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Introduction to This Special Issue: The Role of Morphology in Learning to Read

Ludo Verhoeven

School of Education
University of Nijmegen

Charles Perfetti

Learning Research and Development Center
University of Pittsburgh

Reading involves the decoding of written forms into language forms that represent phonological, morphological, and word level units. Thus, orthographies convey not only phonological but also morphological information—the word roots, syntactic inflections, and derivational relations that constitute the minimal semantic and grammatical units of a language. There are many psycholinguistic issues brought to light by the facts about morphology. However, the central one has focused on decomposition—whether and how language users, including readers, decompose morphologically complex words into their constituent morphemes.

Linguistically, an important distinction is made between derivation and inflection (for an overview, see Bybee, 1985, 1988, 1995). Derivational morphology concerns the generation of distinct words from a base morpheme across different grammatical categories. For example, *dark, darkness,* and *darken* all derive from a single base morpheme. Inflectional morphology is concerned with the systematic marking of grammatical information on a word stem. For example, nouns may have distinct case forms; adjectives may agree with the nouns they modify; and verbs may have distinct forms for tense, aspect, mood, voice, and valence, as well as num-

Requests for reprints should be sent to Ludo Verhoeven, Professor of Psychology and Education, University of Nijmegen, Montessorilaan 3, 6525 HR Nijmegen, The Netherlands. E-mail: L.Verhoeven@ped.kun.nl

ber, person, and gender agreement. In an inflectional expression, semantic units are bound into a single word in the form of affixes to a stem (e.g., *looked*) or in the form of a change in the stem itself (e.g., *saw*). Unlike derivations, inflections are morphemes that do not change the class of the word they are affixed to and generally can be added to every word within the same grammatical class.

Morphological patterns vary greatly in their productivity, the ease with which new lexical items can be created and understood. Productivity in derivational morphology is possible to a much greater extent than in inflectional morphology. For instance, in addition to *dark, darkness,* and *darken* a derivational paradigm can allow such forms as *undark, darkish,* and *darkity.* As such examples suggest, this greater productivity of derivations can lead to larger changes in meaning compared to inflectional morphology. The meaning changes that result from inflection are largely constrained by the grammatical system under consideration. Derivational meaning changes are subject to variations in transparency. In some cases the meaning of a complex word form can easily be derived from its constituent parts (e.g., *short, shortness*), whereas in other cases it is not (e.g., *fine, final*). Many complex word forms are nonnative words that constitute sublexicons with their own morphological rules. The Latin, Greek, and early French and Germanic roots of many English words form a case in point. The case of productivity shows that the distinct word forms in a language compose a complex network, the nature of which can be the object of experimental research. It can be assumed that productive word patterns are highly predictable in their meaning and allow the use of compositional processes to take place (cf. Berent, Pinker, & Shimron, 1999).

MORPHOLOGICAL PROCESSES IN LEARNING TO READ

Experimental evidence has converged on the point that morphological structure is represented in the mental lexicon. However, different models have been proposed on the role that morphological decomposition plays in reading complex words. According to the decomposition hypothesis, the meanings of morphologically complex words are understood from their constituent morphemes in two phases: An analysis of their constituent components is followed by a look-up of the meaning of the base word in the mental lexicon. The overall conclusion from a series of experiments by Taft and Forster (1975, 1976) and Taft (1981) was that base words are represented in the internal lexicon and that prior to lexical access, letter strings may be decomposed into their constituents. According to the full-listing hypothesis, complex word forms have their own representation in memory (Butterworth, 1983; Henderson, 1985; Manelis & Tharp, 1977). This hypothesis predicts that every lemma, notwithstanding its complexity, has its own entry in the lexicon. The two hypotheses have been combined in more interactive models, which propose a direct lexical route involving ac-

cess to full form representations along with a parsing route (cf. Caramazza, Laudanna, & Romani, 1988; Taft, 1994). According to such models, a great deal of the variation in measures of word identification can be accounted for by the frequency and orthographic regularity of words (see Bertram, Baayen, & Schreuder, 2000; Paap & Noel, 1991; Schreuder & Baayen, 1995, 1997).

