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Phoneme awareness and pathways into literacy: A comparison of German and American children

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Abstract. Where American kindergartners are taught letters and letter sounds, German kindergartners are not; where American first and second graders receive an eclectic blend of whole language, whole word and phonics-based approaches, their German counterparts are taught by an intensive synthetic phonics approach. As a probe to the consequences of these pedagogical differences on the emergence of phoneme awareness, this study administered two tests of phoneme awareness to kindergarten-, first- and second-grade children in Germany and America, along with reading tests, the digit span test and a test of RAN color naming ability. The American kindergarten children excelled on a phoneme identity judgement and a phoneme deletion task that the German kindergartners found difficult. Their advantage held equally whether the manipulated sound was a syllable onset or the initial part of a consonant cluster. The first and second graders surpassed the kindergartners in both countries; however, the German first and second graders equaled their American peers on both tasks and both types of units. In addition, the German children were more accurate decoders of pseudowords by the end of second grade, and the association between phoneme awareness and German decoding ability was weaker. An increased emphasis on phonics and the greater transparency of the German alphabet are discussed as possible factors in the decoding excellence of the German second graders and its decreased association with phoneme awareness. The contrast between the American and German kindergartners and the equivalence of the first and second graders in the two countries are consistent with a view that phoneme awareness develops primarily as a product of literacy exposure.

Key words: Cross-language comparison, Early literacy, Phoneme awareness

Introduction

The discovery of a strong relationship between children's awareness of phonemes and their progress in learning to read has been hailed as one of the great successes of modern psychology (Bryant & Goswami 1987). In study after study, English-speaking children who are successful beginning readers consistently surpass the poorer readers of their classrooms in the ability to count, compare, delete or otherwise manipulate phoneme-sized segments within spoken words. Superior performance on such tests of phoneme awareness has been a consistent characteristic of kindergartners and even preschoolers who go on to become good readers in the early elementary

grades (for reviews, see, for example: Adams 1990; Goswami & Bryant 1990; Brady & Shankweiler 1991; Wagner & Torgesen 1987). Prompted by this evidence that phoneme awareness is both an attribute and precursor of reading success, we have explored one possible basis of individual differences in phoneme awareness. Where many studies have compared children at different reading levels or different ages, we have compared children from two different cultures, Germany and America. These two cultures afford different paces with respect to the onset of alphabetic instruction, thus comparison between them can offer a particularly opportune window into the relation between early literacy exposure and the development of phoneme awareness.

To expand upon this point, between kindergarten and the first two years in school there exists a key difference between the onset of alphabetic instruction and the pedagogical preferences of the German and American educational systems. In German-speaking countries (Germany, Austria, Switzerland), the onset of literacy instruction is delayed until children are in the first grade. The kindergarten year is spent on activities other than letters and reading such that most children arrive in the first grade (after having reached the age of six years) without any reading ability and with very limited (if any) letter knowledge. Once in school, the pace quickens and children are systematically and progressively led to self-reliant word recognition. Letters are introduced not by name but by sound and initial reading is little else than word decoding via sound blending. This synthetic phonics approach is relatively easy to realize as the letter-sound relations are simple and the whole writing system is quite consistent.

In contrast, the English-speaking world favors earlier, more gradual and pedagogically varied instruction. The culture of home literacy and preschool training is such that the majority of children are already acquainted with letters and letter names by the time they enter kindergarten. Many kindergartners can even recognize an appreciable number of written words. The kindergarten year typically offers many opportunities for learning letter names and sounds, as well as exposure to 'pre-reading' activities that call attention to the phonological segments of words. On entering the first grade (in many places, the children need only be six by the first of December) the children are exposed to an eclectic variety of teaching approaches. The pedagogical methods range from meaning-based, whole-language approaches to sight-word, basal approaches to phonics, with most teachers using a mixture. It is tempting to link the pedagogical uniformity seen in German schools to the transparency of the German writing system and the variability in American schools to the complex grapheme-phoneme relations embodied in the relatively 'deep' English system.

