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www.sagepublications.com Vol 29(1): 113–142 (200902)
DOI: 10.1177/0142723708097484

On the relationship between morphological and phonological awareness: Effects of training in kindergarten and in first-grade reading

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ABSTRACT
This study examined the relationship between phonological and morphological awareness in kindergarten, and their respective influence on learning to read in first grade, through an experimental training design with three groups of children. One experimental group received phonological awareness training while the other received morphological awareness training. The control group did not receive any training. Both training sessions were efficient since the largest pre- and post-test improvements were observed in the trained domains. Reciprocal influence analysis indicated that morphological awareness improved phonological sensitivity, but not the explicit manipulation of phonemes. In addition, phonological awareness training helped children to segment morphemes, but not to derive complex words. Thus, while some processes are shared by both metalinguistic domains, each domain appears to have its own specificity and may develop independently, at least partly. Even though morphological awareness training was found to be efficient at the kindergarten level, no clear impact on reading was found at the first-grade level, while phonological training displayed a clear positive effect on reading.

FIRST LANGUAGE VOLUME 29 ISSUE 1

KEYWORDS
Learning to read; morphological awareness; morphological training; phonological awareness; phonological training

INTRODUCTION

The role of phonological awareness – broadly defined as the ability to manipulate phonological units of language – in learning to read is now largely acknowledged (Brady and Shankweiler, 1991; Goswami and Bryant, 1990), and it is now admitted that success in mastering print-to-sound correspondences at least partially depends on phonological awareness (Bradley and Bryant, 1983; Byrne, Freebody & Gates, 1992; for a recent review, see Castles & Coltheart, 2004). This is not surprising since alphabetic writing is designed to represent the phonological structure of words, that is, the identity of sounds and their combinations. However, alphabetical systems encode not only the phonological structure of words but also their morphological structure: their internal organization (morphologically complex words are composed of at least two morphemes such as the French word *laiteux* 'milky'), as well as their morphological relationship with other words through morphograms (see: Baayen and Schreuder, 2003; Feldman, 1995). In written French, for example, the silent final letter 't' (called a morphogram) in the word *lait* 'milk' is the morphological link with other members of the morphological family *lait* such as *laitier* 'milkman', *allaiter* 'to nurse/breastfeed', *allaitement* 'breastfeeding'. More, computational studies have shown that English school textbooks propose four times more morphologically-complex words, such as *laitage* 'dairy product', than morphologically simple words such as *lait* 'milk' (Nagy and Anderson, 1984). Very early on, then, the beginning reader encounters a large number of complex words when reading.

The morphological system of French

Three forms of morphology are often considered: inflectional morphology, which involves syntactical information (markers of feminine and plural forms, or verb tense); derivational morphology or word-formation by adding derivational affixes (which bear semantic information); and compound noun composition or compounding, which consists of bringing two words together to form a third, different word, and which is often considered separately from derivational composition.

Our study is mainly concerned with derivational morphology. A derived word is composed of a base and at least one affix. The affix can be a prefix – if it is placed before the base, as in *unreal* – or a suffix if it is placed after the base, as in *useless*. Affixes have a number of properties. They never appear alone in a language, but are always attached to a base (which is why they are often called bounded morphemes). On the contrary, the base may occur alone. In French, as in many other languages, the suffixation process can also modify the syntactical category of the base (e.g., *lait* 'milk', *laiteux* 'milky'). In French, many words are derived (Rey-Debove, 1984) and most French words (80% according to Huot, 2001) come

from Latin. Moreover, the derivational system is relatively transparent: generally, the meaning of the derived form can be extrapolated from the meanings of the base and the affix (Huot, 2001). This is because French is basically derived from Latin (both 'low' and scholarly Latin), and because the morphological structure of French words is, to a large extent, directly inherited from the morphological structure of Latin.

Morphological awareness in learning to read

Relatively few studies (compared with those conducted on phonological awareness) have investigated the morphological aspects of reading acquisition and particularly the involvement of morphological awareness in learning to read. Longitudinal and correlational studies, however, have suggested that morphological awareness – defined as the ability to consciously manipulate morphemic units – may also be one important component of learning to read (Carlisle, 1995; Casalis & Louis-Alexandre, 2000). Indeed, the importance of morphological awareness has been evidenced in various languages, such as English (Carlisle, 1995; Leong, 2000; Mahony, Singson & Mann, 2000), French (Casalis & Louis-Alexandre, 2000; Colé, Royer, Leuwers & Casalis, 2004), Danish (Elbro & Arnbak, 1996), Serbo-Croatian and Turkish (Fowler, Feldman, Andjelkovic Oney, 2003), where written forms encode morphological information.

More precisely, longitudinal studies have indicated that morphological awareness tests account for a small but significant independent part of variance in reading scores, suggesting that morphological awareness may indeed play a crucial role in learning to read. Although the correlational data obtained so far do not establish a causal connection, the predictive value of morphological awareness should inspire studies designed to probe for such a connection.

What also clearly emerges from these studies is the contribution of morphological awareness to the reading ability of children starting in second grade (this is less clear for first graders; for contradictory results, see: Carlisle, 1995; Carlisle & Nomanbhoy, 1993; Casalis & Louis-Alexandre, 2000; Colé et al., 2004; Fowler and Liberman, 1995). In addition, studies such as those by Mahony et al. (2000) and Mann & Singson (2003) have shown that as the contribution of morphological awareness in reading increases from the third grade to the first year of middle school, the contribution of phonological awareness (very important in the first and second grades) decreases. These results suggest that phonological awareness plays an important role in the early grades, while morphological awareness may have a greater role later on (Carlisle, 2000). Phonological awareness would help the understanding of the alphabetical principle – particularly in handling letter-to-sound correspondences – while morphological awareness would help with the reading of complex words, after readers have acquired the main decoding abilities (Carlisle, 2003). This view is supported by results which show that second graders (Carlisle & Stone, 2003; Laxon, Rickard & Coltheart, 1992), third graders (Burani, Marcolini & Stella, 2002), fourth graders (Laxon et al., 1992), fifth graders (Feldman, Rueckl, diLiberto, Pastizzo & Vellutino, 2002) and sixth graders (Verhoeven, Schreuder & Baayen, 2003) are able to use morphemes when reading complex words.

One might hypothesize that morphological awareness emerges earlier in the French language, than in English as far as the derivational system is concerned.[1] There are at least two reasons for this earlier intervention. From an etymological point of view, a large percentage of English words come either from Latin or from German. English words may therefore be constructed according to various principles (inherited from either Latin, Greek or Germanic structures) whereas in French there may be more homogeneity in the derivational system, since words mainly come from Latin. The second reason lies in the nature of French orthography, with its relatively transparent grapheme-phoneme correspondence system.[2] Additionally, as already mentioned, part of the French derivational system is encoded through special graphemes called morphograms (but not through phonemes). Surely processing these silent letters may help children to develop morphological awareness and may be directly associated with morphological processing in reading. French children grasp and use the grapheme-phoneme correspondence system earlier than English children (Seymour, Aro & Erskine, 2003), and phonemic awareness develops quickly – maybe as a result of the relative transparency of French grapheme-phoneme correspondences; French studies have indicated that accuracy scores in the phoneme deletion task reach ceiling values as soon as the middle of first grade (Lecocq, 1991, 1993). When reading scores take only accuracy into account, it appears that the variance due to phonological awareness is reduced by second grade (Casalis & Louis-Alexandre, 2000), and, correlatively, that a significant part of variance in reading achievement is due to morphological awareness by second grade (Casalis & Louis-Alexandre 2000), and even as early as first grade for certain tasks (Colé et al., 2004). The French data suggest that morphological awareness could play a very early role in learning to read. This pattern of results contrasts with English studies, which indicate a later role of morphological awareness (Deacon & Kirby, 2004; Mahony et al., 2000). However, the general pattern of both groups of studies is that the larger part of variance at the beginning of literacy is due to phonological awareness while morphological awareness plays an increasing role in the development of reading skills.

