designed to introduce the notion ofinconsistencies (e.g., pictures depicting a situation contained some oddities such as two butterflies flying in a goldfish bowl; children had to find them and to explain why this was a strange or inappropriate representation of the situation) to more complex ones in which children had to find and correct inconsistent information expressed in a text in relation to a situation shown on a picture.

Necessary and logical inferences. Particular attention was paid to resolving references, understanding causality and connectives, and deductive reasoning. The first set of exercises focused on anaphora, connective processing, and causality. They were aimed at teaching comprehension strategies and how to reason about potential difficulties, and they emphasized the importance of correctly interpreting certain linguistic devices. The second set revolved around deductive reasoning and was used to teach children how to use logical procedures to solve problems while relying on linguistic data.

Situation model and story structure. All of the preceding skills were then put to use in building a situation model and understanding the structure of a story.

SA

SA consisted of the repeated reading and analysis of the same storybook over a relatively long period (4–8 weeks, depending on the story and the children's age and comprehension level). This type of training was introduced to compare the CS program just described to a more conventional way of teaching language comprehension in French preschool. Traditionally, the teacher reads a story to pupils and then asks them questions about what they heard. Our storybook training involved story analysis too, but the teachers were instructed to apply the principles of shared reading (Holdaway, 1979), that is, to create story-reading and listening conditions close to those observed in natural settings such as storytelling in the home. No instructions were given to teachers about the comprehension skills to consider; they were simply told to repeatedly read aloud the stories or parts of them and to encourage discussions about the text and the story while following up as much as possible on the pupils' comments. However, we wanted the teachers to be aware of difficulties present in the texts, so the storybooks were analyzed collectively during preparation sessions (see next). Two storybooks were studied by prekindergartners (eight sessions for each book) and three other storybooks were studied by kindergartners (four sessions for the first one and six sessions for the two remaining storybooks). All storybooks were chosen with the agreement ofthe teachers in charge of this type of training but, of course, the same books were studied by everyone and during a given training period, as summarized in Appendix A.

PHO

This PHO program provided explicit training in phonological awareness via listening, verbal memory, and articulatory cues. A broad range of structured activities were used. The activities began with general listening tasks and gradually went on to tasks involving progressively smaller linguistic units (from syllables to rhymes to phonemes) and involved epilinguistic as well as metalinguistic skills according to Gombert's (1990) characterization. A manual was written documenting the phonological activities and training procedures (Lambert & Doyen, 2005). There were 24 lessons (or sessions) for prekindergartners and 24 lessons for kindergartners; each lesson contained two different exercises.

The prekindergarten activities focused first on epiphonological skills (pseudoword repetition, discrimination of sounds; 8 exercises) and went on to syllable and rhyme awareness. Thirty-four exercises involved syllable awareness (segmentation oftwo- or three-syllable words, identification or matching initial and final syllables, locating a syllable in a word, combining syllables to form words, removing the initial or final syllable of a word), and 6 involved rhyme awareness (identification and matching).

The kindergarten activities focused on phonemic awareness and letter-sound mapping. After reviewing the syllable and rhyme work, phonemic awareness activities were combined with letter-sound mapping activities involving matching graphemes and phonemes, breaking syllables down into phonemes, identifying and matching initial phonemes, and finally blending phonemes. Each session was made of two different exercises. In all, 1 involved epiphonology, 12 syllable awareness, 12 rhyme awareness, and 23 phonemic awareness. The phonological curriculum is presented in Appendix A.

Training Procedures and Implementation

The two comprehension programs (CS and SA) lasted 14 to 16 consecutive weeks per year[4]. During these periods, each pupil was trained for a 30-min session each week. For the phonological training program children were trained for 12 consecutive weeks per year. Each group was provided with two 20-min sessions a week. Beyond this difference in scheduling, the total amount of training was equated across groups. Out of the total time spent at school, training lasted between 7 and 8 hr each year. This corresponds to the optimal duration reported in the phonological training literature for typically developing children (Ehri et al., 2001).

Prior to the training period, the teachers in the experimental groups participated in a 4-hr preparatory course. They were first given theoretical information on phonology or comprehension depending on the training program they were

[4] The training period for the two comprehension programs were initially set at 16 weeks. Because of absence of teachers for health reasons or for their involvement in national protest strikes (especially during the second year), training were reduced to 14 sessions in some classrooms.

engaged in. They were then introduced to the didactic principles they were to follow. In preparation for the comprehension training programs (CS or SA), the teachers were trained to work with small groups of pupils (4–7) who had comparable language-comprehension skills as measured at pretest. Children who obtained low or very low scores were engaged in the smaller groups (4–5 pupils each), and those who obtained higher scores were allowed to participate in slightly larger groups (6–7 pupils). This was done to make sure that children with weaker comprehension skills would be given the opportunity to participate and would not be left in the shadow of their more skilled classmates. Teachers were also told to make sure to create a friendly classroom environment and to encourage debates so that all children would be able to express themselves, present and justify their own opinions, and compare them to the other children's ideas. With these principles in place, we intended oral language to become an object of study and a focus for problem-solving activities. For the phonological training, the children were also taught in small groups of comparable phonological skills according to pretest results (4–7), and the teaching principles to be applied were essentially the same.

The teaching materials were then presented to the teachers and they were given time to familiarize and practice the two first lessons (CS and PHO). Teachers in the SA group chose the first storybook, decided on the parts of the story that they would concentrate on during the first two sessions, and analyzed the textual difficulties (lexical, syntactic, or inferential) to keep in mind during the two first training sessions.

Supervision of teachers was given in 2-hr meetings every 2 weeks during the first 6 weeks of each training year and then monthly until the end. The meetings were specific for each training group and involved the teachers, their pedagogical advisor, and one member of the research team. The meetings were used to prepare the forthcoming sessions and to discuss and resolve any difficulties encountered in the implementation of the previous sessions and to sustain the teachers' motivation. The pedagogical advisor was available to give help in classrooms when needed, and the teachers' attendance at these meetings was good. Qualitative observations from these supervision sessions indicate that teachers adhered closely to the intervention protocols and each week delivered the training they were supposed to. The teachers also ensured that each child participate in one session per week. However, no quantitative data regarding implementation fidelity were recorded.

RESULTS

SCORING

The data were scored by members of the research team assisted by five paid graduate students. A grid for correction and quotation was first prepared collectively by the researchers, and each protocol was scored according to this grid. When scoring difficulties arose, they were resolved through a judge agreement procedure. The tests used to assess children's language abilities were built up with different numbers of items, across time and across skills. The scales are not directly comparable, and for this reason, the oral comprehension, vocabulary, and phonological awareness scores, the variables of interest in this study, were calculated and normalized (M =0, SD = 1). They are presented in Table 2 and were used in the growth-curve models described next.

GROUP EQUIVALENCE AT T1

An analysis of variance across groups, on comprehension, vocabulary, and phonological scores observed at T1, revealed that the seven experimental groups were not exactly equivalent on all three scores, $F(6, 1194) = 2.63$, $p = .015$ for vocabulary; $F(6, 1176) = 3.25$, $p = .003$ for comprehension; and $F(6, 1176) = 6.71$, $p < .000\ 1$ for phonology. Pairwise comparisons using Bonferroni corrections revealed that no comparison reached statistical significance for vocabulary. The PHO2 group obtained significantly higher scores than PHO1 in comprehension performance at T1 ($t8 = 3.736$, $p < .01$) and had significantly higher T1 scores in phonology relative to five experimental groups (CS 1, SA1, SA2, PHO1, CONT; $t8$ = 4.787, 5.313, 5.286, 4.138, 3.849, respectively; $p < .01$). No other comparison reached significance. In sum, the PHO2 group differed from the other experimental groups at the beginning ofthe study, especially in phonological skills. The computation of the effect size for each possible pair of T1 phonological and oral comprehension scores confirms this result. Comparisons excluding the PHO2 group show no major between group differences (effect sizes are ranging in the interval [0.0 1 – 0.3 8], with four values out of 30 above 0.25—comparison PHO 1/CS2 (.30) for oral comprehension, and comparison SA1/cont (.26), SA2/CS2 (.28) and SA1/CS2 (.30) for phonology). However, the effect sizes involving PHO2 fall in the interval [0.07 – 0.38] for the oral comprehension scores—with 3 above .25 (CS 1/PHO2 (.30), SA1/PHO2 (.28), PHO1/PHO2 (.38)) andin the interval [0.38 –0.72] for the phonological awareness scores. This represents a weakness of our protocol, which is discussed in the following sections.