The different pathways into literacy that are available to German and American children can offer a particularly appropriate window into some underlying assumptions about the emergence of phonemic awareness. If phoneme awareness is triggered by some type of exposure to an alphabetic writing system (e.g., Barron 1991, 1994; Morais, Cary, Alegria & Bertelson 1979; Read, Zhang, Nie & Ding 1986), then the different pathways into literacy should lead to different pathways into phonemic awareness. In particular, we would expect the low or absent letter and word knowledge of the German kindergarten children to be reflected in low or absent phonemic awareness. Such was shown for Serbo-Croatian illiterates with varying levels of letter knowledge (Lukatela, Carello, Shankweiler & Liberman 1995). However, an alternative view is that the emergence of phoneme awareness is a more natural concomitant of language development, reflecting developmental changes in the organization of the lexicon. Several authors (e.g., Elbro 1996; Fowler 1991; Walley 1993) have suggested that phoneme awareness arises as a concomitant of a change from holistic to more explicit, segmental representations of words. From this view we would expect the phoneme awareness of German children to be more or less equivalent to American children of the same age. We may further speculate that equivalence despite widely different levels of alphabetic instruction should be most evident for simple judgments as opposed to extensive manipulations of phonemes. Exposure to alphabetic instruction might also have less of an effect on tasks that involve more shallow levels of phonological sensitivity, such as those focussed upon syllable onsets as opposed to phonemes within a consonant cluster (see Stanovich, 1986, for a discussion of levels of phonological sensitivity).

Before justifying and pursuing these predictions, we want to draw two contrasts between the early reading skills of English- and German-speaking children that substantiate our point about there being different pathways to literacy. The first contrast involves letter knowledge, and the massive advantage of American and British preschoolers over their German counterparts. To illustrate, in one large sample of kindergarten children (five- and six-year-olds) in Florida, mean letter name knowledge for upper case letters was 21/26 (Wagner, Torgesen & Rashotte 1994), another Florida-based study of four- and five-year-olds in a middle-income sample reports a mean of 20 (Lonigan, Burgess, Anthony & Barker 1998). Among one younger sample of four-year-olds in Britain, mean letter knowledge was 4.6 (Johnston, Anderson & Holligan 1996). A recent study conducted in the UK (Muter, Hulme, Snowling & Taylor 1998) reports letter knowledge of 4.3 at four years, 12 at five years and 18.6 at six years. In contrast, to the data obtained from English-speaking children, mean letter knowledge was between three and six in a sample of German kindergarten children (mainly six-year-olds;

see Schneider & Näslund 1993). For a comparable level of letter knowledge among English speaking children we must turn to the population of four-year-olds in the UK (Johnston et al. 1996; Muter et al. 1998), or a low SES population of four- and five-year-olds in America (Lonigan et al. 1998). These children recognized an average of four letters, possibly as a consequence of being afforded fewer opportunities for formal and informal instruction (Lonigan et al. 1998). In Germany, decreased letter knowledge coincides with a delayed onset of formal education, but may also reflect a decreased emphasis on literacy-related activities in the home and preschool. For example, German children are not exposed to programs like 'Sesame Street' and ABC books are not widely available (for a discussion of how such cultural differences contribute to differing phonological awareness skills among French vs. English children, see Bruck, Genesee & Caravolas 1997). Whatever the source, formal schooling or home literacy environment, differences between the letter knowledge of American and German children appear to be real and it is our intent to determine whether these differences provoke differences in phoneme awareness.

The second contrast that we wish to underscore concerns decoding accuracy and the massive advantage of German first graders over their American and British counterparts. A number of different studies of German-speaking children at the end of first grade report decoding accuracy scores of around 90% correct for grade appropriate words and pseudowords alike (Schneider & Näslund 1993; Wimmer & Hummer 1990; Wimmer, Landerl, Linortner & Hummer 1991; Wimmer, Mayringer & Landerl 1999). In contrast, Wagner et al. (1994) report that at the end of first grade the children in their Florida-based longitudinal sample could only read 7% of the 106 words on the Woodcock Word Identification Test and 7% of the 42 pseudowords on the Word Attack Test. At the end of third grade, their subjects' reading accuracy scores were still only around 50% (Wagner, Torgesen, Rashotte & Hecht 1997). For their sample of first-grade children in upper state New York, Scanlon and Vellutino (1997) report mean scores of 35% of the words on the Word Identification Test and 31% on the Word Attack Test, still paling in comparison to the scores of the German children. Two studies have the advantage of using more or less the same words and pseudowords for assessment of reading ability in English and German. These have also shown that German-speaking children have an enormous reading accuracy advantage (particularly for pseudowords) over children in the UK (Frith, Wimmer & Landerl 1998; Wimmer & Goswami 1994). In discussions of the lower performance of the English children, these authors call attention to the more transparent German orthography and to the possibility that the decoding

difficulties of the English-speaking children are in large part due to their less extensive phonics-oriented instruction.