The relationship between phonological and morphological awareness

Even though phonological awareness precedes morphological awareness in learning to read, the question concerning the relationship between the two is still open. Correlational studies have indicated that phonological and morphological awareness are highly intercorrelated (Carlisle, 1995; Fowler & Liberman, 1995), even though scores of each ability contribute to an independent part of variance in learning to read, which suggests that they may involve common abilities. At the same time, it is not possible to determine whether one of these abilities may depend on the other one. As we have already mentioned, it is generally admitted that phonological awareness plays an important role in reading in the first grades, while morphological awareness may have a greater role in later grades (Carlisle,

2000). But this does not imply that morphological awareness depends on phonological awareness from a developmental point of view. Such a relationship, if the case does arise, has to be proven.

Theoretically, phonological and morphological awareness may be linked because both are involved in the manipulation of parts of speech. More specifically, in French, from a phonological point of view, different derivational processes may be considered. In 'transparent' cases, derived forms are produced simply by adding a suffix to the base. In a second case, that specifically involves bases ending with a nasalized sound (*camion* 'truck', *jardin* 'garden'), adding a suffix triggers a denasalization process (e.g., *camionneur* 'truck driver', *jardinier* 'gardener') that modifies the phonological form of the vowel, with only minor orthographic change. In a third case, adding a suffix necessitates adding a phoneme between the base and suffix (e.g., *lion* 'lion', *lionceau*, 'lioncub'). In a fourth, 'opaque' case, the phonological form of the base is transformed in the derivational process. In these cases of allomorphic forms, the vowel sound is modified (e.g., *clair/clarté* 'clear/clarity'). Another case of phonological opacity comes from 'doublets', when forms derived from low Latin and scholarly Latin are perceived as belonging to the same morphological family (e.g., *nage/natation* 'swimming' in French are perceived as belonging to the same morphological family, whereas *nage* comes from low Latin and *natation* from scholarly Latin).[3] In these cases, the phonological form of the bases may be relatively different. Thus, the relationship between base and derived forms appears to take place along a continuum, from phonological transparency to opacity. Manipulating morphemes may necessitate manipulating the phonological form of the base, and therefore may enhance phonological awareness. Thus, a reciprocal relationship between these two domains may be envisaged.

It has been suggested that morphological awareness covers a broader range of abilities than phonological awareness, and that some of these emerge early in development (Fowler & Liberman, 1995). Phonological awareness includes the ability to manipulate phonological units such as syllables, onset-rimes and phonemes. While performance may depend on the difficulty of the task (in terms of task complexity, memory involvement, length and structural complexity of items) it is acknowledged that children are able to manipulate syllables from the age of about 4 or 5, and become competent in phoneme tasks at age 6 or 7. The development of phonological awareness seems thus to be concentrated at the kindergarten and first grade levels. Morphological awareness, inversely, may develop earlier in early childhood and later in school years. For example, Leong (2000) and Mahony (1994) found that morphological awareness continues to develop beyond fourth and fifth grades, which suggests that the development of morphological awareness takes longer than the development of phonological awareness. From this point of view, phonological analysis may expand from morphological awareness. The relationship between these abilities – whose importance in learning to read seems indisputable – has not been elucidated. While large correlations between both domains have been found, no causal connection has been established.

One of the aims of the present study is to examine the connections between phonological and morphological awareness more precisely through a training study.

As Castles & Coltheart (2004) have recently pointed out, longitudinal studies (using correlational data) raise methodological problems for the investigation of complex relationships between two sets of skills in learning to read. Training studies seem to offer a sound alternative for dealing with this type of question; they are also an excellent means of assessing causal links between linguistic skills (such as phonological or morphological knowledge, for example) and reading skills. This is the second aim of this study.

Morphological training studies

To our knowledge, very few studies have involved training for morphological awareness, and most of them have examined the question of whether the development of morphological awareness would be beneficial to reading. For example, Henry (1988, 1993) proposed an instructional plan for promoting the development of morphological awareness, in order to improve the decoding and spelling of polysyllabic words. The plan consisted of an explicit analysis of word structure and origin (Anglo-Saxon, Greek and Latin). Close to 500 third, fourth and fifth graders (mainly average readers) were given this instruction over a two-week period. Post-test data suggested that instruction improved the knowledge of morphological word structure, as well as performance in decoding and spelling.

In a study designed to improve the reading performance of 10- and 12-year-old dyslexic children, Elbro & Arnbak (1996; see also Arnbak & Elbro, 2000) proposed remediation – based on the morphological analysis of aurally-presented words – as an alternative strategy for word recognition. The results of the study could not establish a specific relation between morphological awareness and complex word reading. However, passage comprehension improved after training, suggesting that morphological awareness may be trained, and may also have a positive (though limited) impact on reading, even when phonological skills are poor.

In a more recent study devoted mainly to spelling skills, Nunes, Bryant & Olsson (2003) compared the effects of phonological and morphological training in children aged 7–8. The authors tested the hypotheses that specifically learning morphological rules would help children to spell complex words (for which the use of morphological rules is required), while learning conditional phonological rules would specifically promote the spelling of patterns involving these particular rules, and that there would be no reciprocal influences between the two. The results showed that both interventions had positive effects on reading and spelling, since the two trained groups performed higher than the control group. Even though this study focused on the effects of training on spelling, it reveals some effects relevant to our discussion. In particular, Nunes et al. (2003) also evidenced a positive impact of morphological training on reading. However, this impact was not specific, since it could not be differentiated from possible effects of phonological training, because the authors used a standard reading score as well as a score that specifically assessed the use of morphological rules in reading (as measured by the reading of derived words or pseudowords). Finally, the impact of morphology training was both stronger and more specific on the spelling tests than on the reading tests.

Overall, these studies illustrate that morphological awareness training can help children develop strategies which improve their reading skills. They reveal little, however, concerning a possible causal role that morphological awareness may play in learning to read. These studies concerned 'older' children – from third to sixth grade (except for the spelling study of Nunes et al., 2003); the role of morphological awareness in the first stages of learning to read remains unclear. A possible relationship with phonological awareness has not been examined, and the question of how morphological awareness is connected to reading is unclear.

To our knowledge only one study has been conducted that directly addresses the issue of the relationship between phonological and morphological awareness in the early stages of reading acquisition. Lyster (2002) compared the effects of training in phonological and morphological awareness in kindergarteners, and dealt with various questions. The first one examined the effects of morphological awareness training on metalinguistic development, compared with phonological awareness training. Morphological training was found to foster growth in phonological awareness, and phonological awareness training was found to foster growth in morphological awareness. However, in some phonological tests, children trained in phonological awareness outperformed children trained in morphological awareness. In addition, in some morphological tests, the group trained in phonological awareness outperformed the group trained in morphological awareness, which suggests that phonological processing may play a vital role in development of morphological awareness. The second question was to examine whether morphological awareness training was beneficial for later reading (in first grade). As a corollary, the third question examined whether this benefit arises from phonological skills. In this study, training of both phonological and morphological awareness was associated with print exposure, but not in a systematic way, and print exposure differed slightly across groups. More precisely, in the phonological group, the children were exposed, for a part of exercises, to letters or letter sequences corresponding to the sound that they were working/playing with; in the morphological group, children were presented with free morphemes and whole words in activities that focused them on the concept of words and sentences. In accordance with metalinguistic training objectives, children trained in phonological awareness were exposed to one-syllable words, while children trained in morphological awareness were exposed to two- or three-syllable words. Contrary to what was observed with metalinguistic development, the impact on reading was stronger for morphological awareness training than for phonological awareness training, although both groups displayed positive effects on reading. Finally, it was found that while the phonological awareness training benefited all the children (and especially children with poorly-educated mothers), morphological awareness training benefited children with highly-educated mothers. In all, the results of this study indicated that while phonological awareness training was more efficient in developing morphological awareness, the impact of training on reading was larger with morphological awareness training. This last result does not fit with some of the results obtained for morphological awareness in first grade (Casalis & Louis-Alexandre, 2000), and may be explained by the fact that the children enrolled in Lyster's study had also been

exposed to print. This may have complicated the picture. In addition, the two groups were not exposed to the same kind of words: the 'morphological group' was trained with complex words, which could partially explain the result obtained for reading, since the children were confronted with both the phonological and morphological structures of the words.

The present study

The aim of the present study was thus to examine the early relationship between phonological and morphological awareness as precisely as possible, through a training study focused on derivational morphology (Study 1). Derivational morphology was used because, as already mentioned, it is the most frequent morphological process in French. In order to examine this relationship as purely as possible, our training sessions avoided print exposure (Castles & Coltheart, 2004).

