The contributions and limits of phonological awareness in learning to read

Ulla Richardson, Lea Nieminen

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In this chapter, we describe the role of phonological awareness in learning to read and how it varies in different alphabetic orthographies. We provide an overview of the concept of phonological awareness and how it is typically assessed while pointing out the contributions as well as the limitations connected to phonological awareness in learning to read. In addition, we provide a practical example in which phonological awareness plays a role by presenting evidence of the effectiveness of an instructional method in which the relationship between the phonology and orthography of a particular target language is taken into account in designing an instructional digital training tool for learners of varying skill levels. Taken together, the evidence points towards a significant predictive power of phonological awareness in reading skills in alphabetic orthographies. This facilitates important early identification of children at risk for reading difficulties and thus provides the basis for targeted treatment in which phonological awareness plays a role. However, the degree of importance of phonological awareness seems to be highly dependent on the type of connection spoken language has to its written language form.

At the time children start to learn to read, they already have effortlessly become masters in using spoken language for communication. However, to master written language as well, a conscious effort is needed when trying to understand what written symbols stand for and how a written system relates to familiar, naturally acquired spoken language. In practice, this means that a child needs someone to show that written strings of symbols can be meaningful. Typically, attention is also paid to smaller meaningless units such as single letters in alphabetic orthographies. Working from meaningless units toward meaningful expressions is a new type of exercise altogether in learners’ communication. When doing this, learners start attending to phonology, the underlying abstract sound system of their spoken language in order to learn how this system on the one hand relates to phonetics, the actual produced spoken language sounds, and, on the other hand, to the symbols used in writing. This process takes time and effort but typically children learn the basics of decoding within only a few months or sometimes up to several years depending on the nature of the target language and its relationship to its orthography.
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The role of phonological processing, including phonological awareness in learning to read, has been shown to play a critical part in the process (e.g., Brady & Shankweiler, 2013). Poor phonological awareness detectable for example in an inability to segment words into smaller units is reflected in poor reading and writing skills. This finding particularly at the early stages of learning to read and write has been shown in many studies although mainly in connection with the English language and orthography. In this chapter, we describe the role of phonological awareness in learning to read in different alphabetic orthographies. At first, as an essential background, we will look into the nature and development of phonological awareness.

Phonological awareness

According to Gombért (e.g., 1992), metaphonological development (phonological awareness) can be considered to be a part of both metalinguistic and metacognitive development. The first signs of the ability to discriminate sounds are present already very early in a child’s life. However, only discrimination of linguistic sounds is the first step of metaphonological development and this comes only with the experience with linguistic elements in the child’s environment. If the child is able to distinguish between two linguistic sounds, for example jail vs. whale, it does not yet mean that the phonological difference between the initial sounds has been consciously identified by the child. However, this unconscious behaviour is a prerequisite for developing a conscious skill of identifying sounds.

Gombért (1992) describes how metaphonological identification occurs in several different phonological units. Syllabic identification refers to the ability, for example, to tap according to syllables within words. To do this a child needs to be able to break down a meaningful word into meaningless but natural, relatively easily distinguishable linguistic units, which are syllables. Another easily distinguishable and large meaningless phonological unit is a rhyme unit. Rhyme identification entails understanding that the ends of the words sound the same as for example in the words light and kite.

In learning to identify smaller phonological units, single speech sounds, a child needs to learn to further analyse spoken words to perceive the smallest meaningless parts they are made of. Speech sounds are very short, and, partly due to coarticulation, difficult to perceive and segment. On top of that they are difficult to pronounce on their own in comparison to larger units such as syllables and rhymes, which provide even fewer possibilities to make these sounds less abstract and more explicit. Thus, cognitively, individual speech sounds’ phonological identification is a demanding task. Apart from basic sensory abilities such as hearing, a child needs to be able to retrieve from his or her lexicon1 items that both resemble and differ slightly, and start inferring what parts and properties could be considered as integral parts of spoken language that are associated with meaning in a way that by using these particular units they can affect the meaning of a word. However, it should be noted here that even very young infants can detect small differences between speech sounds while around six to nine months of age infants start to pay attention only to those features that are linguistically relevant for their native language environment (e.g., Kuhl et al., 1992; Richardson et al., 2003; Werker and Tees, 1984) and this ability is reflected in their speech production as well. This type of natural phonological development does not necessarily imply, however, that children would be able to consciously identify small speech elements without specific cognitive effort.