Table 2 – Normalized Mean and Standard Deviation of the Main Scores

Group		*CS1*	*SA1*	*PHO1*	*CS2*	*SA2*	*PHO2*	*Control*
Score	Time of evaluation							
Oral comprehension	T1 (pretest)	–0.092	–0.081	–0.192	0.117	–0.036	0.187	0.010
		(0.926)	*(0.971)*	*(1.032)*	*(1.019)*	*(0.962)*	*(0.944)*	*(1.043)*
	T2	0.086	–0.116	–0.041	0.111	–0.095	0.079	–0.051
		(0.931)	*(1.011)*	*(1.008)*	*(0.985)*	*(1.019)*	*(0.999)*	*(1.021)*
	T3	–0.060	–0.199	–0.066	0.168	–0.181	0.561	–0.095
		(0.958)	*(0.986)*	*(1.055)*	*(0.918)*	*(1.083)*	*(0.873)*	*(0.943)*
	T4 (1st grade)	0.346	–0.077	–0.199	0.110	–0.038	–0.028	–0.060
		(1.074)	*(0.914)*	*(0.942)*	*(0.935)*	*(0.951)*	*(0.997)*	(1.034)
Phonological awareness	T1 (pretest)	–0.127	–0.252	–0.019	0.052	–0.234	0.386	0.016
		(1.012)	*(1.030)*	*(0.921)*	*(1.005)*	*(1.031)*	*(0.761)*	*(1.011)*
	T2	–0.119	–0.190	0.359	0.098	–0.305	0.041	–0.041
		(1.042)	*(0.980)*	*(0.971)*	*(0.973)*	*(0.891)*	*(0.997)*	*(0.994)*
	T3	–0.260	–0.111	0.447	0.119	–0.039	0.364	–0.191
		(1.040)	*(1.024)*	*(0.841)*	*(0.944)*	*(1.015)*	*(0.841)*	*(0.993)*
Vocabulary	T1 (pretest)	0.044	–0.144	–0.131	0.089	–0.068	0.142	0.031
		(1.028)	*(1.005)*	*(1.040)*	*(0.982)*	*(0.893)*	*(0.930)*	*(1.032)*

Note. CS = comprehension-skill training ; SA = story-analysis training ; PHO = phonological training.

BETWEEN-SCORE CORRELATIONS

Between-score correlations were calculated for the phonological awareness, oral comprehension, and vocabulary scores. As shown in Table 3, all scores were significantly correlated within and across times of measurement.

Concentrating on Time 1, the three initial measures are significantly correlated, with phonological awareness and vocabulary sharing an equivalent correlation with comprehension (according to Steiger's test [1980], $t8 = 1.45$, *ns*) but a relatively smaller correlation with each other (in fact, phonology is more strongly correlated with comprehension than vocabulary, $t8 = 8.19$, $p < .001$, and vocabulary is more strongly correlated with comprehension than phonology, $t8 = 6.64$, $p < .00 1$). This is not surprising, however, because all three scores evaluate children' s language skills and one can surmise that both vocabulary and phonology are involved to some extent in comprehension. But the analysis of initial correlations also indicates that the children's language skills could already be differentiated fairly well as correlations are only medium-sized: Not only could phonological skills be distinguished from comprehension skills, but syntactic and textual skills could be differentiated from semantic knowledge. This rules out the idea that the development of language comprehension is solely a matter of vocabulary growth in young children and supports recent developmental analyses by Cain et al. (2004); the NICHD Early Child Care Research Network (2005); and Storch and Whitehurst (2002). This idea is further sustained by two observations: (a) Over test times, oral comprehension scores are more strongly correlated with each other than they are with phonology and vocabulary, respectively. The same is true when focusing on phonological scores. (b) Correlations between oral comprehension and phonology gradually decrease over time.

Table 3 - Correlations (Pearson's Coefficient) Between Comprehension, Phonology, and Vocabulary Scores on the T1 to T4 Points of Test.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1. Comprehension at T1	1.00							
2. Comprehension at T2	0.764	1.00						
3. Comprehension at T3	0.679	0.741	1.00					
4. Comprehension at T4	0.578	0.645	0.582	1.00				
5. Phonology at T1	0.601	0.625	0.574	0.399	1.00			
6. Phonology at T2	0.553	0.621	0.550	0.425	0.738	1.00		
7. Phonology at T3	0.470	0.517	0.560	0.327	0.588	0.605	1.00	
8. Vocabulary at T1	0.567	0.552	0.496	0.412	0.424	0.401	0.353	1.00

Note. Each coefficient is significant at $p < .0001$.

Growth-Curve Modeling

We used growth-curve models because they are specifically designed to analyze multiple-wave data and they allow one to analyze not only the final achievement level but also the rate of change during the period under study. Furthermore, given that the sampling variance is taken into account, they can model the true rate of change and the true status at each point in time. Another fundamental advantage of growth-curve models is that they separate interindividual variance from intraindividual variance, so that each pupil has his or her own curve (Raudenbush & Bryk, 2002; Singer & Willett, 2003).

Growth-curve models are generally used to assess the rate of change between measures that remain on the same scale over time. This permits the assessment of "absolute" rates of change. In the present study, the test items were not the same from one time point to the other, and hence the scores are not on the same scale. It was therefore not possible to assess the absolute rate of change. This is why standardized scores, with the same mean and standard deviation over time, were used to assess the degree of relative change between groups. Goldstein et al. (1998) employed the same method to assess how changes in reading attainment vary from student to student. Two growth models were fit to the data, one with oral comprehension as the outcome and the other with phonological awareness as the outcome. There were four waves of data for the oral comprehension measures, so curvilinear models could be tested, but we had only three waves of data for phonological awareness so the model specified was linear.

For the two outcome measures, an empty model and an unconditional growth model were first fit to the data. Control variables were then entered and their interaction with time considered. Only significant interactions were retained. Afterward, the experimental variables (training groups) were entered and their growth curves examined.

Oral Comprehension

The results obtained with oral-comprehension scores as the outcome are summarized in Appendix B, Table B1. The empty model allowed us to address the nested structure of the data. It showed that the intraindividual variance represented 31.7% ofthe total variance. The interindividual variance represented 61% of the variance and the interschool variance amounted to 7.6% of the total variance. So there was more interindividual variability than interschool or intra-individual variability in the oral comprehension data. The unconditional growthcurve model allowed us to examine random effects of time (not surprisingly, the fixed effect of the time variable was not significant as the oral-comprehension scores were standardized for each evaluation time). More interesting, the random effects showed that both the initial statu s of schools differed and the rate of change differed significantly across schools. There was also negative covariance between the school's initial status and the rate of change indicating that the relative rate of change tended to be weaker for schools having children with higher oral comprehension at the onset of the study. Random effects also showed that the initial status of the participants differed as well as the rate of change across individuals. However, once the covariance between the initial status of schools and their rate of change is taken into account, the initial status of the participant did not interact with the rate of change.