We also focused on the relationship between phonological and morphological awareness *before* learning to read for two main reasons. First, as already mentioned, phonological awareness (as measured by accuracy scores) reaches ceiling values very early in French children. Data collected with pre-readers will allow us to consider reciprocal influence with valid conditions, and will allow for the interpretation of longitudinal data in training studies. Second, some recent studies suggest that morphological awareness plays an early role in French reading acquisition, even though, as in English, its role may increase with the development of reading skills.[4] In languages such as French, therefore, it is of particular interest to study such an early relationship. Such a design will allow us to examine to what extent phonological awareness may develop independently of morphological awareness and, inversely, morphological awareness may develop independently of phonological awareness. Following Castles & Coltheart's (2004) recommendations, we avoided print exposure during the training session in order to examine impact on reading as purely as possible. In addition, the direct impact of both phonological and morphological awareness on learning to read may be compared when children have reached first grade (Study 2). Of course, since studies have already demonstrated that impact on reading was greater if printed materials are used in addition to metalinguistic training, marginal effects may be expected. However, the effects of both kinds of metalinguistic training on reading level may be directly compared.

The rationale of Study 1 was the following: if morphological awareness depends, at least partially, on phonological awareness, the effects of phonological training (if proved to be relevant to phonological awareness) should be larger on morphological awareness scores than the effects of morphological training on phonological awareness scores. Inversely, if phonological awareness depends, at least partially, on morphological awareness, the effects of morphological training (if proved to be relevant to morphological awareness) should be greater in phonological awareness scores than the effects of phonological training on morphological awareness scores. In a more fine-grained analysis, various aspects of both phonological and morphological awareness are examined, and relationships between both domains may be studied in detail.

STUDY 1: PHONOLOGICAL AND MORPHOLOGICAL TRAINING IN KINDERGARTEN

METHOD

Participants

Children came from various areas in the northern France (including urban and rural zones), representing a wide range of socio-economic levels, although there was a majority of low-income families. Children were randomly selected from a population conforming to the following selection criteria: in their sixth year (no early-starters or repeaters); average-to-above cognitive abilities (25th percentile and above); French as native language (no bilinguals); no difficulties with oral language; non-readers; parents having given permission to take part in the study. In the kindergarten regular curriculum, children are trained to count syllables in words but not phonemes. They do not learn letter-sound correspondences and they generally know the letters of their own first name; they get handwriting training for letters but the training focuses more on the motor gesture than on the alphabetical principle.

A total of 144 children were tested in a first pass. Children who did not fit the criteria were excluded. The remaining children were divided into three equivalent groups, matched on: socio-economic status, age, non verbal cognitive abilities (Progressive Matrices; Raven 1976), knowledge of letters, memory span, vocabulary and syntactic comprehension. In order to make three groups of 30 children, some children of each group were randomly excluded, ensuring, however, that the equivalence of groups on the preceding measures was preserved. Then each group of 30 children was randomly assigned to a training condition (morphological, phonological, control). Data on selection measures are indicated in Table 1; see below.

Design

The morphological group (M) received morphological-awareness training; the phonological group (P) received phonological-awareness training; the control group (C) received no specific training. Contrary to what is usually recommended (Troia, 1999), it was not possible here to offer unrelated training, as a control.

There were six experimenters, all teachers attending courses in order to become school psychologists. Experimenters attended lessons on morphology and phonology. Each experimenter trained a group of five children on morphology and a group of five children on phonology. There were, therefore, twelve groups of 5 children who participated in a training programme. There were twelve 30-minute training sessions each for morphological and phonological awareness. There were one or two training sessions per week, over a period of 9 weeks. During each training session, the children were taken from their classroom, and they worked with the experimenter in a separate quiet room. In both training programmes, the 5 children in each group were trained collectively, with each child questioned in turn. Each experimenter had to follow the training programme scrupulously; the timing was

identical for each subgroup of both training sessions. In order to ensure the homogeneity of the group training procedures, instructions were exhaustively detailed in a booklet which was given to each experimenter. During training, the children's errors were discussed by the experimenter, who asked all the children to give their opinions. Each group had to follow the progression exactly. If a child encountered difficulties, he/she received more explanations, without interrupting the group's work; a few minutes of each training session were specifically devoted to children who needed more explanations. The objective was that all the children got the same amount of information. Thus, experimenters were instructed to follow the programme rigidly, and a weekly meeting was organized for experimenters in order to ensure that the progression between groups was comparable.

Phonological training sessions

The phonological training programme was identical to Lecocq's (1991, 1993). Stimuli and tasks were different in the pre- and post-tests, as far as possible (Troia, 1999). In the programme, there was a progression from large units to smaller phonological units: for example, children were trained to segment sentences into words in the first session, while they were trained to segment syllables into phonemes in the last sessions. Blending and segmentation tasks alternated so that children could work from meaning to sounds and from sounds to meaning. The training programme consisted of a twelve-session progression. Each session proposes a particular task (the segmentation of a sentence into words, categorizing phonemes; segmentation and fusion of phones in one-syllable words; counting the number of phones in a word [last sessions]), and pursues a particular objective (helping the child to focus his/her attention on the phonetic aspect of a word, helping the child to reach the meaning through the fusion of syllables). The exercises proposed followed a game format and, since they were aimed at kindergarteners, no written symbols were used; all the games were presented orally. The games included: puppets who couldn't articulate words and omitted parts of them, noise games in which children were asked to produce phones, riddles, French 'rébus' (where pictures are used to represent – punning fashion – the syllables of words and phrases).

Morphological training sessions

The morphological training programme was created for the purpose of this study. It focused on derivational morphology (except one session, where inflectional morphology was considered). Its rationale was based on the phonological programme. As far as possible, stimuli and tasks were different from those of the pre- and post-test tasks. Unlike the phonological training sessions, there was no progressive focus on smaller units, except in the first two sessions, which focused on larger segmentation levels (sentences into words in first session, analysis of compound nouns in the second session). In fact, it is not possible to reduce the size of morphological units progressively, as one can with phonological units (syllable, onset-rime, phoneme). The order of progression of the morphological tasks was based on the order of difficulty experienced by children in a previous study (Casalis & Louis-Alexandre, 2000); various

aspects of morphological processing were successively explored. As in the phonological training programme, fusion and segmentation alternated, so children could work from the meaning of the word towards those smaller meaning units – bases and affixes – and from smaller meaningful units to larger ones.

The training programme followed a 12-session progression. Each session pursued a particular objective, with a focused activity. For example, in the third morphology session, the notion of *suffix* was introduced via inflectional morphology: children were asked to produce feminine forms of nouns and adjectives. Children were taught to focus their attention on the base, and then on the meaning of the affix, the idea being that this would sensitize them to the notion that words may contain more than one unit of meaning. In another example, children had to choose from a set of drawings the one corresponding to a word pronounced by the experimenter; the foils shared either the base or the affix. In the segmentation tasks, prefixes were introduced before suffixes, since prefixes were considered both as semantically more transparent and easier to segment from a phonological point of view. Similarly, suffixes that coincided with syllables were trained before suffixes that did not (since the syllabic segmentation of a suffix may depend on the base, the same suffixes were introduced in many sessions). Children were trained to give the root (which is often not a word, but may be entirely and clearly separated from the affix without any additional operation) and then the base (this often requires more than simple suffix deletion, since the addition of one or more phonemes may be necessary in order to arrive at the smallest word in the morphological family). This was done because the children's attention was focused on phonological segmentation; and it was necessary to shift the attention to the notion of family words. For fusion tasks, which alternated with segmentation tasks, the same rationale was applied: children were asked first to merge prefix and base, then root and suffix, then base and suffix. The fusion of base and suffix necessitates a phonological segmentation operation (involving the final phoneme of the base), so that the suffix can be added. This method was adopted to encourage the children to focus their attention on the manipulation of meaning units, and not only on phonological strings. Pseudoword derivation tasks were proposed during the final sessions, in order to focus on affix manipulation, independently of known whole-word meaning. For the morphological training phase, game activities were proposed, and no written symbols were used.