After distinguishing speech sounds from other sounds, and distinguishing speech sounds from one another and developing the ability to count and identify them, the third step in
the development of phonological awareness is to gain control over the phonological information of the language. This metaphonological control includes, for example, the ability to intentionally manipulate syllables and sounds. In practice this means that a child is able to change the order of sounds or syllables in a word, or delete and add them. The easiest task is to delete the final or initial syllable or sound, whereas manipulating the medial units is much more demanding and requires a high degree of conscious control (Gombért, 1992). It should be noted that the development of phonological awareness to different sizes of perceptual segments of speech is the same in different types of languages with first the bigger units such as syllables and rhymes being more salient and readily available to children before they start to be aware of single phonemes (Ziegler and Goswami, 2005). Also being able to perceive bigger units in words facilitates access to smaller units when noticing similarities and differences (s-ack tr-ack b-ack).

The abilities to discriminate, identify and manipulate phonological information correspond to what is generally called phonological awareness or sometimes phonological sensitivity. It is this awareness that has been said to be one of the most important prerequisites of learning to read and the main difficulty associated with dyslexia, a specific developmental difficulty in learning to read. However, there is not a clear consensus on whether phonological awareness is really a prerequisite or a by-product or a consequence of learning to read. For example, it has been shown that reading improves phonological awareness greatly and that this relationship is at least reciprocal instead of uni-directional (e.g., Perfetti et al., 1987).

It is not possible to get direct information on children’s phonological awareness skills, and therefore researchers have designed several types of tasks in an effort to find out what children are able to understand of the phonological form of their native language. Phonological awareness has typically been assessed with tasks in which children need to either auditorily perceive, deduce and decide on the similarity or difference of speech units or to identify stimuli. Moreover, different manipulation skills are required in order to perform successfully in the tasks designed to measure phonological awareness. Sound deletion or replacements of single sounds, syllables or rhymes are typically included in the tasks. The tasks require children to remember the single items or sometimes a string of words, and thus, they also place demands on both short-term and working memory capacity. Typically the focus in the tasks is most often limited to the quality of different size speech segments per se rather than suprasegmental features such as linguistic stress, pitch or phonotactics.

The kind of demanding cognitive exercise that is needed in phonological awareness tasks is not necessary at all for using spoken language and probably does not interest children before they start to learn to read. It is likely that only after being explicitly instructed that, for example, a particular letter is associated most often with a particular sound, children start more or less consciously analysing where this sound occurs in their spoken language. To facilitate the discovery of the connection between written and spoken language, teachers often use both visual and auditory examples to demonstrate the connection such as ‘This is the letter d and it stands for the sound [d] as in the word dog’. This kind of an explicit demonstration works well if the name of the letter and the sound associated with the letter are consistently used and represented, as is the case in more transparent orthographies.

With more opaque orthographies the task is much more complex if only phoneme and grapheme size units are used at the beginning of instruction. Phonemes are not represented consistently at all by single letters and vice versa but more often a more consistently represented connection is between larger units such as is the case with rime\(^2\) units in the English language. Next we will look in more detail at the role of phonological awareness in different alphabetic orthographies.
The role of phonological awareness in learning to read languages with an alphabetic orthography

The modern writing systems can be divided into three basic categories according to what kind of a linguistic unit each written symbol represents. Two of the systems, alphabetical and syllabary, are based on phonemes and syllables respectively, which are phonological and meaningless speech units, but the third one, the logographic system, has its correspondents in morphemes or whole words which both convey meanings. The alphabetical writing system is the most common system in the Western world. It is a system where a relatively small set of written symbols, that is letters of an alphabet, in principle represent individual sounds of the target language. Not all alphabetic orthographies use the same script, the system of written symbols. For example this text, just like texts in the majority of European languages, is written in Latin script, but if this was translated into Russian or Greek the script would change to Cyrillic or Greek script respectively.