An important question is, What role do morphological representations play in learning to read? Learning to read in an alphabetic orthography involves the acquisition of mappings between phonemes and graphemes. Clear research evidence shows that word identification in learning to read requires a phonological mechanism that generates phonological word forms. A phonological constituent applies as soon as the child begins to treat the letters of a word as having speech associated with them. However, the role of morphology in learning to read is less well understood. How children learn to recognize more complex words on the basis of their constituent parts remains to be established. Although children perceive speech and recognize words, there is nothing in that ability that makes visible the composition of the speech in terms of morphological constituents. Some morphological awareness seems to be required for children to be successful in reading. Progress in reading acquisition requires gaining knowledge of morphemes as abstract linguistic units. The relationship between awareness of morphology and progress in reading acquisition can also be seen as reciprocal and mutually facilitative in that morphological awareness develops as a consequence of reading instruction.

Alphabetic orthographies differ in the degree to which they adhere to a consistent representation of phonemes, or alternatively, the degree to which they deviate in a principled way from representing the phonetic level to preserve deeper linguistic or lexical information. In comparative studies on learning to read and write in different languages, cross-linguistic differences in orthographic regularity are usually expressed along the continuum *deep* versus *shallow* (see Berninger, 1994). In shallow orthographies like Italian, Finnish, or Serbo-Croatian, for example, morphemes are said to be represented by the graphemes in a direct and unequivocal manner. In deeper orthographies, such as English and French, on the other hand, the relationship between spelling and the basic "subword sounds" that make meaningful contrasts in the spoken language are more opaque. Although the lack of grapheme consistency in these languages has many sources (especially in English), one source is that pronunciation changes with morphological variation, but spelling tends not to change—for example, *library–librarian*, *human–humanity*. In learning to read, children learn that word parts that are related in meaning are usually spelled consistently, despite changes in pronunciation. Thus, they learn the Isomorphism Principle, which assigns similar spellings to similar (parts of) words, as long as pronunciation allows this. Given the fact that in many cases spelling rules are not directly governed by the phonological syllable structure, the learner must convert sounds to an underlying spelling representation with orthographic syllables reflecting morphemes (cf. Treiman, 1992, pp. 259–272).

A major unresolved issue concerns the process of learning to read polysyllabic words. It is by no means clear how beginning readers identify such subword units as syllables and morphemes or the extent to which frequency influences the assignment of stress for polysyllabic words. Although a clear conceptual distinction can be made between reliance on grapheme-to-phoneme correspondence rules and the development of analogies based on specific lexical exemplars, it has proved very difficult to discriminate between the two processes for the identification of polysyllabic words. The possible independence of lexical and nonlexical knowledge is also complicated by the nature of the spelling–sound rules that characterize the nonlexical route. Critical questions to be answered are how orthographic, phonological, and semantic information become available during visual word identification, how children become morphologically aware, how they acquire sets of rules for reading and spelling multimorphemic words, and to what extent such rules can be explicitly taught.

During the past years, the study of morphology in learning to read has received only scant attention (cf. Mann, 2000). It can be assumed that lessons in which the etymological correspondences and degrees of relatedness between words are explicitly taught may promote children's reading and spelling abilities. As children encounter more polymorphemic words in their reading, their misspellings tend to reflect processes of derivational morphology and reveal a conceptual readiness to explore how spelling preserves the semantic relationships across derivationally related words (see Frisson & Sandra, 2002; Templeton & Morris, 2000). There is also reason to believe that directing children's attention to the relationships between orthography and meaning may help children with reading and spelling derivationally complex words (Derwing, Smith, & Wiebe, 1995; Fowler & Lieberman, 1995; Hughes & Searle, 1997). Nagy and Anderson (1984) claimed that children in the intermediate grades respond to new words in the vast majority of cases by analyzing these words into constituent parts. Research has indeed convincingly shown that children's morphological awareness makes a significant contribution to reading ability in the intermediate grades (Anglin, 1993; Carlisle, 1995, 2000; Carlisle & Nomanbhoy, 1993; Leong, 2000) and the higher grades (Nagy, Diakidoy, & Anderson, 1993; Nagy & Scott, 1990; Tyler & Nagy, 1989).