Thus there is ample evidence that, where American kindergartners know more about letters than their German counterparts, and that by first or second grade, German children are more successful decoders. Before we present our design for investigating the possibility that these differences may associate with differences in phoneme awareness, it is important that we discount possible confounds. Perhaps the most obvious source to consider is the phonological characteristics of English and German. Phonological influences have been invoked by Cossu, Shankweiler, Liberman, Katz and Tola (1988) to explain the somewhat higher syllable and phoneme counting scores of Italian children compared to the American children originally studied by Liberman, Shankweiler, Fischer and Carter (1974). However, Cossu et al. found the largest cross-language differences in the first grade and, therefore suggested that the Italian advantage may be due to the more consistent Italian orthography, above and beyond the simpler syllable and vowel system of Italian. Language differences are also relevant to Caravolas and Bruck's (1993) comparison of the development of phoneme awareness in Czech- and English-speaking children. They report that the Czech speakers achieved better performance for onset-clusters than did the English speakers, which could be related to the extremely high number of different onset clusters in Czech. We note that the Czech advantage increased between kindergarten and first grade, which Caravolas and Bruck interpreted as a likely consequence of the consistent (i.e., shallow) Czech orthography. Language differences, differences in orthographic transparency and different forms of instruction are all evoked by Durgonoglu and Oeney (1999) to explain the superior syllable and final-phoneme deletion of Turkish kindergarten and first-grade children relative to American children of the same age. For our purposes, English and German are a more appropriate comparison since they are far more comparable than English and Italian, English and Czech or English and Turkish. The phonological characteristics of English and German are quite comparable due to their common Germanic roots. As a consequence, neither the prevalence of open vs. closed syllables nor the number of consonant clusters are confounds. English may have a more complex vowel system than German, but we can minimize the impact of this difference by limiting our tasks to the segmentation and judgment of consonants. German has a greater use of compound words, but we will be using simple words. A further methodological advantage of a German-English comparison is that the occurrence of common root words allows us to present the same consonants in the same positions (e.g., ball – *ball*, bread – *brot*). The German alphabet is clearly more transparent than English and this could possibly have consequences

for the relationship between phoneme awareness and the ability to become a proficient reader. However, from the perspective of the beginning reader, the phonological structures of the spoken languages are comparable and any differences in phoneme awareness would be presumed to arise from factors other than the phonology of the spoken language.

Confounds aside, let us now return to the putative role of literacy in the development of phoneme awareness. That alphabetic literacy is the primary determinant of phoneme awareness was first proposed by Morais et al. (1979), whose research on the phoneme awareness of alphabet-illiterate adults suggested that the awareness of phonemes is a consequence of learning to read an alphabetic orthography. This view is consistent with the spurt in phoneme awareness that occurs when American children begin literacy instruction (Liberman et al. 1974). It is supported by other research with alphabet-illiterate adults (Read et al. 1986; Lukatela et al. 1995). It is further supported by research on the effects of training (for a review see Torgesen & Davis 1996). That direct training can facilitate phoneme awareness accords with some of the French language research on the effects of phonics vs. whole-word reading instruction on young children's performance on a phoneme reversal task (Alegria, Pignot & Morais 1982). However, an emphasis on training is at odds with some of the English-language research (Connelly, Johnston & Thompson 1999; Thompson & Johnston 2000; Tumner & Nesdale 1985). In these studies, while both pseudoword reading and regularity effects in real words correlated with phoneme deletion and improved with phonics training, phonics training did not have a significant effect on phoneme deletion.