Details and examples of morphological training are given in the Appendix.

Materials for pre- and post-test measures

Nonverbal cognitive ability

The Raven Progressive Matrices, coloured series A, AB, B, were used as measure of the children's level of nonverbal cognitive abilities. The score was the number of correct items (max.: 36). Children who performed below the 25th percentile were excluded from the study. This test was used in the pre-test assessment only.

Vocabulary

The children took a receptive vocabulary test (Vocabulaire en images; Légé & Dague 1974), in which they choose out of four pictures the one corresponding to

a pronounced word. The final score indicates the number of correct drawings designated. There were 103 words, but the test was stopped after six failures on eight consecutive items.

Syntactic comprehension

In this test (ECOSSE; Lecocq, 1996), which is a French adaptation of the TROG (Bishop, 1983), children are presented with a sentence. Once the sentence is heard, children are presented with four images and have to choose that which corresponds to the sentence. As distractors, there are syntactic pitfalls and lexical substitutions. Comprehension is measured by the number of correct picture choices. For example, for the sentence 'the square inside the star is blue', the pictures were: a blue square in a white star, a white square in a blue star, a blue star in a white square and a white star in a blue square. There were 46 sentences. Pictures were presented in book format, and the responses were manually recorded.

Phonological awareness

Three phonological tasks were administered to the children.

Syllable deletion test After hearing a three-syllable word, children have to delete the first syllable and pronounce what remains (e.g., *pantalon* 'trousers' … *talon*); there were 10 items. Inter-item reliability was 94%.

Phoneme deletion test After hearing a short monosyllabic word, children have to pronounce what remains after deletion of the first phoneme (e.g., *cil* 'eyelash' … *il*); there were 10 items. Inter-item reliability was 90%.

Phoneme oddity task After hearing a set of four monosyllabic words, children have to pronounce the word that does not begin with the same phoneme as the others (e.g., *peur*, *lune*, *lac*, *lampe* 'fear', 'moon', 'lake', 'light' … *peur*); there were 10 items. Inter-item reliability was 74%.

Morphological awareness

All the words included in the morphological awareness tasks were selected from the books used in the classrooms.

Morphemic segmentation task Children have to say the base of a suffixed word pronounced by the experimenter (e.g., *rougeur* 'redness' … *rouge* 'red'); 20 items. In order to explain the task, the notion of word family' was introduced. Children were told that they 'have to say a word that is a part of the whole word pronounced [by the experimenter]; this word part belongs to the same word family as the whole, because they share a part of the meaning'. Inter-item reliability was 72%.

Derivation in sentence context Children have to complete a sentence with either a derived word (30 items) or pseudoword (10 items). There were 40 items in this task (e.g., young: 'the man remembers his … youth'). As in the previous task, the notion of 'word family' was introduced. Children were instructed 'to complete the sentence with a word belonging to the same family as the word used in the sentence'. Inter-item reliability was 92%.

Inflectional task Children have to give inflected forms of words and pseudowords. In half the cases, the children have to give the feminine form of a noun or pseudoword (e.g., *un boulanger* 'a baker', *une … boulangère*); in the other half, they have to give the conjugation of a verb or a pseudoverb. Verbs had to be conjugated in the past tense (20 items). In this task, children were instructed to do the same as in the example. Thus, contrary to the previous tasks, children were supposed to proceed by analogy, without explanation. Inter-item reliability was 75%.

Procedure

In all the phonological and morphological tasks, experimental items were preceded by two examples, with explanations provided. The children were then presented with a series of two training items. For these training items, children were asked to provide a response, and feedback was given by the experimenter. If the response was not correct, corrective feedback was given, with more explanations. Experimental items, without feedback, were then proposed to each child, whatever his/her performance on the training items.

The tests administered by the experimenters were given as pre-tests before the training sessions began. They were given again as post-tests one month after the last training session. Test sessions were divided into three 30-minute assessment interviews, for a total of about 1½ hours of testing. In each session, children were given the vocabulary test, the syntactic comprehension test or other tests (memory span, letters, matrices), and a morphological and phonological test – children began with one or the other in alternation.

RESULTS

Group matching on general measures

Groups were constituted to be as homogeneous as possible, according to level of performance on the pre-test measures. Pre-test means and standard deviations are reported for each group in Table 1, for general as well as phonological and morphological measures. Separate ANOVAs with group as between factor were conducted for each test. Scores were very close across groups except for syntactic comprehension, for which a marginal effect emerged ($F(2, 87) = 2.58$, $p < 0.10$), with the phonological training group (P) performing slightly lower.

For each test, a 2 (period: pre-test vs. post-test) $\times$ 3 (groups) analysis of variance was first conducted. Then, ANCOVAs were conducted, with Groups as the between factor, scores on tasks as the dependent variable and pre-test syntactic comprehension score as the covariate (since groups were not strictly matched on this measure). Newmans-Keuls post-hoc comparisons were conducted, since all the pair comparisons were relevant to assess the reciprocal effects of training: comparisons between the P group and the control group (C), and between the Morphological training groups (M) and C were run to determine the benefit of each type of training. A direct comparison of the results for P vs. M training directly compares these two types of training.

Table 1 Mean scores of the control (C), morphological (M) and phonological (P) groups on pre-test and post-tests measures (standard deviations in brackets)

	C group (N = 22)		*M group (N = 24)*		*P group (N = 24)*	
	Pre-test	*Post-test*	*Pre-test*	*Post-test*	*Pre-test*	*Post-test*
Age in months	66.00		65.80		65.93	
	(3.03)		(3.24)		(3.44)	
Raven matrices (max. 36)	18.40		18.47		18.57	
	(3.33)		(3.30)		(4.17)	
Socio-economic status	3.73		3.43		3.57	
	(0.52)		(0.82)		(0.77)	
Syntactic comprehension	34.63	33.27	35.43	38.52	33.27	38.24
(max. 46)	(3.35)	(3.58)	(4.22)	(4.06)	(3.58)	(3.50)
Vocabulary (max. 103)	69.63	68.63	68.57	71.79	68.63	70.59
	(8.16)	(10.55)	(9.53)	(8.93)	(10.55)	(10.86)
Word span	3.67	3.73	3.53	3.76	3.73	3.79
	(0.48)	(0.74)	(0.51)	(0.63)	(0.74)	(0.49)
Knowledge of letters	5.53	6.17	5.57	6.21	6.17	6.97
(max. 10)	(3.70)	(3.80)	(3.73)	(3.66)	(3.80)	(3.47)
Morphology						
Derivation in sentence	10.17	14.21	9.30	20.24	9.30	16.28
(max. 40)	(4.11)	(4.73)	(4.66)	(7.34)	(3.63)	(6.66)
Inflectional morphology	9.07	11.93	8.87	14.62	8.70	12.86
(max. 20)	(3.39)	(2.78)	(4.12)	(3.00)	(4.74)	(3.70)
Morphemic segmentation	12.43	14.07	11.30	17.00	12.47	15.45
(max. 20)	(4.62)	(2.95)	(4.56)	(1.96)	(4.96)	(3.29)
Phonology						
Phoneme oddity	2.50	2.69	2.40	3.69	2.90	4.62
(max. 10)	(1.22)	(1.20)	(1.67)	(1.71)	(1.32)	(1.97)
Phoneme deletion	1.43	2.03	1.27	3.31	1.10	5.17
(max. 10)	(1.99)	(2.41)	(1.80)	(2.65)	(2.20)	(3.05)
Syllable deletion	5.40	7.10	4.13	6.86	4.73	7.90
(max. 10)	(3.27)	(3.38)	(3.14)	(3.37)	(3.62)	(3.33)

General measures

Data for general measures at post-test are presented Table 1. For vocabulary, knowledge of letters and memory span, there was no period x group interaction ($F(1, 87) < 1$ for each test). However, a significant pre- and post-test improvement was found for both vocabulary ($F(1, 87) = 5.35$, $p < 0.05$) and letter knowledge ($F(1, 87) = 9.53$, $p < 0.01$), but not for memory span ($F(1, 87) = 1.39$, *ns*). The ANCOVAs, with the syntactic comprehension pre-test score as covariate, revealed no group effect ($F(2, 83) < 1$ for each of the three measures). In contrast, there was a group x period interaction

for syntactic comprehension ($F(1, 87) = 4.26$, $p < 0.05$). While there was a marginal trend for the P group to perform lower than the others at the pre-test level ($p < 0.10$), the ANCOVA conducted at the post-test level indicated no difference between groups ($F(2, 83) = 1.4$, *ns*).