THIS ISSUE

This issue of *Scientific Studies of Reading* compiles a set of five research-based articles that examine the role of morphological representations in learning to read: modeling morphological processing, uncovering morphological awareness, finding units of analysis, and contrasting implicit versus explicit learning. The focus is on the role of morphology in learning to read in three alphabetic languages: English, Dutch, and French. As such, the findings from the large body of studies on the

acquisition of reading and spelling in English are cross-validated with research evidence from two other languages.

First, Reichle and Perfetti propose a model of word reading that combines simple and morphologically complex words in a single framework. They start from the well-established idea that the meaning of many words is determined though morphemic compounding. In English, for example, the meaning of *blackbird* can be generated from its constituents, *black* and *bird*. In other languages (e.g., German), this process is even more prevalent, allowing an endless variety of complex nouns to be generated from relatively simple constituents. Although this generative process is poorly understood, evidence suggests that the meanings of morphemically complex words can become available either directly, through the identification of whole lexical units (words), or indirectly, through the composition of sublexical (morphemic) constituents. Reichle and Perfetti's model handles these morphological phenomena in a model that also handles simple monomorphemic words. The key idea is that individual encounters with word types build up frequency-sensitive memory representations of the words, including their morphological components. The simulations suggest the model can handle at least some phenomena in morphology as well as some classic issues in word identification (frequency and regularity). An important feature is that they demonstrate a separation of inflectional and derivational effects based not on their predefined status but as a function of the degree of orthographic, phonological, and semantic similarity.

In the next article Carlisle and Fleming explore the role of morphological awareness in learning to read English. Their study explores emerging lexical processes that may be the foundation for early elementary children's acquisition of morphological knowledge and the relation of these processes to the development of vocabulary and reading comprehension. First and third graders were given two tasks of lexical analysis involving morphologically complex words. Two years later, they were given a measure of processing derived words in sentence contexts and a test of reading comprehension. The results indicated that third graders were significantly better than first graders at analysis of word form and meaning (a) to distinguish words that could and could not be decomposed and (b) to define and use complex words. Further analysis of children's definitions of derived words (e.g., *knotless*) suggests that first graders were less likely than third graders to have lexical representations of suffixes that included semantic and syntactic information. The relation of lexical analysis and later morphological processing and reading was stronger for third than first graders. The results support models of morphological processing that highlight the importance of developing lexical representations for bound affixes as well as base and complex word forms. Further, they suggest that integrative processing of form and meaning and access to semantic and syntactic knowledge of suffixes plays a role in the development of vocabulary and reading comprehension by the late elementary years.

In their article, Verhoeven, Schreuder, and Baayen examine the units of analysis in reading Dutch bisyllabic pseudowords in two experiments. Although Dutch orthography is highly regular, several deviations from one-to-one correspondence occur. In polysyllabic words the grapheme *e* may represent three different vowels, which may yield varying morphological information. In the first experiment, children in Grade 6 were given eight word lists of bisyllabic pseudowords: words containing two *e* graphemes, the first syllable being (a) a morpheme, (b) a prefix, or (c) a random string; words with *e* in the first and another vowel in the second syllable, the first syllable being (d) a morpheme, (e) a prefix, or (f) a random string; and words with a random string in the first and *e* in the second syllable (g) with or (h) without a morpheme in the first syllable. It was found that both the pronunciation and stress assignment of pseudowords was dependent on word type, showing that morpheme boundaries and prefixes are being identified. However, the identification of prefixes could also be explained from the fact that in the present word set prefix boundaries coincide with syllabic boundaries. To exclude this alternative explanation a follow-up experiment with the same group of children was conducted contrasting pseudowords containing two *e* graphemes, with a prefix in the first part of the word not coinciding with syllable boundaries versus similar pseudowords with no prefix. The results of the first experiment could be replicated in that the children identified prefixes and assigned word stress accordingly. The findings of the two experiments are discussed with reference to a parallel dual-route model of word decoding.