Barron's (e.g., 1991, 1994) 'Proto-literacy Hypothesis' is a more recent refinement of the literacy account. It assumes that the critical level of literacy required for the inducement of phonemic awareness is rather minimal, being letter knowledge as opposed to decoding ability. In this view, a child who, for example, learns that ⟨a⟩ is /ae/ may become aware of /ae/ as an invariant segment of words yet be unable to recover the sequence of phonemes that a sequence of letters transcribes. Consistent with this hypothesis, previous studies with English speaking children found very substantial correlations (around 0.60) between letter knowledge and phoneme awareness measures in pre-reading children (Bowey 1994; Johnston et al. 1996). A study of alphabet-illiterate adults has also shown a direct link between knowledge of letters and performance on phoneme awareness measures (Lukatela et al. 1995).

Contrasting with the accounts that emphasize the role of literacy are those recent accounts that link phoneme awareness to changes in lexical organization. These emphasize that the emergence of phoneme awareness is an inherent aspect of language development, they propose that phoneme

awareness emerges when the need to store large numbers of vocabulary items efficiently and adequately leads to some change in lexical representation. From word perception and word production studies, Fowler (1991), for example, inferred that as children learn more and more similarly structured words, the lexicon changes from a syllable- or word-based format to a format based on phonemes (e.g., the beginning of the word "bread" may be re-formatted into two phonemes, when words like "bed" and "red" enter the lexicon). Fowler further posited that the reorganization towards segmental representations may well last into the early school years.

Fowler's observations are echoed in Walley and Metsala's 'Lexical Restructuring Model' which emphasizes the impact of continued vocabulary growth on spoken word recognition in childhood (e.g., Walley 1993; Metsala & Walley 1998). This model raises the possibility that phonemes are not preformed perceptual units whose conscious accessibility changes with literacy exposure. Instead, it suggests that phonemes gradually develop over childhood, as the growth of spoken vocabulary causes lexical representations to become more segmental. With regard to phoneme awareness, Walley and Metsala (1998, p. 102) state that "the phoneme emerges first at an implicit level for the perceptual representation and processing of spoken words and thus only later as a cognitive unit that can be consciously accessed and manipulated." They thus imply that lexical restructuring is necessary but not sufficient for phoneme awareness. While they leave unresolved the factors or experiences that allow awareness to develop once restructuring has taken place, they do explicitly deny that reading experience will influence phonemic awareness (p. 108).

A related but slightly different view of developmental phonological organization owes to Elbro's 'Distinctness Hypothesis' (Elbro 1996; Elbro & Peterson 1998), which proposes that the lexicons of young children (and dyslexic children in particular) may possess relatively indistinct phonological representations that employ fewer phonetic features than those of mature language users. In such indistinct representations, the boundaries between phonemes can be blurred and this can lead to poor performance on phoneme awareness tests.

Quite simply, a strong emphasis on literacy exposure predicts differences between children in the two countries; a strong emphasis on lexical reorganization does not. An emphasis on the role of literacy predicts that different levels of phonemic awareness should accompany differences in the onset and pacing of early literacy and a decreased level of phoneme awareness should accompany the reduced exposure to early literacy among German kindergarten children. At the same time, the intense exposure of German first and second graders to synthetic phonics instruction should ameliorate any lag in

phoneme awareness by the early elementary grades. Indeed, to the extent that first and second grade children in Germany are superior readers, they may even excel with respect to first and second graders in America. An emphasis on the role of lexical reorganization, however, predicts a more equivalent profile of age-related changes in phoneme awareness performance across the two countries. Presumably, normally developing German and American children at the onset of kindergarten would be at a similar stage of vocabulary development (Clark, 1995, provides data on the comparability of their lexical creativity). They should be equally poised for reorganizing phonological representations. There should be age-related changes as children's lexicons develop, but the profile of these changes should be more comparable for the German and American children.