Phonological tests

Data for phonological and morphological tests at post test are presented Table 4 (see below). Whole performance on syllable deletion improved between pre- and post-tests ($F(1, 84) = 50.63$, $p < 0.001$), but there was no difference between groups ($F(2, 84) < 1$) and no interaction between groups and period ($F(2, 84) = 1.5$, *ns*), which suggests no particular effect of training on syllable deletion. Indeed, the post-test ANCOVA (with syntactical score as covariate) reveals no effect of group for the syllable deletion ($F(2, 83) = 1.4$, *ns*). In contrast, in the oddity test, while there was a main effect of period ($F(1, 84) = 77.15$, $p < 0.001$), the interaction ($F(2, 84) = 14.1$, $p < 0.001$) indicated that the progress of performance differed between groups. The post-test ANCOVA revealed a significant group effect ($F(2, 83) = 10.95$, $p < 0.001$). Newman-Keuls pair comparisons indicated that the P group differed significantly from both the C group ($p < 0.001$) and the M group ($p < 0.05$) at the post-test level. The difference between M and C groups was also significant ($p < 0.05$). In the phoneme deletion test, another pattern of results was observed: the progress in performance differed between groups ($F(2, 84) = 6.54$, $p < 0.01$, for the group x period interaction); at the post-test level, there was a main effect of groups ($F(2, 83) = 10.96$, $p < 0.001$). Newman-Keuls pair comparisons indicated that while the P group outperformed both the M group ($p < 0.05$) and the C group ($p < 0.001$), the difference between the M group and the C group failed to reach significance.

Morphological tests

In the inflectional morphology test, there was no main difference between groups ($F(2, 84) = 1.09$, *ns*.), but performance improved between pre-test and post-test ($F(1, 84) = 143.66$, $p < 0.001$); moreover, there was an interaction between group and period ($F(2, 84) = 6.057$, $p < 0.01$), indicating that improvement of performance differed across groups. The post test ANCOVA revealed a significant group effect ($F(2, 83) = 5.17$, $p < 0.001$). Post-hoc Newmann Keuls comparisons revealed significant differences at the post-test level between the M and C groups ($p < 0.001$) and the M and P groups ($p < 0.05$), but no difference between the P and C groups. In the morphemic segmentation task, there was no difference between groups ($F(2, 84) < 1$); while there was a main effect of period ($F(1, 84) = 83$, $p < 0.001$), the interaction ($F(2, 84) = 10.93$, $p < 0.001$) indicates that the progress in performance differed between groups. The post-test ANCOVA indicated a significant effect of group conditions ($F(2, 83) = 8.16$, $p < 0.001$). Post-hoc Newmann Keuls comparisons indicated that the M group outperformed the C group ($p < 0.001$) and the P group ($p < 0.05$) at the post-test level. The difference between the P and C groups was also significant ($p < 0.05$). In the derivation in context test, the same pattern was observed: while groups did not differ ($F(2, 84) = 2.154$, *ns*), there was an

effect of period ($F(1, 84) = 193.33$, $p < 0.0001$), and the interaction was significant ($F(2, 84) = 14.393$, $p < 0.001$). At the post-test level, the ANCOVA indicates a significant effect of group condition ($F(2, 83) = 7.03$, $p < 0.01$): there was a difference between the M and C groups ($p < 0.01$) and between the M and P groups ($p < 0.05$), while there was no difference between the P and C groups. In addition, it should be emphasized that there was high variability in post test results in both trained groups. This could be due to the fact that the score covers many processes, some of which are phonological (since pseudowords are involved) and syntactic (since appropriate suffixes have to be selected depending on the sentence). These skills were trained in a focused way. The sentence derivation task may necessitate the integration and coordination of all kinds of information, so that trained children may differ in their ability to integrate and coordinate the language processes involved in the task.

DISCUSSION

In summary, phonological and morphological training were found to be effective. At the same time, transfer between domains (from morphology to phonology and from phonology to morphology) was found to be specific and not generalized.

There was no specific effect of training on general measures, except for syntactical comprehension. It is noticeable that, on this test only, the P group performed slightly lower than the others at the pre-test level. The phonological training sessions allowed them to catch up with the other groups. There was no improvement in memory span between pre- and post-tests. In contrast, both vocabulary and knowledge increased, but this progress was not different between groups. Thus, it appears that our training sessions tapped very specific abilities, and had no general impact on performance level. This pattern of results ensures us that necessary validity conditions are fulfilled, so that we may analyse the impact of training.

Training effects

Both types of training (phonological and morphological) were found to be effective. In particular, children trained in each domain were found to perform systematically better in the trained domain. The progress obtained with the phonological training provides additional evidence for French kindergarteners, thus replicating the previous evidence that phonological awareness may be enhanced in kindergarten. It also shows specific impact on metaphonological development and more precisely on phonemic manipulation since the P group outperformed both the M and C group for phoneme manipulation (as assessed both with the phoneme deletion and oddity tasks) and but not for syllable manipulation since scores progressed in all the groups, whatever their status (trained or control). This is not too surprising, since our training programme did not specifically focus on syllables, but rather on phoneme manipulation. At the same time, French kindergarteners are strongly trained in syllable manipulation in their classrooms. Since the P group outperformed the M group, it cannot be argued that the improvement could be due to a general

effect of stimulation, since trained groups differed according to the kind of training they received.

In the case of the morphological training the results clearly show that morphological awareness can be successfully trained in kindergarden. This result is of importance since, to our knowledge, there is only one morphological training study reported in the literature (Lyster, 2002). As was observed with the phonological training, the morphological training produced specific results too. Thus, although morphological awareness scores improved between pre- and post-test, in all the three tasks (morphemic segmentation, derivation in context and inflectional morphology) and for both the three groups, the M group reached the highest level of performance at the post-test level and systematically outperformed both the P and C groups. Thus it may argued that morphological training was effective for improving the morphological awareness in kindergarten children.

Transfer effects

Transfer between domains (from morphology to phonology and from phonology to morphology) was found to be specific and not generalized: while phonological training helps to segment the speech into morphemic constituents, it does not have any impact on the derivational process itself (production of a suffixed or inflected form when given a base form). Thus, it was found that while the M group outperformed both the P and C groups, the P group was not found to perform higher than the C group on the derivation test and on the inflectional test. In contrast, the P group performed higher on the morphemic segmentation test at the post-test level than the control group.

Similarly, it was found that morphological awareness training cannot help children to segment words into phonemic units, but may increase their sensitivity to sounds. More precisely, while there was no effect of training (whatever the domain) on syllable deletion, in the phoneme deletion test the P group outperformed the M group, and there was no significant difference between the M and C groups. However, in the oddity test, while the P group outperformed other groups, the M group reached a higher level of performance compared with the control group. This suggests that morphological training may help to improve the child's sensitivity to phonemes, while it does not help the child to manipulate phonological material explicitly.

Concerning the relationship between the phonological and morphological domains, two main conclusions can be drawn. Since the segmentation process necessary to isolate the base from the suffix (manipulation of speech analysis) may be enhanced through phonological training, it is suggested that phonological segmentation is therefore possibly helpful for morphemic segmentation. But the reverse is not true: morphological training does not help with segmenting speech into phonemic constituents. Thus, both domains clearly involve independent knowledge and processes. However, morphological training does enhance sensitivity to the phonological form of words. Thus both domains may involve some common abilities, but should not be confused. Overall, while our results help to explain correlations frequently found between morphological and phonological tasks (Carlisle, 1995;

Carlisle & Nomanbhoy, 1993; Casalis & Louis-Alexandre, 2000), they clearly illustrate the specificity of each domain, indicating that morphological awareness is not just 'more phonological' awareness, as indicated by Deacon & Kirby (2004). This may highlight its specific contribution to reading achievement (Deacon & Kirby, 2004).