The last model we considered was a conditional growth-curve model. As Table B1 shows, the –2logL statistic decreased significantly between the unconditional growth model and the conditional one, $\chi^2(32) = 2108.9$, $p < .001$, indicating that the latter represents a better fit to our data. The interindividual variance was strongly reduced (from 61.6% to 22.3%) as well as the interschool variance (from 9.8% to 1.3%). Moreover, the covariance between the initial status of schools and the rate of change was no longer significant. But, as the other coefficients (interindividual, interschools, and intraindividual) were still significant, a significant part of the variance remained unexplained once the variables were included in the model. Intraindividual variability remained virtually unchanged from the empty to the conditional growth curve model. This was, however, an expected result, as the conditional growth curve model presented here was mainly designed to explain interindividual variability and contained no regressors intended to assess intraindividual variability.

An analysis of the fixed effects of the conditional growth model we retained showed that a number of parameters were significant contributors to the oral-comprehension scores, and that the contribution of some of them changed over time. Let us first examine the children's characteristics: (a) Children from low-status or very low-status homes got significantly lower comprehension scores than their counterparts from higher socioeconomic classes. (b) A child' s month of birth had a negative impact on oral comprehension performance; children born later in the calendar year had poorer oral comprehension than children born earlier in the year. Of interest, however, the month of birth interacted with time. This interaction was positively related to the oral-comprehension score: Whereas younger children were at a disadvantage at the beginning of the study, they reduced the gap with time. (c) Initial phonological skills and vocabulary also contributed positively to oral comprehension. This confirms the previous correlational analysis as well as earlier studies showing that language abilities are highly intertwined in young children. Moreover, initial phonological status also interacted with time according to a quadratic function; phonological skills contributed less to oral comprehension at later time points.

Let us turn now to the effects of our treatment groups. First, the experimental groups did not differ on oral comprehension performance from the control group at the onset of the study. However, significant interactions showed up between time and group. As shown in Figure 1, the rates of change obtained for our experimental groups followed very different patterns.

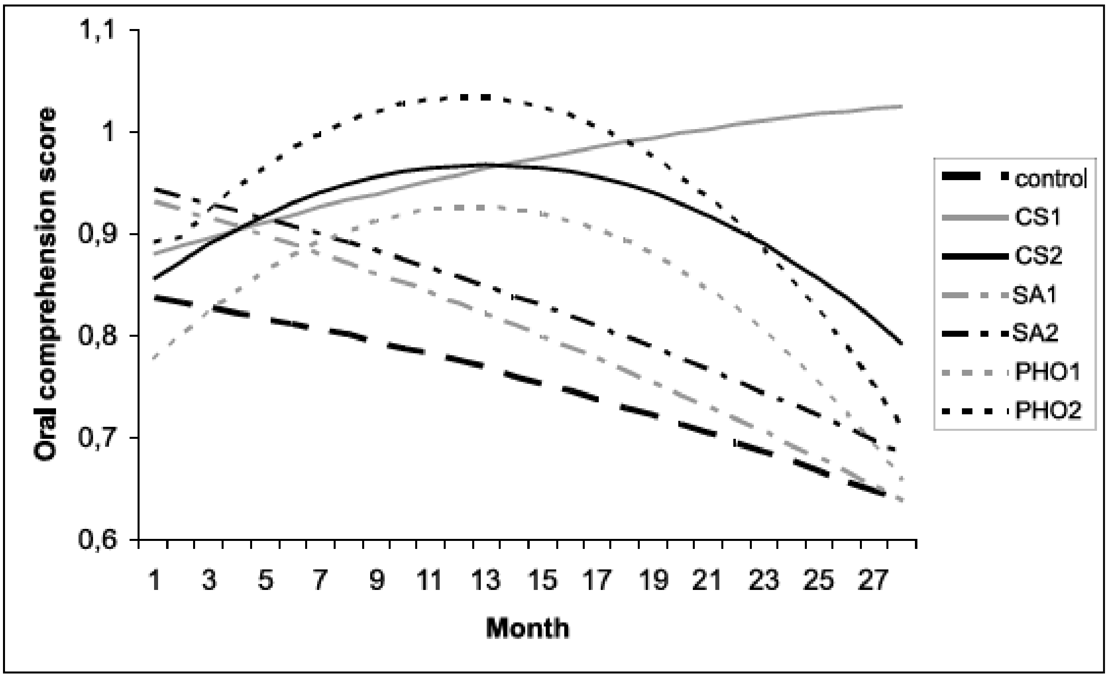


Figure 1. Relative rate of change for oral comprehension performance as a function of experimental group. Curves represent the relative rate of change for boys born in June, from a middle- to high-status home. CS = comprehension-skill training; SA = story-analysis training; PHO = phonological training.

First, the two groups trained in comprehension by means of story analysis (SA1, SA2) did not differ from the control group. So the first conclusion that can be drawn is that a general, implicit, meaning-focused activity is not sufficient to promote the development of oral language comprehension skills among preschool children[5].

Second, the learning curves of three groups—PHO1, PHO2, and CS2—had comparable shapes: Their comprehension scores followed an inverted U-shaped curve. But it is important to notice that the U-shape was much more pronounced for the two phonologically trained groups. Group CS2, which was trained using the comprehension-skills program during kindergarten, did improve its comprehension score at the end of training and maintained that level at T4 (month 27), that is, 9 months later (the quadratic term was not significant). Thus, phonological training did not help children improve their comprehension skills on a long-term basis but explicit training in comprehension did so to some extent for the CS2 children.

Third, the children in the last experimental group (CS1), who were trained using the explicit comprehension-skill program in prekindergarten and kindergarten, exhibited a very distinct learning curve: Their oral comprehension improved regularly and linearly over time. More important, their performance continued to improve during first grade. Nine months after the training program had ended, CS 1 children clearly outperformed their counterparts in oral comprehension skills, and the training effect remained effective in the middle term. Effects size showed that the SC1 group gained 0.4 standard deviations on comprehension score at T4 ($\beta_{cs1} = 0.398$), whereas SC2 group improved their comprehension score to a lesser ex- tend ($\beta_{cs2} = 0.135$).

[5] It is worth noticing here that the observed decreasing slopes do not indicate that the absolute performance is decreasing with time. As outlined earlier, what is modeled here is the relative change between groups. The decreasing slopes indicate that children involved in those groups improved their oral comprehension performance to a lesser extend than children belonging to the other experimental groups. The same argument will hold in interpreting the phonological growth curves.

PHONOLOGICAL AWARENESS

The results obtained for the phonological awareness outcome measure are summarized in Appendix B, Table B2. The empty model showed that the intraindividual variance represented 33% of the total variance; interindividual variance represented 57% of the total variance, and interschool variance amounted to 8 % of the variance. These proportions are comparable to what was observed for the oral comprehension scores. So there was more interindividual variability than interschool or intraindividual variability in the phonological awareness data.

The unconditional growth-curve model allowed us to examine the random effects of time (again, the fixed effect of the time variable was not significant, as phonological awareness scores were standardized for each evaluation time). The random effects showed that the initial status and the rate of change both differed significantly across schools. Moreover, the negative covariance between the initial status and rate of change indicated that the relative rate of change tended to be weaker for schools whose children had higher phonological awareness scores at the onset of the study. Random effects also showed that the initial status of the participants differed as well as rate of change across individuals. There was also a negative covariance between the initial status of the participants and the rate of change indicating that the rate of change tended to be weaker when the children' s phonological scores were higher at the onset of the study.