The number of phonemes in different languages varies a lot and so does the number of letters used in writing the languages. For example, Rotokas, one of the languages spoken in Papua New Guinea, has only 11 different phonemes and it is written with a set of 12 letters: A E G I K O P R S T U V, with both S and T referring to the phoneme /t/ but in different word positions. In contrast, in English, there is a set of 26 letters corresponding to as many as 44 different phonemes. If Rotokas or English had adopted a syllabic writing system, the number of symbols used in writing would be remarkably larger because there are always many more different syllables than different sounds in languages. When comparing Rotokas with 12 letters and English with 26 letters to the logographic writing system of Chinese with 60,000 characters, we can see that there are 5000 times more symbols to memorize in Chinese than in Rotokas and approximately 2300 times more symbols than in English.

Generally speaking, the fewer symbols there are, the easier they are to learn and remember. However, having fewer symbols is not just an advantage: it also means that the system is more abstract. Namely, in logographic systems the counterpart of a symbol is a meaningful unit but in alphabetic systems the counterparts are meaningless sounds or sound combinations. In addition, classification of sounds is not necessarily easy because in a spoken language, sounds are always co-articulated with other sounds. This creates small differences that the writer must recognize and know precisely where the boundary of two different sounds is and which letter to use accordingly (Treiman and Kessler, 2005).

Each language applying an alphabetic writing system does it differently; in other words they have different orthography, spelling rules. Seymour et al. (2003) have investigated how different European orthographies can be placed on a continuum from transparent (shallow) to opaque (deep) orthography. A simple and ideal transparent orthography has a consistent one-to-one relationship between sounds and letters: the same letter always in all word contexts corresponds to the same sound and vice versa. The description almost perfectly suits the Finnish orthography which is said to be one of the most transparent orthographies in the world. The consistent correspondence from spelling to reading and vice versa makes the connection highly explicit, thus facilitating learners’ understanding of the phonemic structure of the language.

On the other end of the continuum there are languages in which the relationship between sounds and written symbols is inconsistent and not straightforward. English is a good example of this since the same sound may be written in several different ways (e.g. phoneme f in the words fish, enough and philosophy) and the same letter may refer to different sounds (e.g. the letter a in the words man, make, car and walk). Thus, English learners need more exposure
to different words, their morphology as well as phonology, to learn how the small set of letters or letter strings represents a much larger number of sounds. Most alphabetic orthographies fall somewhere between these two extremes. The rule of thumb is that the more opaque the orthography is, the longer it takes to learn to read it because of all the inconsistencies and irregularities it has.

In alphabetic orthographies the role of phonological awareness in reading development has been at the centre of investigations for over 30 years now. Many investigations have reported a close connection between phonological awareness and reading skills especially around the time when children learn to read (e.g. Adams, 1990; Goswami and Bryant, 1990; Griffin et al., 1998). Similar findings have also been shown even several years before children start to learn to read (Puolakanaho et al., 2007). A majority of these investigations have been conducted in learners of English. Regardless of the types of assessment tasks, the evidence shows that phonological awareness skills predict reading skills in English and have a significant impact on reading and writing accuracy during the first years of school. Apart from the language limitation, these studies typically focus on phoneme awareness (phonemic awareness) possibly partly due to the rather simplistic idea that just understanding that letters represent speech sounds is sufficient in learning to read for all learners in different types of languages.

Learning the alphabet in English either with the letter names or corresponding letter sounds is not enough to be able to read and write in English. This is due to the non-transparent orthography of English on a grapheme–phoneme level. The fact that virtually none of the English phonemes are represented consistently in all word contexts with the very same letter(s) or vice versa shatters the illusion that just by mastering letter–sound connections, learners would know how to decode or spell all words in English. Due to this inconsistent nature of phoneme–grapheme connections, it takes rather a long time and experience with written English to discover the most frequently and consistently behaving letter strings to learn to read and write accurately. Investigations by Seymour and his colleagues (2003) showed that in highly irregular orthographies such as English it takes up to two years to reach the same decoding level that can be reached in only one or two months in a highly consistent orthographies such as Finnish. In written English, especially vowel sounds are represented in a way that makes it absolutely necessary to look at the larger contexts such as the rime unit in which the letter exists. The connection between rime units to speech sounds is more consistent than that of single letters (see, e.g., Goswami, 2002). Also syllable structures in English are complex which adds to the challenges of auditorily detecting different elements within the complex structures. Therefore, learners need to pay attention to longer letter strings, but importantly also to the morphological, sometimes also syntactic and semantic context in order to accurately realize connections between written and spoken language units in English.