But such a picture was not found by Lyster (2002) who trained kindergarten children in both domains. In her study, there were large reciprocal influences. The phonological training group outperformed the morphological awareness training group on both phonemic tasks (at least some of them) and morphological subtests. Differences between the Lyster study and the present one concern mainly two points: print exposure and the nature of the morphological training (manipulation of derived forms vs. compound nouns). It is reasonable to suggest that print exposure may have increased reciprocal influences between morphological and phonological awareness; metalinguistic development appears to maintain reciprocal influences with reading.

Finally, while various studies have indicated that morphological and phonological measures are correlated, our study suggests that each domain is separable from the other. It has also been shown that both phonology and morphology make a significant and independent contribution to the reading score (Carlisle & Nomanbhoy, 1993; Casalis & Louis-Alexandre, 2000). Our data suggest that abilities in each domain may be solicited separately, even though to a certain extent, reciprocal influences have to be taken into account. It should also be emphasized that our study concerned kindergarten children. It is possible that reading acquisition – or even print exposure – modifies this pattern of relationship. Thus a somewhat different relationship between morphological and phonological awareness may develop once reading has been introduced. Finally, training in kindergarten raises the question of its impact on reading achievement. In order to examine the effects of both phonological and morphological training on reading acquisition, the same children were tested one year later on reading measures.

STUDY 2: THE INFLUENCE OF TRAINING ON FIRST-GRADE READING SKILLS

METHOD

Participants

The same children who attended morphological and phonological training sessions, as well as the control group, were tested at the end of first grade mean age 83 months. It was not possible to test all the children, because some of them had moved. However, 24 children who received phonological training, 24 children who received morphological training, and 30 children from the control group were tested at the end of the school year. In the first months of first grade, some children who performed poorly in reading attended a special programme, devoted to providing more intensive reading practice, in very small groups. Such remediation programmes are currently proposed to first graders who encounter difficulties in learning to read very early. It is noteworthy that no child from the morphological or phonological training

group attended these remedial groups, while eight children from the control group required early remediation. This may suggest that all the children of the trained group were considered as ready for reading while this was not the case for control group children. Since all groups were equated on pre-test measures, this may suggest that morphological and phonological training effectively prepared children for reading. Unfortunately, this difference in the control group also considerably reduces the scope for a well-equated group study, so the results of all the children who received remedial training were removed from our study. Pre-test and post-test data for the remaining children are presented Table 2. The groups were strictly matched on each measure, except for syntactic comprehension. There was a nonsignificant trend for the P group to be outperformed by the others ($p < 0.10$). Consequently, ANCOVAs were conducted for first-grade reading measures, with pre-test syntactic scores as covariate.

Materials

As reading and spelling tests, subtests of the TLCP test (Pasquier, 1979) were selected, including word and short text levels. In the Word Spelling and Text Spelling subtests, children were asked to write 12 words and a short text under dictation (including simple words as in *une bonne soupe* 'a good soup'; *une tarte aux pommes* 'an apple tart'). In the Word Reading subtest, children were asked to join up words to pictures (e.g., *pipe* 'pipe'; *moustache* 'moustache'); 12 items. In the Text Reading subtest, they had to draw a picture given the information provided in a short text. In addition, a homophone choice task was administered: in this test, children have to circle the word that corresponds to the definition pronounced by the experimenter, among homophone and pseudohomophone distractors (for the sentence 'it is a colour', for example, alternatives were *vert* 'green', *verre* 'glass', *veire* [pseudoword]).

RESULTS

Table 3 shows the means score data for the reading and spelling subtests for each group.

For each test, as in the first part of the study, an ANCOVA with pre-test syntactic comprehension as covariate was computed. However, contrary to the first part, no pair comparisons were planned. For each training condition, the assumption of a positive effect of training on reading was tested, and the trained groups compared with the control group (Dunnett test).

Significant effects of group condition were found in the Word Reading subtest ($F(2, 6) = 3.92$, $p < 0.05$), the Text Spelling subtest ($F(2, 66) = 3.23$, $p < 0.05$), the Text Reading Subtest ($F(2, 66) = 4.59$, $p < 0.05$) and in the homophone choice task ($F(2, 53) = 3.23$, $p < 0.05$), but not in the Word Spelling subtest. Dunnett tests indicated that the P group outperformed the C group only in the Text Spelling and Text Reading subtests.

In all, significant effects for group conditions emerged in four subtests, and no effect in one subtest. Specific effects are more difficult to obtain. In particular, there

Table 2 Performance in kindergarten children in the control (C), morphological (M) and phonological (P) groups, pre-test and post-test for the 70 first graders enrolled in the follow up (standard deviations in brackets)

	C group (N = 22)		*M group (N = 24)*		*P group (N = 24)*	
	Pre-test	*Post-test*	*Pre-test*	*Post-test*	*Pre-test*	*Post-test*
Age in months	65.77		65.42		66.08	
	(3.32)		(3.16)		(3.53)	
Raven matrices	18.05		18.58		18.92	
(max. 36)	(3.23)		(3.35)		(4.55)	
Socio-economic status	3.77		3.38		3.63	
	(0.53)		(0.82)		(0.82)	
Syntactic comprehension	34.55	38.55	35.33	38.38	32.75	38.08
(max. 46)	(3.67)	(4.06)	(4.66)	(4.30)	(3.43)	(3.74)
Vocabulary (max. 103)	70.05	71.95	67.67	70.50	68.83	70.13
	(8.38)	(7.19)	(10.29)	(8.18)	(11.24)	(10.06)
Word span	3.64	3.73	3.58	3.79	3.79	3.83
	(0.49)	(0.46)	(0.50)	(0.66)	(0.66)	(0.48)
Knowledge of letters	5.36	6.32	5.46	6.04	6.92	7.50
(max. 10)	(3.63)	(3.33)	(3.99)	(3.84)	(3.62)	(3.19)
Syllable deletion	5.14	6.64	4.58	6.83	4.58	7.50
(max. 10)	(3.27)	(3.71)	(3.22)	(3.29)	(3.55)	(3.19)
Phoneme oddity	2.36	2.59	2.42	3.58	2.83	4.75
(max. 10)	(1.05)	(1.05)	(1.79)	(1.79)	(1.43)	(1.87)
Phoneme deletion	1.09	1.45	1.08	2.92	0.92	5.13
(max. 10)	(1.85)	(1.87)	(1.72)	(2.39)	(1.72)	(2.83)
Morphemic segmentation	12.45	13.77	11.08	16.83	12.96	15.79
(max. 20)	(3.73)	(2.98)	(4.80)	(2.10)	(3.43)	(2.96)
Derivation in sentence	10.2	14.00	9.42	19.63	9.38	15.88
(max. 40)	(5.16)	(5)	(4.06)	(7.59)	(5.24)	(6.24)
Inflectional morphology	9.05	11.91	9.29	14.58	8.42	12.92
(max. 20)	(3.39)	(2.93)	(4.09)	(3.17)	(4.32)	(3.49)

was no indication of significant effect of morphological training in kindergarten on first grade reading scores, while there were more indications of the impact of phonological training on reading, even though the P and C group comparisons mostly failed to reach significance level. These results may appear to call into question the relationship between morphological awareness and early literacy, and we will discuss them in greater detail below. In order to examine possible connections between morphological awareness and learning to read, longitudinal correlations between kindergarten phonological and morphological measures and reading

Table 3 Mean scores of the control (C), morphological (M) and phonological (P) groups in reading and spelling at the end of Grade 1 (standard deviations in brackets)

	C group (N = 24)	*M group (N = 24)*	*P group (N = 22)*
Word spelling (max. 12)	6.05 (2.87)	5.50 (3.87)	6.58 (3.54)
Word reading (max. 12)	9.86 (3.40)	9.13 (3.62)	10.63 (2.41)
Text spelling (max. 48)	31.23 (11.06)	29.13 (13.32)	35.78 (8.96)
Text reading (max. 12)	7.41 (3.76)	7.17 (3.90)	9.58 (2.93)
Homophonic choice (max. 20)*	9.36 (2.75)	10.86 (3.83)	11.30 (2.74)

*53 participants (C group 17, M group 21, P group 20).