The last model we considered was a conditional growth-curve model. As seen in Appendix B2, the –2logL statistic decreased significantly, $\chi^2(26) = 665.4$, $p < .001$, between the unconditional growth model and the conditional one, indicating that the latter fits our data better. The interindividual variance was strongly reduced (from 57% to 33%) as well as the interschool variance (from 8% to 3%) but each component remained significant. Obviously, once the variables were included in the model, a significant part of the variance remained unexplained. However and as already noticed for oral comprehension, the intraindividual variability remained virtually unchanged from the empty to the conditional growth curve model. Once again, this was an expected result as the conditional growth curve model presented here was mainly designed to explain interindividual variability and contained no regressors intended to assess intraindividual variability.

An analysis of the fixed effects of the conditional growth-curve model showed, as earlier for oral comprehension, that children from low-status or very low-status homes had significantly lower phonological awareness scores than children from higher socioeconomic classes. The month of birth also had a negative impact on phonological awareness. Children born later in the calendar year got lower phonological awareness scores than children born earlier in the year. However, and again as for oral comprehension, month of birth interacted with time; although younger children were at a disadvantage at the beginning of the study, they reduced the gap with time. The two last individual characteristics that contributed significantly and positively to phonological awareness were the children's initial oral-comprehension and vocabulary scores. Moreover, the initial comprehension status interacted negatively with time showing that the comprehension skills contribute to a lesser extent to phonological awareness as time passed.

Looking now at our treatment groups, we can see that the results are not as clear-cut as for the comprehension training effects. Learning curves for the seven experimental groups are shown in Figure 2. Three points can be made. First, the two comprehension-skill training groups (CS1 and CS2) did not differ from the control group. So this kind of comprehension training did not have an effect on phonological development. Second, of the two story-analysis groups (SA1 and SA2), trained by shared reading and story analysis, the SA2 group improved its rate of change on phonological skills (the effect size is rather small, $\beta_{sa2} = 0.167$ and only marginally significant). Third, of the two groups trained in phonological awareness, only the PHO1 group, trained during two years, significantly improved the children' s phonological skills ($\beta_{pho1} = 0.75$) and displayed a positive true rate of change. The participants in the PHO2 group, trained during the second year only, did not improve their phonological skills significantly.

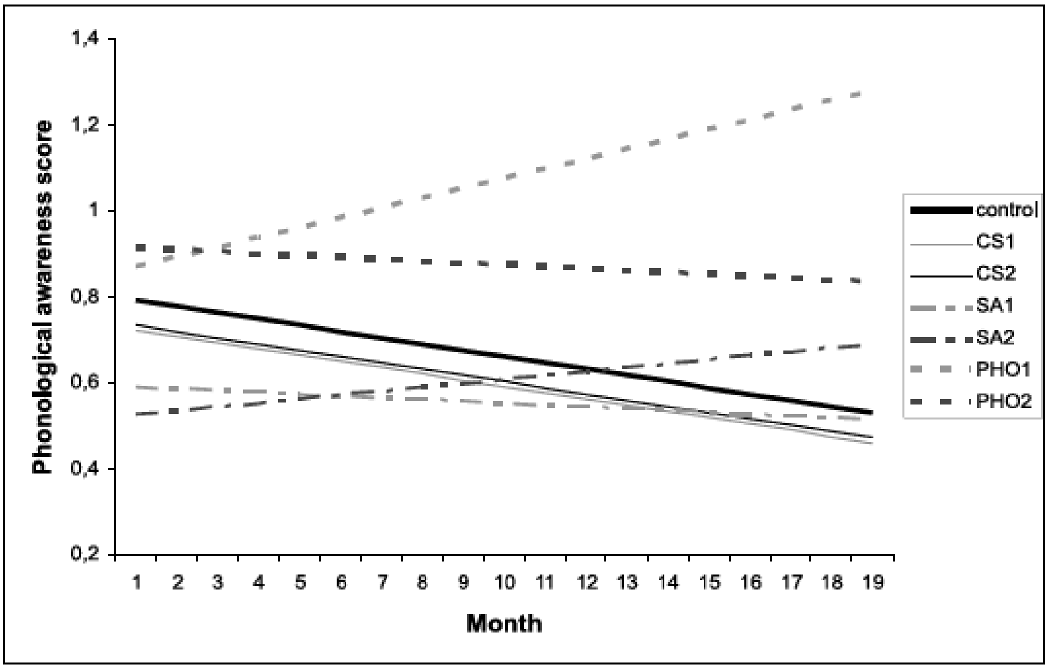


Figure 2. Relative rate of change for phonological awareness performance as a function of experimental group. Curves represent the relative rate of change for boys born in June, from a middle- to high-status home. CS = comprehension-skill training; SA = story-analysis training; PHO = phonological training.

DISCUSSION

The use of multilevel growth curve models here allowed us to model the shape of relative change over groups during and after the training period. The relative decline of the PHO1, PHO2, and CS2 groups in oral comprehension is of clear inter- est as it shows that in the long run the benefits of the intervention fade away. The only group that shows long-term positive training effects is CS1. Second, multilevel growth curve modeling has allowed us to separate interindividual variance from interschool variance as well as from intraindividual variance. This showed that (a) interindividual variance is twice as high as the intraindividual variance (empty models reveal that interindividual variance amounts to 0.57 for phonological awareness and to 0.61 for oral comprehension, whereas intraindividual vari-ance is 0.32 for oral comprehension and 0.33 for phonological awareness), (b) interschool variance represents about 8% of the total variance for oral comprehension as well as for phonological awareness. Variance in slopes could also be estimated and this showed that initial status, at individual and school level, as well as the rate of change differed across both schools and children during the period of the study. Third, it showed that the effect of some student characteristics varies over time. This was the case with month of birth showing that although younger children were at a disadvantage in phonological awareness and oral comprehension at the beginning ofthe study, this gap reduced with time. The oral comprehension skills were also found to interact with time in explaining phonological awareness performance and the phonological skills were found to interact with time in explaining oral comprehension performance. Moreover and in accordance with earlier results (de Jong & van der Leij, 2002; Muter, Hulme, Snowling, & Stevenson, 2004), the influence of the initial phonological level decreased with time.

Our results provide clear answers to the main research questions raised here about early language training and development. First, they show that early training in the high-level components of language comprehension is possible and helps young children improve their ability to parse syntactically complex sentences and texts. Our comparison of two comprehension training programs showed that activities aimed at enhancing the component skills of text comprehension is effective. Improvement in oral comprehension seems to occur under two main conditions: the training must include explicit, well-defined comprehension-focused activities, and it must be a regular classroom activity that spans a relatively long period, as shown here for the children trained for two semesters, who improved much more than children trained for one semester only. This result is consistent with McDonald Connor et al. (2006) recent claim. It is also worth noting that when these conditions are met, the improvement in comprehension performance seems to be relatively durable, because the training effects obtained here were still in effect 9 months after the last training session.

Second, the results of our phonological awareness training support a vast body of literature on this topic and extend the findings by providing data for the French language. They confirm that phonological awareness can be enhanced by training and can easily be taught via specific activities. They also show that two semesters of training triggers greater improvement than training lasting only one semester.

Third, our results clearly show that code-related skills and oral language comprehension skills evolve somewhat independently but simultaneously during the preschool years. We were able to show that phonological training improved code-related skills (phonological awareness in this study) but not comprehension skills, and conversely that comprehension training benefited oral language skills but not code-related ones. These findings corroborate the T2 test results obtained at the end of the 1st year of study: Group CS1 got a higher comprehension score but not a higher phonological awareness score, and conversely group PHO1 improved in phonological awareness but not in oral comprehension (Bianco, Pellenq, & Coda, 2004). This finding extends and reinforces the results of longitudinal studies, which have pointed out the utility of this distinction in describing language development and its relationship to literacy acquisition (Gough & Tunmer, 1986; NICHD, Early Child Care Research Network, 2005; Savage, 2006; Sénéchal & Lefèvre, 2002; Storch & Whitehurst, 2002).