The inconsistencies between spoken and written English are due to the discrepancy of the forms of modern spoken English with the forms and rules of the English orthography that have remained static over hundreds of years while spoken language has been influenced by French and other languages and gone through sound changes (see, e.g., Crystal, 2012). Thus, written English does not comply with the simple alphabetic principle. English learners who have poor phonological sensitivity to start with are guided to written language with the help of the letter–sound connections to crack the alphabetic code but these basic tools do not reveal the connection between written and spoken languages in most cases. This means that at first struggling learners in effect need to learn that spoken language has small units such as phonemes and these can be represented by written letters. After this, by trying
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to apply these tools they need to discover that they actually must learn how to disregard them in many aspects in order to learn to decode English words. Therefore, learning to read in English for struggling learners is doubly difficult.

In more transparent alphabetic orthographies, by learning the alphabetic principle with a relatively small set of letters, children can quickly learn to decode and spell any words in their language without previously being exposed to them. However, the predictive value of phonological awareness tasks is high regarding early reading skills even in languages with transparent orthographies. In a cross-linguistic study by Ziegler et al. (2010) the specific question regarding the importance of phonological awareness in different types of orthographies was investigated. They found that in both the more transparent and less transparent alphabetic orthographies included in the study (Finnish, Hungarian, Dutch, Portuguese and French) phonological awareness had a significant impact on developing reading skills (Ziegler et al., 2010). There are also studies that do not support this finding. For example Georgiou et al. (2008) showed that children's performance in phonological awareness tasks did not correlate with their reading skills in Greek.

In languages with transparent alphabetic orthographies the straightforward system where learning what speech sound each letter stands for seems to be enough to guide even the most struggling learners to decode words accurately, although the decoding process might be painstakingly slow. This implies that already at the time children have learned the letter sounds, they will be able to perform accurately in tasks that measure phonological awareness. Therefore, the correlation and prediction power of phonological awareness tasks diminish in these types of languages after children have learned the connections of the letters to speech sounds used in the language. If a child already knows the alphabetic principle this may help her/him to count and identify sounds, especially in transparent orthographies where counting and identifying sounds is closely related to the task of counting and identifying the letters in a word. In fact, the effect of reading skills on performance in phonological awareness tasks has been shown in several studies. Ziegler et al. (2004) showed that adult readers are significantly slower to decide whether words such as pain and lane rhyme due to the knowledge that they are spelled differently whereas preliterate children do not have such problems. Similarly, Goswami et al. (2005) showed that preliterate German and English speaking children are as good at rhyme judgements with phonologically similar word structures since their performance relies solely on auditory perception, but once they start to learn to read, German children's performance surpasses that of English at rhyme judgements due to the consistent spelling patterns of German. Therefore, when children have learnt the basics of reading skills in transparent orthographies, other types of skill assessment tasks, such as rapid automatized naming tasks, become more powerful in predicting reading skills' level. Also the level of decoding skill is measured more meaningfully with the time spent in a reading task rather than accuracy.