Table 4 Correlations between kindergarten performance on phonological and morphological pre-tests and reading and spelling scores in first grade ($N = 70$)

	Word spelling	*Word reading*	*Text spelling*	*Text reading*	*Homophones*
Syllable deletion	0.36*	0.36*	0.42*	0.24*	0.23
Phoneme deletion	0.28*	0.19	0.28*	0.41*	0.32*
Phoneme oddity	0.27*	0.31*	0.35*	0.27*	0.24
Morphemic segmentation	0.22	0.33*	0.32*	0.34*	0.14
Derivation in sentence	0.33*	0.39*	0.34*	0.46*	0.20
Inflectional morphology	0.23	0.28	0.29	0.32*	0.15

*$p < 0.05$.

scores were calculated. These correlations are reported in Table 4. Most of the correlations were significant (70% of the cells were significant at $\alpha = 0.05$ level). All but 3 cells were significant, suggesting a high level of correlation between phonological awareness scores and reading scores. Morphological awareness scores were significantly correlated with the Text Reading Subtest (with coefficients ranging from 0.26 to 0.52); there were also correlations between morphological scores and the Spell Test subtest as well as the Word Reading subtest, while morphological awareness was more poorly correlated with the Word Spelling subtest. In general, the homophone choice task was not correlated with the morphological awareness pre-test, but was significantly correlated with phonological awareness scores. Finally, a stepwise regression analysis was conducted, with

Table 5 Stepwise regression analysis

Step		*R^2 increase*	*F value*	*Significance*
1	Morphemic segmentation	0.17	14.70	<0.001
2	Knowledge of letters	0.18	17.72	<0.01
3	Phoneme deletion	0.04	14.10	<0.05

Text Reading as the dependent variable, group condition and pre-test data as predictors.

The first step of this analysis revealed that the morphemic segmentation task accounted for 17% of the variance. The second step identified letter knowledge as accounting for an additional 18%, so that 35% of the variance was accounted for, and the third step showed that the phoneme deletion test accounted for an additional 4%, and thus 39% of the variance was accounted for. Parameters are reported in Table 5.

Overall, our data confirm previous results (Carlisle & Nomanbhoy, 1993; Casalis & Louis-Alexandre, 2001), suggesting an early involvement of morphological awareness in learning to read.

DISCUSSION

Given that children were trained in kindergarten on both phonological and morphological awareness, such a design offered the possibility of directly testing the effects of kindergarten training on first-grade reading scores. We wish to emphasize that the eight children participating in the experiment who were enrolled in an individual remediation programme (offered to children who encounter important difficulties with sounds and letters as early as the first weeks of first grade) were all from the control group. It could therefore be argued that phonological and morphological training may have protected children from 'encountering severe difficulties'. Group comparisons on the various subtests at the end of first grade may reveal some aspects of the role of phonological and morphological awareness in early literacy. But, as pointed out earlier, the control group did not received any training, which may prevent us from distinguishing specific training benefits. In parallel with significant effects of training (see Study 1) for the trained groups (leading to an improvement in both morphological and phonological awareness at the end of kindergarten), there were differences between group conditions on most reading and spelling subtests. However, clear-cut differences between groups were more difficult to obtain. This may suggest that although differences between groups emerge, they are too small to be evidenced in paired comparisons. The impact on reading was evidenced only for phonological awareness training. These small effects may be due to the fact that the metalinguistic training sessions did not use writing. As has been long evidenced (Hatcher, Hulme & Ellis,

1994), metalinguistic training is found to be more efficient on reading scores if children are exposed to written forms when trained. For a number of reasons, our study did not include print exposure. While it enables the analysis of a potential relationship between morphological and phonological awareness, this approach may have reduced strong positive benefits in reading. Overall, our data indicate that phonological training is more efficient than morphological training in kindergarten for reading achievement. These data are convergent with the view that phonological awareness is crucial in the beginning of reading (Brady and Shankweiler, 1991; Lundberg, Frost & Petersen, 1988). This may not be the case for morphological awareness, at least not for such early stages of reading.

Our results differ from the Lyster (2002) study, where impact on reading was stronger for morphological awareness than for phonological awareness. However, as Lyster (2002) pointed out, the benefit from the morphological awareness training was larger for the more highly phonologically-skilled children. Children enrolled in morphological training sessions were faced with polysyllabic words, while children enrolled in phonological training were faced with monosyllabic words. Such a difference may have fostered phonological skills in the morphological group more than morphological skills in the phonological group. In addition, differences may come from the structure of the languages considered (French and Norwegian).

Finally, as in previous studies, significant correlations were found between both phonological and morphological awareness in kindergarten, and first-grade reading achievement. This indicates that phonological and morphological awareness are related to reading acquisition. Thus, even though no effect of morphological awareness on reading score was found at this early stage, our data do not discredit the importance of both phonological and morphological awareness in early literacy. However, a more precise connection between morphological awareness and learning to read still has to be established.

GENERAL DISCUSSION

The major goal of the present study was to examine in greater detail the relationship between phonological and morphological awareness. In particular, the aim of the study was to test the relationship between both domains in a direct manner. A simple way to test this relationship directly was to train children in either the phonological or morphological domain, and to examine the reciprocal influence of each type of training. For a number of reasons, training was conducted with kindergarten children. The first reason was technical: phonological awareness rapidly increases with reading instruction, and ceiling effects may prevent clear comparisons as early as first or second grade. Second, while the role of phonological awareness is clearly associated with early literacy, the impact of morphological awareness during reading acquisition is not so clearly identified. An early role for morphological awareness is particularly relevant in a language like French, which encodes morphology in spelling, and has relatively transparent grapheme-phoneme correspondences, both of which may help in a rapid development of phonemic awareness.

Recently, it has been argued that morphological awareness is highly correlated with first- and second-grade reading achievement (Carlisle, 1995; Casalis & Louis-Alexandre, 2000) and not only with later reading achievement (Mahony, Singson & Mann, 2000). Thus, there were both technical and theoretical reasons for working with kindergarteners. Of course, the introduction of reading instruction may modify the pattern or relationship between phonological awareness and morphological awareness; other studies will be necessary to supplement this one. The three groups of children were equated on general measures, and two groups received 12 sessions of training in phonological or morphological awareness. Both training programmes were efficient to the extent that the trained groups systematically outperformed the other groups in that particular domain. It is important to underline the effectiveness of the morphological awareness programme in our study; this suggests that morphological awareness is a specific domain, independent, at least for a part, of both phonological awareness and vocabulary. This last point is important. While it has been proved that the morphological training has a specific impact on the production of derived forms, this training has no impact on vocabulary. While some studies have evidenced a link between morphological awareness and vocabulary (see, for example, Carlisle, 2000), surprisingly no such effect was found here. Since materials used for the tests and training sessions differed, it cannot be considered that children simply learned new words. Our results also indicate that children are able to focus and to learn to focus their attention about the morphemic structure of words as early as kindergarten. Such a pattern of results allows us to examine the question of reciprocal influences in good validity conditions. The major result was the specificity and reciprocity of phonological and morphological awareness. While the impact of phonological awareness training on morphological post-test scores concerns the (morphemic) segmentation process, morphological training led to an increased sensitivity to phonemes, as revealed by scores on the oddity task. This improvement did not extend to the phoneme deletion test, which is considered to tap into more explicit processes. The limited reciprocal influences between phonological and morphological awareness suggest that, beyond the correlations that have previously been found between scores, they constitute separate abilities. One implication is that children should develop abilities in both domains in order to master reading. Another consequence is that poor abilities in one domain may possibly be compensated for by the other (Casalis, Colé & Sopo, 2004).