In the subsequent article, Pacton and Fayol investigate the possibility of implicit learning of morphological units in French. In previous studies, the authors had demonstrated that elementary school children implicitly learned orthographic and morphological regularities that are untaught, even though these regularities can easily be described with rules. Of importance for both kinds of regularities, children's performance differed as a function of the familiarity of the material used. Familiarity effects of the material used, which were very stable across grade levels, suggest that children learn orthographic regularities by learning statistical regularities rather than by acquiring increasingly abstract, rule-based knowledge. An important remaining question concerned whether subjects rely on abstract, general rules when such rules are explicitly taught—a question that leads the authors to address interactions between implicit learning and explicit learning. In this article Pacton and Fayol address this question by taking into account two morphological rules of French that are explicitly taught (but that children do not apply in the framework of systematic exercises): the rule of formation of adverbs and the rule of formation of gerundives. Whether sixth graders and adults rely on rules or whether their spellings are (predominantly) based on the memorization of encountered instances is assessed with tasks involving words that differ concerning their frequency of occurrence in French (to test the frequency effect) and pseudowords (to test the lexicality effect). The main hypothesis was that if the explicitly taught

rules are systematically applied, performance should not differ as a function of the types of items involved. However, in case spelling patterns are (also) determined by retrieval processes, lexicality and frequency effects should be observed. The results show spelling performance improve when adverbs and present participles were introduced within sentences that provided morphosyntactic information about the words they comprised. (This effect was significant only with rare items.) The morphosyntactic information provided by the syntactic structure of the sentence influenced third graders' spelling performance, whereas the rules used in this study are taught from fourth grade onward, which could be seen as further evidence that children learn various aspects of written language implicitly. An important result with regard to whether the children relied on morphosyntactic rules is that spelling performance varied as a function of the frequency of the items used.

In the final article, Nunes, Bryant, and Olsson examine the possible effects of explicit morphological training in English. They claim two types of conditional spelling rules to be of great importance in learning to read and write. The first relates to phonology (e.g. the final *e* affects the pronunciation of the previous vowel) and the second to morphology (e.g., the spelling of regular past verb endings as *-ed*). Children's success with these conditional rules does not depend on specific knowledge of words, because they also apply them to pseudowords. The authors carried out two training studies with the aim of teaching children conditional phonological and morphological rules. In the first, children ages 7 to 9 were randomly assigned to four intervention groups: phonological training without writing, phonological training with writing, morphological training without writing, and morphological training with writing. The intervention lasted for approximately 12 sessions. These children were compared to a control group who were given no special training. All four training groups performed significantly better than the control group at posttest word reading. Only the group that received phonological intervention in coordination with writing made more progress in spelling. The researchers concluded that children who have mastered the alphabetic phase in word reading and spelling can benefit from instruction that focuses on conditional phonological and morphological rules. The aim of the second study was to investigate the possibility of teaching poor readers these conditional rules. The children, who showed an average delay in word reading and spelling of at least 18 months, were randomly assigned to one of three groups: control, phonological training in association with writing, and morphological training in association with writing. The training lasted for 20 weekly sessions. The control group made approximately the progress expected during the period in terms of improvement in reading age, which was 7.4 months; the morphological training group progressed of 11.7 months; and the phonological training group progressed 13.1 months in the same period. The phonological training group made significantly more progress than the other groups in reading, but not in spelling words and pseudowords that involve conditional phonological rules. Assessments of word and pseudoword reading and

spelling with conditional morphological rules showed that children in the morphological treatment group made significantly more progress than children in the other two groups in spelling these words and pseudowords but not in reading.

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