There were some unexpected results and limitations to the study. The first point refers to the effects observed for the groups trained via storybook reading and analysis, that is, a significant positive rate of change on phonological awareness for the SA2 group and a null effect on oral comprehension for both groups. Regarding phonological awareness, one could contend that exposure to the oral language by means of implicit, meaning-focused activities has an impact on the formal analysis of the “sounds” of the language by directing children’ s attention to the language. This conclusion is tentative and would be more convincingly supported if the same effect was also observed for the SA1 group. This result reveals more probably that the normally developing children in the SA2 group were simply catching up with others on phonological awareness. Indeed, the mean phonological scores of the SA2 group was the lowest one at the beginning of the study, and the final mean scores were comparable to those of the CS and control groups. However, the data just presented do not allow us to choose between these two interpretations.

Concerning the null effect on oral comprehension from the SA program, this is a surprising result, given the large number of studies indicating the benefits of shared storybook reading on oral language development (e.g., Garton & Pratt, 2004; Robbins & Ehri, 1994; Sénéchal & Lefèvre, 2002; Whitehurst & Lonigan, 1998). However, the situations studied in the shared-reading literature differ in several respects from our story-analysis training program. First, most shared reading settings are home-literacy environments (Sénéchal & Lefèvre, 2002) and when, if ever, they take place in preschool, the activities are usually aimed at preventing language difficulties among at-risk children in programs like Head Start (Storch & Whitehurst, 2002). This, we believe, is the first major difference that might explain our results. It may also have to do with the organization of the French educational system. French children begin school at the age of 3 years (Insee, 2007), and as a result, all of our pupils were beginning their second year of preschool at the onset of the study. Furthermore, storybook reading represents a daily activity in French preschools, and teachers are very sensitive to this aspect of the language curriculum. The main difference between the traditional French preschool activity and our training program is that teachers usually read stories to the whole class, whereas our story-analysis training program was performed in small groups. Considering this property of the French preschool system, one can argue that every child attending preschool is already familiar with storybook reading, regardless of his or her home-literacy environment. This being the case, our results lead to the conclusion that doing more of the same thing is not the best way to help children develop their oral comprehension skills. This does not mean that storybook reading is not a useful activity on the road to literacy development; it simply means that for normally developing children who are highly familiar with this activity at school, improvement will be promoted to a greater extent by more varied and more explicit analytic activities. The second point with regard to shared reading concerns the assessment of oral language improvement. The effects reported in the literature have mostly been observed for vocabulary growth, especially for children who already have a large vocabulary before training (Robbins & Ehri, 1994). However, during the exploratory phase of our data analysis, we failed to find an effect of the story-analysis training program on vocabulary growth. Recall that our sample was made up of a large majority of children from low SES homes. Knowing that vocabulary improvement in young children is highly correlated with SES, one can suggest that the null effect obtained with storybook reading is partly due to our sample composition.

The second unexpected result is the null effect of phonological training observed for the PHO2 group that contrasts with the large positive effect found for the PHO1 group and with what is usually found in phonological training studies. This result is the most probably due to the main limitation of this study. As stated earlier, it was not possible to design a strictly randomized protocol. As a consequence, and despite the care taken to involve schools sharing similar socio-economical characteristics, the experimental groups were not strictly equivalent at the onset of the study.

The first and most important limitation of the study is the fact that the assignment of teachers and children to the experimental groups was not randomized. This undoubtedly questions the generalization power of our results. We claim however that the positive and selective effects of comprehension and phonological training obtained here cannot be dismissed by appealing to biases caused by nonrandom assignment.

A second limitation of the study is that no measures of the fidelity of program implementation were obtained.

CONCLUSIONS

This study shows that comprehension skills can be taught at an early age to normally developing children. Our results are consistent with those reported by Bowyer-Crane et al. (2008) for children with poor oral language at school entry. We also were able to show that comprehension skills develop relatively independently of phonological skills. These results have both theoretical and practical implications.

From a practical point of view, our data are in line with a recent claim made by McDonald Connor et al. (2006) in an observational study. These authors noted that the best way to promote language abilities in 3- to 5-year-old children is to regularly engage them in focused activities, be they code- or meaning-focused. Furthermore, our training programs were run in natural settings and carried out by regular classroom teachers. Such programs could therefore be integrated into the regular classroom settings and be useful for preventing language comprehension difficulties in typically developing children whatever their socioeconomic background.

From a theoretical point of view, our results clearly show that the various components of oral language develop simultaneously but to some degree independently. This leads us to suggest that although different component language skills can be trained and promoted more or less independently, they all contribute to oral language development and are all crucial to literacy development. This idea was put forward by the NICHD Early Child Care Research Network (2005) team in their statement that “interventions and assessments that focus only on phonemic awareness and vocabulary development will be too narrow to support later academic achievement” (p. 440). Finally, more data are needed to determine exactly how oral language comprehension and reading skills are related and the extent to which early interventions to promote oral language skills will be effective in promoting the development of later reading (both decoding and comprehension) skills.

ACKNOWLEDGMENTS

This research was supported by grants from a national research program “School and Cognitive Sciences” of the French Research Ministry.

REFERENCES

Baker, L. (1985). How do we know we don't understand? Standards for evaluating text comprehension. In D. L. Forrest, G. E. MacKinnon, & T. G. Waller (Eds.), *Metacognition, cognition and human performance* (Vol. 1, pp. 155–205). New York, NY: Academic Press.

Baker, L., & Zimlin, L. (1989). Instructional effects on children's use of two levels of standards for evaluating their comprehension. *Journal of Educational Psychology, 81,* 340–346.

Baumann, J. F. (1986). Teaching third-grade students to comprehend anaphoric relationships: The application of a direct instruction model. *Reading Research Quarterly, 21,* 70–90.

Baumann,J.F.,CarrEdwards,E.,Font,G.,Tereshinski,C.A.,Kame'enui,E.J.,&Olejnik,S.(2002). Teaching morphemic and contextual analysis to fifth-grade students. *Reading Research Quarterly, 37,* 150–176.

Bianco, M., Coda, M., & Gourgue, D. (2002). *Compréhension, Grande section.* Grenoble, France: Editions de la Cigale.

Bianco, M., Coda, M., & Gourgue, D. (2006). *Compréhension, Moyenne section.* Grenoble, France: Editions de la Cigale.

Bianco, M., Lima, L., & Sylvestre, E. (2004). Comment enseigner les stratégies de compréhension. In E. Gentaz & P. Dessus (Eds.), *Comprendre les apprentissages et enseigner: Apports des sciences cognitives* (pp 48–68). Paris, France: Dunod.

Bianco, M., Pellenq, C., & Coda, M. (2004). Enseigner des stratégies pour comprendre en moyenne section de maternelle. *Le langage et l'homme, 39*(2)*,* 69–86*.*

Bowyer-Crane, C., Snowling, M. J., Duff, F. J., Fieldsend, E., Carroll, J. L., Miles, J., et al. (2008). Improving early language and literacy skills: Differential effects of an oral language versus a phonology with reading intervention. *The Journal Of Child Psychology and Psychiatry, 49*(4), 422–432.

Bus, A. G., & van Ijzendoorn, M. H. (1999). Phonological awareness and early reading: A meta-analysis of experimental training studies. *Journal of Educational Psychology, 91,* 403–414.

Cain, K., & Oakhill, J. (1998).Comprehension skill and inference-making ability: Issues ofcausality. In C. Hulme & R. Malatesha Joshi (Eds.), *Reading and spelling: Development and disorders* (pp. 329–342). Mahwah, NJ: Erlbaum.

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*, 671–681.