Utilizing phonological awareness skills and the role of orthography in an effective reading method: the case of GraphoGame

As phonological awareness skills seem to have an impact on early stages of reading either directly or indirectly, reading instructions and programmes typically include some level of training with phonological aspects of the target language. One such programme is the digital learning environment, GraphoGame, developed within a multidisciplinary research and development team in Finland at the University of Jyväskylä and the local non-governmental organization the Niilo Mäki Institute, specializing in learning disabilities (see more on
The GraphoGame training method provides training with the basic building blocks of the target language in a game-like environment in which learners’ task is to connect spoken language units to the corresponding written language units. Importantly, the nature of the target language and its orthography is taken into account in the design of the method. Since the method aims to help specifically struggling learners, specific attention is paid to the quality of spoken language units presented in the game. The idea is that since learners need to listen to the speech sounds (single sounds to words and sentences) many times during gaming, this provides an opportunity to improve their phonological representations, since one of the prevailing theories is that poor readers have poor or fuzzy phonological representations (e.g. Elbro et al., 1998). In addition, by constantly having learners connect speech sounds with their corresponding written units (i.e. auditory–visual stimuli paring), the method makes the connection concrete and explicit, and therefore it facilitates the understanding of the phonological system and how the system is represented in written language. Another central feature of the method is that with each target language, the specific connection of written language units to spoken language units is utilized so that the most consistent and frequently occurring written units are presented with their corresponding spoken language units. For example, in English, the most consistently used written units in terms of the corresponding speech sounds are not single letters as is the case with transparent orthographies, but instead longer letter strings. For example, rime units are used, and the rime units are presented first to facilitate learning of the connection between written and spoken language units (Kyle et al., 2013). The game environment provides a good platform for intensive training, since it provides plenty of repetition in short time periods especially for those who need more training. The game adjusts its level of difficulty according to each player’s skills so that it is sufficiently challenging without being too difficult or easy (see Richardson and Lyytinen, 2014).

The GraphoGame method has been developed for several different languages. Since the method is evidence-based, the impact of each language version is investigated in controlled intervention studies. The evidence on the positive effects of training with the method is encouraging. So far, the game has been developed already for over 20 languages, including languages such as Finnish, Greek, Spanish, German, French, English, Kiswahili and Chinese using both Pinyin (Mainland China) and Zhu–Yin–Fu–Hao (Taiwan). A short version of the character game for Mandarin Chinese has also been developed. In all of the game versions, the effect of training is evident even after very short intervention periods of approximately 5–11 hours within 6–12 weeks. For instance, the results of the intervention study conducted with the English GraphoGame based on rime units showed that after only a 12-week intervention period with a total of 11 hours of training with GraphoGame, children’s word-reading skills improved by 0.69 standard scores per hour (Kyle et al., 2013), a clear indication of effective reading intervention (cf. Torgersen et al., 2001). Brain studies conducted in Switzerland with six- to seven-year-old kindergarten children playing German GraphoGame revealed significant changes in brain activation showing emerging print sensitivity after training merely three to four hours within six weeks (Brem et al., 2010). Thus, this method in which specific features of each spoken language and its orthography are carefully taken into consideration in an individually adaptive training environment seems to be an efficient way to enhance learning even for struggling learners. This can be taken as proof that it is essential to focus on both learners’ spoken language skills, particular the phonology, as well as on the relationship of orthography to spoken language, in order to support children’s reading development efficiently.
Summary

In sum, it seems that phonological awareness has a significant impact on developing reading skills especially in alphabetic writing systems. The impact merely diminishes or strengthens due to the specific characteristics of the language and orthography children are learning. The limitations of phonological awareness and its power for explaining learning or struggling in learning, however, might emerge particularly when logographic orthographies are concerned. However, regardless of the writing system, it is quite clear that teaching methods should take into account the important role of spoken language in learning to read together with the relationship it has with its orthography. The numerous studies on phonological awareness in developing reading skills clearly show the importance of assessing phonological awareness skills early in development since the predictive power of phonological awareness for detecting reading difficulties is significant in most orthographies. In turn, information on poor phonological awareness skills enables targeted early treatment that will help both in improving phonological awareness and reading skills at the same time, at least in alphabetic languages.

Notes

1 A lexicon refers here to the knowledge or mental database that a native speaker has about his or her own native language in terms of words and phrases, including meaning and usage but also form.

2 The term rime refers to a spelling pattern rather than just the phonological segments within a syllable from the vowel sound onwards to the end of the syllable (vowel sounds constitute the nucleus of a rhyme unit and the following consonants at the end of the syllable constitute the coda part of the rhyme unit).

3 GraphoGame training was done in short periods (10–15 minutes) at a time, typically once a day per school day.

References