It is a problem for the study of letter knowledge and phoneme awareness that pre-reading children with high letter knowledge may come from stimulating home and preschool environments and may possess a wide variety of cognitive-linguistic competencies quite different from those of pre-reading children with little or no letter knowledge. All of the above-mentioned studies attempted to circumvent this problem by using control measures, most typically vocabulary, to assess cognitive-linguistic differences associated with letter knowledge and phonemic awareness. However, these have met with mixed results. Burhanpurkar and Barron (1997) and Johnston et al. (1996) found that the associations between letter knowledge and phonemic awareness were reduced but remained reliable when control measures of vocabulary were partialled out. Bowey (1994) found that the massive phonemic awareness difference between the high-letter- and the low-letter-knowledge group was no longer reliable when vocabulary and verbal memory differences were controlled. For the present cross-cultural comparison of phonemic awareness in American and German kindergarten children there is little reason to expect German kindergarten children to be either accelerated or delayed in cognitive and language development more generally. Nevertheless, to confirm that the German and American participants are equivalent in basic cognitive skills, we included within our battery two commonly-used tests that readily lend themselves to cross-language comparisons: the RAN test for colors (Denckla & Rudel 1974) and the forward digit span (Wechsler 1967). As we were aware of no expressive vocabulary test that was available in both English and German, we opted against testing vocabulary directly, taking note of the fact that others have shown that digit span to be well correlated with vocabulary development in this age range (Gathercole, Hitch, Service & Martin 1997; Gathercole, Service, Hitch, Adams & Martin 1999).

A fair assessment of phoneme awareness in pre-literate children requires a task format that does not depend upon knowledge of letter sounds or other

abilities related to reading and writing. Ideally the task should also be similar to those used in prior research. To these ends we employed two tasks: a phonological identity judgement task and a phonological deletion task. Each task focused exclusively upon consonants in utterance initial position. Half of the items in each task focus upon a single consonant that is also the onset of a syllable (e.g., 'ball' and 'fire') where half focus upon a consonant that is part of a two-consonant cluster (e.g., 'bread' and 'flat'). This was intended to distinguish onset awareness from phoneme awareness, per se. The child who performs less well on cluster items than on items that contain single consonant onsets may be said to be more aware of onsets than of phonemes. Awareness of the boundary between onsets and rimes is an aspect of phonological awareness which, like phoneme- and syllable-awareness has been linked to progress in learning to read (see Goswami & Bryant 1990; Treiman & Zukowski 1996, but also see Muter et al. 1998). It is also regarded as a lower level of awareness (see Stanovich 1986).

We chose to include a version of the deletion (elision) task because deletion has been used quite widely in the literature. It was employed in studies of alphabet illiterate adults (for example, Lukatela et al. 1995; Morias et al. 1979) as well as in many studies of beginning readers (see, for example, Mann 1986; Rosner & Simon 1971; Yopp 1988), including several we have cited (for example, Durgunoglu & Oeney 1999; Elbro & Peterson 1998; Lonigan et al. 1998; Muter et al. 1998). Unlike phoneme counting (e.g., Liberman et al. 1974), phoneme deletion requires relatively little training and memorization on the part of the child. Many deletion tests are quite complicated in varying both the size (syllable, onset, phoneme) and position (initial, medial, final) of the unit being manipulated (e.g., Lonigan et al. 1998; Rosner & Simon 1971). We kept our task relatively straightforward by focussing only upon the deletion of segments in initial position. In keeping with the design of our deletion task, we examined deletion of single consonant onsets as well as consonants at the beginning of two-consonant clusters. We further avoided all use of letter names or sounds to minimize the demand on letter knowledge that has been a confound in other research.

We chose a version of the phoneme identity judgement task, because it constitutes a superficially simple, but nevertheless valid assessment of phonemic awareness as argued by Byrne (1998). In our version of that test, which we adapted from Byrne and Fielding-Barnsley (1991), the child is given a target word (e.g., "ball" or "bread") and then asked to judge which of two pseudowords (e.g., "baso" or "koso") starts 'in the same way' as the target word. For correct performance the child has to notice the categorical identity of the initial segment in the target and the probe word, despite different articulatory and acoustic realizations of the phoneme. To us, the particularly

attractive feature of the phoneme identity judgement task is its simplicity. It does not require manipulation of phonological structures as is the case for the deletion task, it can be easily explained without reference to phonemes or sounds like 'kuh' or 'buh', and it makes relatively little demand on either working memory or rote memorization. Consistent with this simplicity, Bowey (1994) found the phoneme identity task to be much easier for preschool children than the more widely used oddity detection task. The ease of the phoneme identity judgement task is importance for the present study as it allows a fair assessment of phonemic awareness in German children, who because of their limited letter knowledge may be at a disadvantage in tasks that require explicit segmentation or manipulation of phonological structures.