The second set of results concerns impact of this training on reading. In general, caution is needed in generalizing, since opposite results have recently been found elsewhere (Lyster, 2002). While the main difference may lie in print exposure, it could also be that various aspects of both phonological and morphological awareness may be differently interconnected. Finally, although we found a significant correlation between kindergarteners' phonological and morphological awareness, and reading achievement at the end of first grade, no effect of morphological awareness training in kindergarten was evidenced. Many reasons can be given for these results. It is possible that the training period was too short (12 30-minute sessions) to produce long-term effects. Other studies that have proposed training programmes for phonological awareness usually offered a more intensive stimulation (e.g., Lundberg et al., 1988). Phonological awareness training had no clear

effect either, although positive trends emerged. Another explanation for the lack of an impact of morphological awareness training on reading scores may reside both in the very nature of the test and the period. The TLCP test was chosen as it covered a range of abilities (at the word and text levels, and in both spelling and reading). However, all the words involved in this test were short and simple. In the text subtests, difficulties reside more in syntactic than in lexical processing. A number of recent studies have suggested that children's morphological awareness is associated with the reading of complex words (Carlisle & Stone, 2003; Mann & Singson, 2003). In these studies, the importance of morphological awareness in reading complex words was illustrated for older participants (until sixth graders). Perhaps morphological analysis specifically concerns complex or rare words (not included in the TLCP test), as it could also concern older children. If this is the case, then the precise connection between morphological awareness and early reading achievement still has to be investigated. However, in general, our study corroborates the conclusions of longitudinal studies that attribute a preponderant role of phonological awareness in the earlier stages of reading and a growing involvement of morphological awareness in later development (Deacon & Kirby, 2004; Muter et al., 2004). We have argued that the case of the French language may be considered independently, since morphemic structure is very rich and systematic in French, while the relative transparency of phoneme-grapheme correspondences is rapidly grasped by young readers. This indicates the importance of morphological awareness for beginning French readers. However, our data clearly indicate the importance of phonological awareness in the French language too.

Overall, we have found direct evidence for a connection between phonological and morphological awareness. While the development of morphological awareness may foster sensitivity to phonological structure, phonological awareness has an impact on word structure analysis, but not on derived form production. This may explain the fact that some children develop morphological analysis skills despite poor phonological analysis skills (Casalis et al., 2004; Elbro and Arnbak, 1996). Together, these results encourage further morphological training studies with school-age children. Finally, our study evidenced the fact that morphological awareness is likely to be improved with mildly developed phonological awareness. This may open a scope of developing morphological abilities in children who are impaired in phonological skills, even though, as pointed out in our study, the morphemic segmentation is dependent, at least partly, on phonological processes. Common abilities, however, should not mask the specificity of the morphological awareness, which appears as a separate skill. Its role in learning is to be more deepened.

NOTES

1. For inflectional morphology, the situation could be different, because inflectional information is marked orthographically but not phonologically.
2. Although the phoneme-grapheme correspondence system is more complex (there are often many possible spellings for a specific sound as /o/ may be spelled *o*, *au*, *eau*, *aux*, *eaux*, … (see Ziegler, Jacobs & Stone, 1996). In French, learning to read is far easier than learning to spell.

3. However, in some cases, doublets are not considered as belonging to the same family (e.g., *suite* and *séquence* 'series' and 'sequence').
4. However, since a growing number of studies acknowledges a later role of morphological awareness in learning to read, complementary studies are needed to investigate the relationship between phonological and morphological awareness once the alphabetical principle has been learned.

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APPENDIX

Presentation of the morphological training sessions

In the first session, children were trained to isolate a word from its determiner, to segment a sentence into words, and to reverse the order of words in a compound noun. In the second session, children were shown series of pictures representing words that share a morpheme (a base, then a suffixed form, *jardin* 'garden' and then *jardinier* 'gardener', for example). Children had to choose the picture that represented the word pronounced by the experimenter, and had then to justify their answers. Experimenters progressively guided the children to justify their responses by analysing words into morphemes. This took the form of a series of discussions between each child and the experimenter about the justifications given. The third session was devoted to inflectional morphology. Although inflectional morphology has been considered to be outside the scope of the present study, it was trained in one session as a means of helping the children to establish links between words. Inflectional morphology was considered to be more familiar and easier to manipulate than derivational morphology; it may help the child to learn to focus on the suffix. In this session, children were asked to produce a feminine form of words and pseudowords, to conjugate verbs and pseudoverbs in the plural form, then in the French *passé simple* (a past tense verb form). The remaining sessions were focused exclusively on derivational morphology.

The following tasks were all used throughout the training sessions:

- Segmentation of a prefixed word: a word was pronounced by the experimenter, and the child was asked to give the two parts of the word (*refaire*: *re* + *faire* [redo]). Nesting dolls were used in order to help the children to represent parts of words. In the segmentation task, a whole derived word was pronounced by the experimenter. Children were asked to pronounce the prefix and the base (session 4)
- Segmentation of a suffixed word: given the phonological structure of the suffix (beginning with a vowel, which necessitates intrasyllabic merging at

the end of the base), the task involving segmentation into base + suffix was introduced relatively late, compared with prefix + base segmentation. The first session including segmenting a suffixed word (session 8), involving only items that maintain the phonological transparency of the base in the suffixed word. In the last session (session 12) the task proposed was more complicated, since it included silent final consonants (*blancheur/blanc* 'whiteness/white'), denasalized forms (*maison/maisonnette* 'house') and allormorphic forms (*clarté/clair* 'clarity/clear').

- Merging morphemes: nesting dolls were used in the fourth session, in which the children had to manipulate prefixed verb forms. The top of the doll represented the prefix (*re*), the bottom half represented the verb (*prendre*), and the whole doll *reprendre* 'to take back'. The phonological constraints were very limited in these first merging exercises: prefixes were limited to one syllable, and there was no phonological change in the base form when pronounced in the derived form. In session 5, the children were asked to produce a derived form with two parts, a verb and a suffix; again the nesting dolls were used to help to visualize the process. In this exercise, the subjects had to remove part of the verb to obtain the base before adding the suffix: (*chanter* 'to sing', *er* [infinitive ending] + *eur* [agent suffix] becomes *chanteur* 'singer'). The infinitive verb form was given (and not only the base) in order to illustrate the links between complete forms of words belonging to the same morphological family.
- Derivation: the children were asked to produce derived forms in a sentence context: *on cueille les poires sur un …* (*poirier*) 'pears come from … (pear trees)'; the sentence in French has an active, transitive structure, and the target word is a suffixed form of a noun in the cue.
- Retrieval of the base in a derived form: a derived word (suffixed) was pronounced by the experimenter. Children were asked to pronounce the base form (no phonological changes involved in session 5).
- Identification of the base in three derived forms (sessions 6, 7 and 12): the notion of a word family was presented. Children were taught that a 'mother' (the base form) may have many children (the derived forms). The experimenter asked the children to pronounce the name of the mother (the base form), and to give the names of her children (the derived forms). Thus, for example, children should call the mother *colle* 'glue' if the words pronounced are *collage*, *décoller*, *recoller* 'collage, unglue, reglue'). There was a progression in the items from sessions 6 to 7, with the introduction of a phonological change from the base to the derived forms – progressively more complex forms were introduced (the children had to add or remove a phoneme, or manipulate allomorphic forms, etc.).
- Production of derived forms given a base (session 7): as in the preceding exercise, the analogy with mother and children, illustrating the notion of

word family, was used here. The children were taught the name of the 'mother' (the base form). Children were asked to pronounce the name of her 'children'– that is, the derived forms.

- Judgement of morphological structure (sessions 8 and 9): in this task, the children were asked to say whether a word could be segmented into morphemic parts or not. Words containing pseudoaffixes were introduced. The children were asked to justify their responses, and discussion with all the participants was conducted. In session 8, only transparent forms were used; in session 9, both denasalization (*jardinier* [the *-in* syllable of the base is denasalized] / *jardin* [final *-in* nasalized] 'gardener/garden') and allomorphic forms were used. In both sessions there were pitfalls: half the items could not be segmented from a morphological point of view (e.g., *couleur* 'colour')
- Choose the suffixed form given the base (session 9): the experimenter gave the name of the parent word, and three other words. Children were asked to choose the 'child' (the derived form) of the parent word. For example, for the parent word *chat* 'cat', the three word candidates were *chaton* 'kitten' (the correct choice), *chien* 'dog' (a semantic foil) and *château* 'castle' (a formal/phonological foil). After giving his/her response, the child was asked to explain and justify it. In the training examples, the explanation was presented as a sentence including both the base and derived form (the child is *chaton*, because the *chaton* is a little *chat*).
- Production of derived forms without context (session 10): the children were asked to produce derived forms, given a pronounced base. They were then asked to pronounce the affix (prefix or suffix) separately and to explain the meaning of the complex word and the affix.
- Affixation of pseudowords in sentence context (sessions 11–12): the children had to pronounce a derived form of a pseudoword inserted in a sentence: to *ploss* again is *replosser*.

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