Carpenter, P. A., & Just, M. A. (1986). Cognitive processes in reading. In J. Orasanu (Ed.), *Reading comprehension: From research to practise* (pp. 11–30). Hillsdale, NJ: Erlbaum.

Casalis, S., & Louis-Alexandre, M. F. (2000). Morphological Analysis, phonological analysis and learning to read French: A longitudinal study. *Reading and Writing*, *12*, 303–335.

Castles, A., & Coltheart, M. (2004). Is there a causal link from phonological awareness to success in learning to read? *Cognition,* 91, 77–111.

Chardon, S.C. (2000). Expérience de soutien en lecture auprès de faibles lecteurs de cycle 3 [The effects of a word identification supporting training with grade 5 low achieving readers]. *Revue Française de Pédagogie*, *130*, 107–120.

Crain-Thoreson, C., & Dale, P. S. (1999). Enhancing linguistic performance: Parents and teachers as book reading partners for children with language delays. *Topics in Early Childhood Special Education*, *19*, 28–39.

de Jong, P. F., & van der Leij, A. (2002). Effects of phonological abilities and linguistic comprehension on the developement of reading, *Scientific Studies of Reading*, *6*, 5 1–77.

Deltour, J. J., & Hupkens, D. (1980). *Test de Vocabulaire Actif et Passif* (T. V.A.P.). Braîne le Château, Belgique: Editions Applications des Techniques Modernes.

Dickinson, D. K., McCabe, A., Anastasopoulos, L., Peisner-Feinberg, E. S., & Poe, M. D. (2003). The comprehensive language approach to early literacy: The interrelationships among vocabulary, phonological sensitivity, and print knowledge among preschool-aged children. *Journal of Educational Psychology, 95*, 482–494.

Ehri, L. C., Nunes, S. R., Stahl, S. A., & Willows, D. M. (2001). Systematic phonics instruction helps students learn to read: Evidence from the National Reading Panel's meta-analysis. *Review ofEducational Research, 71*, 393–447.

Ehri, L. C., Nunes, S. R., Willows, D. M., Schuster, B. V., Yaghoud-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.

Elbro, C., & Scarborough, H. S. (2003). Early identification. In T. Nunes, & P. Bryant (Eds.), *Hand-book of children 's literacy* (pp. 361–381). Dordrecht, the Netherlands: Kluwer Academic.

Gaonac'h, D., & Fayol, M. (2003). *Aider les élèves à comprendre: Du texte a multimédia [How to help children comprehend: From text to multimedia*]. Paris: Hachette.

Garton, A. F., & Pratt, C. (2004). Reading stories. In T. Nunes & P. Bryant (Eds.), *Handbook of children's literacy* (pp. 2 13–228). Dordrecht, the Netherlands: Kluwer Academic.

Gernsbacher, M. A. (1990). *Language comprehension as a structure building*. Hillsdale, NJ: Erlbaum.

Gernsbacher, M. A., Varner, K. R., & Faust, M. E. (1990). Investigating differences in general compre-hension skill. *Journal of Experimental Psychology, Learning, Memory and Cognition, 16*(3), 430–445.

Goldstein, H., Rasbash, J., Plewis, I., Drayer, D., Browne, W., Yang, M., et al. (1998).*A user's guide to MLWIN* (Multilevel models project). London, UK: Institute of Education.

Gombert, J. E. (1990). *Le développement métalinguistique [Metalinguistic development*]. Paris, France: PUF.

Goswami, U., & Bryant, P. (1990). *Phonological skills and learning to read*. London, UK: Erlbaum.

Gough, P. B., & Tunmer, W. E. (1986). Decoding, reading and reading disabilities. *Remedial andSpecial Education*, *7*, 6–10.

Hatcher, P. J., Goetz, K., Snowling, M., Hulme, C., Gibbs, S., & Smith, G. (2006). Evidence for the effectiveness of the early literacy support programme, *British Journal ofEducational Psychology*, *76,* 351–367.

Hatcher, P. J., Hulme, C., & Snowling, M. (2004). Explicit phoneme training combined with phonic reading instruction helps young children at risk of reading failure. *Journal of Child Psychology and Psychiatry*, *45*, 228–258.

Holdaway, D. (1979). *The foundations of literacy*. Portsmouth, NH: Heinemann.

Insee (Institut National de la Statistique et des Etudes Economiques). (2007). *Tableaux de l'économie française [Views of the French economy*] . Retrieved from http://www.insee.fr

Kinnunen, R, Vauras, M., & Niemi, P. (1998). Comprehension monitoring in beginning readers. *Scientific Studies of Reading, 2*, 353–375.

Lambert, E., & Doyen, A. L. (2005). *Phonoludos entrainement MS & GS [Phonoludos, training for prekindergartners and kindergartners].* Grenoble, France: La Cigale Editions.

Lecocq, P. (1992). *La lecture, processus, apprentissage, troubles [Reading, processes, learning, and disorders]*. Lille, France: Presses Universitaires de Lille.

Lecocq, P. (1996). *Ecosse: Une épreuve de compréhension syntaxico-sémantique [Ecosse: A syntacticosemantic test]*. Lille, France: Presses Universitaires de Lille.

Mann, V., & Wimmer, H. (2002). Phoneme awareness and pathways to literacy: A comparison of Ger- man and American children. *Reading and Writing, 15*, 653–682.

McDonald Connor, C., Morrison, F. J., & Slominski, L. (2006). Preschool instruction and children's emergent literacy growth. *Journal of Educational Psychology, 98,* 665–689.

McKeown, M. G., Beck, I. L., Omanson, R. C., & Perfetti, C. A. (1983). Theeffects of long-term vocabulary instruction on reading comprehension: A replication. *Journal ofReading Behaviour, 15*, 3–18.

Morrow, L. M. (1985). Retelling stories: A strategy for improving young children's comprehension, concept of story structure and oral language complexity. *Elementary School Journal, 85*, 647–66 1.

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*, 665–68 1.

Nagy, W., Berninger, V. W., & Abbott, R. D. (2006). Contributions of morphology beyond phonology to literacy outcomes of upper elementary and middle-school students. *Journal of Educational Psychology, 98*, 134–147.

Nation, K., & Snowling, M.J. (1998). Semantic processing and the development of word-recognition skills: Evidence from children with reading comprehension difficulties. *Journal of Memory and Language, 39*, 85–101.

NICHD, Early ChildCareResearchNetwork. (2005). Pathways to reading: Therole of oral language in the transition to reading. *Developmental Psychology, 41*, 428–442.

Oakhill, J. (1994). Individual differences in children's text comprehension. In M. A. Gernsbacher (Ed*.), Handbook of psycholinguistics* (pp. 82 1–848). San Diego, CA: Academic Press.

Oakhill, J., & Cain, K. (2003).The development of comprehension skills. InT. Nunes & P. Bryant (Eds*.), Handbook of children's literacy* (pp. 155–180). Dordrecht, the Netherlands: Kluwer Academic.

Oakhill, J., Cain K., & Yuill J. (1998). Individual differences in comprehension. In C. Hulme & R. Malatesha Joshi (Eds.), *Reading and spelling: Development and disorders* (pp. 329–342). Mahwah, NJ: Erlbaum.

Perfetti, C. A. (1985). *Reading ability*. New York, NY: Oxford University Press.

Raudenbush, S. W., & Bryk, A. S. (2002*). Hierarchical linear models: Applications and data analysis methods* (2nd ed.). London: Sage.

Robbins, C., & Ehri, L.C. (1994). Reading storybooks to kindergartners helps them learn new vocabulary words. *Journal of Educational Psychology, 86*, 54–64.

Rosenshine, B., Meister, C., & Chapman, S. (1996). Teaching students to generate questions: A review of the intervention studies. *Review of Educational Research, 66*, 18 1–221.

Savage, R. (2006). Reading comprehension is not always the product of nonsense word decoding and linguistic comprehension: Evidence from teenagers who are extremely poor readers. *Scientific Studies of Reading, 10*, 142–164.

Sénéchal, M., & LeFèvre J. A. (2002). Parental involvement in the development of children's reading skill: A five-year longitudinal study. *Child Development, 73*, 445–460.

Singer, J. D., & Willett, J. B. (2003). *Applied longitudinal data analysis. Modeling change and event occurrence.* New York, NY: Oxford University Press.

Spires, H. A., & Donley, J. (1998). Prior knowledge activation: Inducing engagement with informational texts. *Journal of Educational Psychology, 90,* 249–260.

Sprenger-Charolles, L., Siegel, L. S., Bechennec, D., & Serniclaes, W. (2003). Development of phonological and orthographic processing in reading aloud, in silent reading andin spelling. A four year longitudinal study. *Journal of Experimental Child Psychology, 84,* 194–217.

Stanovich, K. E., West, R. F., Cunningham, A. E., Cipielewski, J., & Siddiqui, S. (1996). Theroleofinadequate print exposure as a determinant of reading comprehension problems. In C. Cornoldi & J. Oakhill (Eds.), *Reading comprehension difficulties: Processes and intervention* (pp. 15–32). Mahwah, NJ: Erlbaum.

Steiger, J. H. (1980). Tests for comparing elements of a correlation matrix. *Psychological Bulletin, 87,* 245–251.

Storch, S. A., & Whitehurst, G. J. (2002). Oral language and code-related precursors to reading: Evidence from a longitudinal structural model. *Developmental Psychology, 38,* 934–947.
Thiede, K. W., & Anderson, M. C. (2003). Summarizing can improve metacomprehension accuracy.
Contemporary Educational Psychology, 28, 129–160.
Torgesen, J. K. (2002). The prevention of reading difficulties. *Journal ofSchool Psychology, 40,* 7–20.
Torgesen, J. K., Wagner, R. K., Rashotte, C. A., Rose, E., Lindamood, P., Conway, T., et al. (1999). Preventing reading failure in children with phonological processing difficulties: Group and individual responses to instruction? *Journal of Educational Psychology, 81,* 579–593.
Trabasso, T., & Bouchard, E. (2002). Teaching readers how to comprehend strategically. In C. Collins Block & M. Pressley (Eds.), *Comprehension instruction, research-based bestpractices* (pp. 176–202). New York, NY: Guilford.
Trabasso, T., & Magliano, J. P. (1996). Conscious understanding during text comprehension. *Dis- course Processes, 21,* 255–288.
Van den Broek, P. (1994). Comprehension and memory of narrative texts: Inferences and coherence. In M. A. Gernsbacher (Ed.), *Handbook ofpsycholinguistics* (pp. 539–588). San Diego, CA: Academic Press.
Van Dijk, T. A., & Kintsch, W. (1983). *Strategies of discourse comprehension*. New York, NY: Academic Press.
Wagner, R. K., & Torgesen, J. K. (1987). The nature of phonological processing and its causal role in the acquisition of reading skills. *Psychological Bulletin, 101,* 192–2 12.
Whitehurst, G. J., Arnold, D. S., Epstein, J. N., Angell, A. L., Smith, M., & Fischel, J. E. (1994). A picture book reading intervention in day care and home for children from low-income families. *Developmental Psychology, 30,* 679–689.
Whitehurst, G. J., & Lonigan, C. J. (1998). Child development and emergent literacy. *ChildDevelopment, 69,* 848–872.
Wimmer, H., Landerl, K., Linortner, R., & Hummer, P. (1991). The relationship of phonemic awareness to reading acquisition: More consequence than precondition but still important. *Cognition, 40,* 219–249.
Yuill, N., & Oakhill, J. (1991). *Children'sproblems in text comprehension: An experimental investigation*. Cambridge, UK: Cambridge University Press.

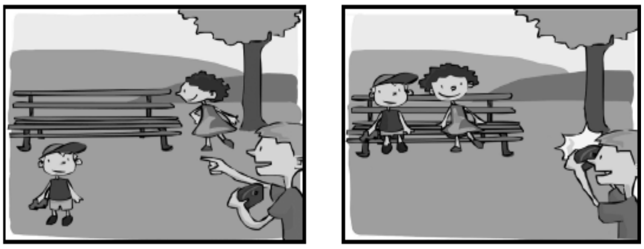
APPENDIX A

EXAMPLES OF ACTIVITIES PROPOSED IN THE COMPREHENSION TRAINING PROGRAM

Example 1: Finding the Appropriate Situation Model

Each child is given two pictures and has to choose the one that corresponds to the situation described in the sentence (or story) read by the teacher: *"Well," Father says to Lucy and Tony, "Sit down on this bench. I'm going to take a picture".*

After every child has chosen a picture, the teacher starts a discussion in order to lead the children to explain the reasons for their individual choices and to arrive at a shared interpretation that points to which picture best represent situation.



Allez, dit papa à Lucie et à Tony, installez - vous sur le banc, je vais vous prendre en photo

Example 2: Interpreting Connectives

Each child is given three pictures and has to put them in the order described in the sentence read by the teacher, for example, *"Guillaume is very thirsty. He opens a bottle of fruit juice and he drinks after filling up his glass."*

After every child has put the pictures in order, the teacher starts a discussion in order to lead the children to explain the reasons for the order they chose, and to arrive at a shared interpretation that points to the right order depicted in the sentences heard.

Note: Illustrations are reproduced with permission from Les éditions de la Cigale, avenue de Chamrousse, Grenoble, France

Table A1 - Organization and Content of the Training Sessions for the Three Programs

	Comprehension Skills Training	*Story Analysis Training*	*Phonological Training*
Semester 1: Prekindergaten			
Session 1	Detection of inconsistencies	***First Album discovery***; teacher reads the whole text.	Pseudo words repetition, Discrimination of sounds
Session 2	Detection of inconsistencies	Reminding of the story; work on pages 1-5; main character.	Discrimination of sounds, Pseudo words repetition
Session 3	Causality	Reminding of the story; work on pages 6-10; main character	Discrimination of sounds, Syllabic segmentation
Session 4	Situation model	work on pages 11-15; settings and actions	Discrimination of sounds, Matching initial syllables
Session 5	Situation model	Re-reading whole story, discussion	Syllabic segmentation, Matching initial syllables
Session 6	Connectors	Work on pages 16 to end; what, when and why?	Pseudo words repetition, Matching final syllables
Session 7	Connectors	Whole story, vocabulary, questions	Discrimination of sounds, Matching final syllables
Session 8	Connectors	Whole Story, what about the end? Reminding	Syllabic segmentation, Matching initial syllables
Session 9	Deduction	***Second album discovery***; teacher reads the whole text.	Discrimination of sounds, Matching initial syllables
Session 10	Deduction	Reminding; work on part 1; vocabulary;	Matching rhymes, Identification of initial syllable
Session 11	Anaphora	Work on part 1; anaphora	Identification of initial syllable, Matching rhymes
Session 12	Story structure	Work on part 2;	Production of pseudo words, Identification of final syllable
Session 13	Causality	Compare part 1 and 2	Identification of initial syllable, Matching syllables
Session 14	Deduction	Whole story; questions	Identification of final syllable, Matching syllables
Session 15	Situation model	Work on part 3; vocabulary, anaphora	Identification of the rhyme, Matching syllables
Session 16	Situation model	Whole story, discussion, different points of view	Identification of initial syllable, Matching syllables
Session 17			Identification of the rhyme, Production of pseudo words
Session 18			Matching syllables, Localisation syllable
Session 19			Combining syllables, Localisation syllable
Session 20			Matching syllables, Production of pseudo words
Session 21			Matching rhymes, Localisation of syllable
Session 22			Localisation of syllable, Combining syllables
Session 23			Matching rhymes, Combining syllables
Session 24			Production of pseudo words, Combining syllables
Semester 2: Kindergarten			
Session 1	Detection of inconsistencies	***First Album discovery***; teacher reads the whole text	Pseudo words repetition, Localisation of syllable
Session 2	Detection of inconsistencies	Reminding of the story; work on pages 1-15; main characters.	Localisation and Comparison of syllables
Session 3	Situation model	Work on pages 16-30; Actions, episodes	Comparison and Localisation of syllable
Session 4	Connectors	Work on pages 31 to end; discussion, summary	Combining syllables, Deletion of syllable
Session 5	Deduction	***Second Album discovery***; look at pictures; what happens?	Deletion of syllable, Combining syllables
Session 6	Deduction	Reminding; teacher reads the whole text.	Combining syllables, Reversing syllables
Session 7	Deduction	Pages 1-15; setting, vocabulary, main characters, why?	Reversing syllables, Identification of the rhyme
Session 8	Situation model	Pages 16-25; "the witch"; where are they? Vocabulary,	Production of the rhyme, Identification of the rhyme
Session 9	Causality	Pages 26 to end; vocabulary, order of actions; when , why, how?	Find the same rhyme, Combine rhymes
Session 10	Anaphora	Whole story, discussion, think of other stories.	Find the same rhyme, Matching rhymes
Session 11	Connectors	***Third Album discovery***; look at pictures; what happens?	Matching rhymes, Combining rhymes
Session 12	Story structure	Reminding; teacher reads the whole text,	Identification of the rhyme, Matching rhymes

	Comprehension Skills Training	*Story Analysis Training*	*Phonological Training*
Session 13	Story structure	Pages 1-15; main character, vocabulary ;	Matching rhymes, Find the same phoneme
Session 14	Situation model	Pages 16-26; main character's friend? When and how?	Find the same phoneme , Identification of phonemes
Session 15	Detection of inconsistencies	Pages 27 to end; characters likes, dislikes and moods;	Identification of phonemes, Blending phonemes
Session 16	Situation model	Reminding, whole story listening, summary	Identification of phonemes, Blending phonemes
Session 17			Blending phonemes, Identification of phonemes
Session 18			Identification of phonemes, Matching initial phonemes
Session 19			Matching initial phonemes, Blending phonemes
Session 20			Blending phonemes, Matching initial phonemes
Session 21			Blending phonemes, Segmentation of phonemes
Session 22			Matching initial phonemes, Segmentation of phonemes
Session 23			Matching initial phonemes, Segmentation of phonemes
Session 24			Blending phonemes, Matching phonemes

APPENDIX B

Table B1 - Oral Comprehension Growth Model From Prekindergarten to First Grade.

Fixed Effects	*Empty Model* *Estimation (SD), Pr > /t/*	*Unconditional Growth-Curve Model* *Estimation (SD), Pr > /t/*	*Conditional Growth-Curve Model* *Estimation (SD), Pr > /t/*
Intercept	–0.0389 (0.049)	–0.0615 (0.054)	0.2095 (0.073)**
Time		0.0018 (0.001)	–0.0169 (0.005)**
Time2			0.0003 (0.0001)*
SES (low)			–0.1841 (0.044)***
SES (very low)			–0.1288 (0.051)*
Month of birth			–0.0195 (0.006)**
Time × Month of birth			0.0011 (0.0003)**
Phonology T1			0.4321 (0.023)***
Vocabulary T1			0.3113 (0.019)***
Phonology T1 × Time			0.0060 (0.003)
Phonology T1 × Time2			–0.0004 (0.0001)**
CS1			0.0429 (0.082)
CS2			0.0186 (0.094)
SA1			0.0952 (0.094)
SA2			0.1070 (0.110)
PHO1			–0.0608 (0.093)
PHO2			0.0216 (0.088)
CS1 × Time			0.0128 (0.004)**
CS2 × Time			0.0232 (0.010)*
SA1 × Time			–0.0034 (0.005)
SA2 × Time			–0.0022 (0.006)
PHO1 × Time			0.0306 (0.011)**
PHO2 × Time			0.0335 (0.011)**
CS2 × Time2			–0.0007 (0.0003)
PHO1 × Time2			–0.0010 (0.0004)**
PHO2 × Time2			–0.0012 (0.0004)**
Random Effects			
Level 3 (school)			
Intercept variance	0.0767 (0.022)**	0.0982 (0.028)**	0.0127 (0.007)*
Slope variance		0.00006 (0.00002)*	0.00003 (0.00002)*
Intercept × Slope Covariance		–0.0013 (0.0006)*	–0.0004 (0.0003)
Level 2 (individual)			
Intercept variance	0.6113 (0.029)***	0.6165 (0.029)***	0.2235 (0.014)***
Slope variance		0.0002 (0.00004)***	0.0002 (0.00004)***
Level 1			
Residual	0.3169 (0.008)***	0.2828 (0.009)***	0.2685 (0.008)***
–2logL	9696.2	9642.2	7533.3

Note. This covered a period of 27 months. SES = socioeconomic status; CS = comprehension-skill training; SA = story-analysis training; P11O = phonological training.
*p < .05. **p < .001. ***p < .0001.

Table B2 - Phonological Growth Model from Prekindergarten to End of Kindergarten.

Fixed Effects	*Empty Model* *Estimation (SD), Pr > /t/*	*Unconditional Growth-Curve Model* *Estimation (SD), Pr > /t/*	*Conditional Growth-Curve Model* *Estimation (SD), Pr > /t/*
Intercept	− 0.0040 (0.051)	−0.00347 (0.058)	0.4185 (0.081)***
Time		0.00008 (0.007)	− 0.0141 (0.005)**
SES (low)			− 0.1568 (0.048)**
SES (very low)			− 0.2970 (0.057)***
Month of birth			− 0.0378 (0.007)***
Time × Month of birth			0.0009 (0.0005)*
Oral comprehension T1			0.4834 (0.026)***
Time × Oralcomp			−0.0062 (0.002)**
Vocabulary T1			0.1163 (0.023)***
CS1			− 0.0696 (0.082)
CS2			− 0.05780 (0.090)
SA1			− 0.2007 (0.121)
SA2			− 0.2671 (0.146)
PHO1			0.0766 (0.117)
PHO2			0.1205 (0.108)
SA1 × Time			0.0103 (0.010)
SA2 × Time			0.0237 (0.012)*
PHO1 × Time			0.0373 (0.009)***
PHO2 × Time			0.0102 (0.008)
Random Effects			
Level 3 (school)			
Intercept variance	0.0832 (0.025)**	0.1077 (0.033)**	0.0303 (0.012)**
Slope variance		0.0004 (0.0001)**	0.0002 (0.00008)**
Intercept × Slope Covariance		−0.0032 (0.0016)*	−0.0021 (0.0008)*
Level 2 (individual)			
Intercept variance	0.5658 (0.031)***	0.6747 (0.039)***	0.3340 (.0024)***
Slope variance		0.0006 (0.0001)***	0.0005 (0.0001)***
Intercept × Slope Covariance		−0.0083 (0.0017)***	−0.0044 (0.0014)**
Level 1			
Residual	0.3339 (0.011)***	0.2579 (0.012)***	0.2585 (0.012)***
−2logL	7062.3	6907.2	6241.8

Note. This covered a period of 18 months. SES = socioeconomic status; CS = comprehension-skill training; SA = story-analysis training; P11O = phonological training.
*p < .05. **p < .001. ***p < .0001.