To reiterate, we have employed both identity judgement and deletion as measures of phoneme awareness in a cross-sectional comparison of German and American children between kindergarten and second grade. The goal is to probe the relationship between the development of literacy and phoneme awareness. A primary question is whether earlier exposure to literacy will lead to an advantage on the part of the American kindergartners. We will also be asking whether any decoding advantage on the part of German second graders will be accompanied by an advantage in phoneme awareness and whether the expected relation between phoneme awareness and reading ability obtains among first and second graders in each country.

Method

Subjects

The sample consisted of 100 German children (40 kindergartners, 20 first graders and 20 second graders) and 60 American children (20 kindergartners, 20 first graders, 20 second graders) with approximately equal numbers of boys and girls in each group at each age The American children attended a public elementary school in a predominantly Caucasian middle-class, middle to high SES neighborhood in southern California, and were volunteers who participated with the written consent of their parents. On a questionnaire exploring how reading was being taught in their classrooms, all teachers indicated using a mixture of phonics and whole language methods. Their questionnaires also indicated that training on the letters of the alphabet, their names and the specific letter sounds are blended into story telling and singing activities beginning in kindergarten. The German children were volunteers who came from three different kindergartens and a public school in middle-class middle to high SES neighborhoods around Munich and Salzburg. As already noted, there is no reading instruction and letter teaching in kinder-

garten. In first grade and second grade, children are exposed to a systematic synthetic phonics teaching approach that emphasizes letter sound blending as a word recognition strategy. The larger size of the German population reflects a desire to include at least some children with higher letter knowledge; an initial sample of 20 had revealed none.

Tasks

Literacy measures

Letter knowledge. For letter knowledge assessment, children had to read a page with 22 capital letters randomly sequenced and printed in 3 columns. (The letters C, Q, X and Y were not used as these are very infrequent in German.) A response of either the letter name or sound was considered correct. Both accuracy and response time (in seconds) were scored. Since recall of letter names or letter sounds may underestimate the letter knowledge of German kindergarten children, the German children received an additional letter recognition test in which they were shown the same 22 letters from the letter reading task distributed over 5 pages with 4 or 5 letters on each page. For each page children were presented two letter names and asked to point to the corresponding letters. This resulted in 10 recognition trials. We also asked children to write their names and identify the letters. If a child could not write his or her name, the experimenter wrote the name and again asked the child to name the letters.

Reading. All American children (i.e., those in kindergarten and grades one and two) received the Word Attack and the Word Identification test of the Woodcock reading mastery test (Woodcock 1998). To directly compare decoding ability, we presented all the American children and the German first and second graders with a decoding test employing real and nonsense words. All stimuli were written in lowercase 36-point font black ink. Accuracy was recorded by hand, and reading time was recorded (in seconds). The 'Real Word List' contained common words in each language subdivided into nine Content and nine Function words (see Appendix A). Each group of nine words appeared on a single sheet of paper, and reading was timed separately with the content words given first, followed by the function words. The Nonsense word list consisted of nine monosyllables and nine bisyllables that were permissible in either language (see Appendix A). These simple pseudowords are phonologically plausible in either of the two languages and contain neither digraphs nor clusters. Each list was presented on a single sheet of paper and was timed separately. Both real and nonsense lists presented six practice words before the actual test items.

For the German kindergarten children, who were expected to have very limited reading ability, two simplified reading tasks were used to see if any of the children had connected some letters or letter sounds with word pronunciations without possessing any productive reading ability. As an extremely simple recoding test, children were presented with two-letter sequences, with either MA and AM or with SO and OS (depending on the child's letter knowledge). AM and SO are function words, MA and OS are pseudowords. In addition, an environmental print recognition task was designed for the German children based on 32 sight words (Stop, Taxi, etc.) and logos (Mickey Mouse, Twix, Coca-Cola, Ford, etc.) from their environment. A response was counted as correct if the child produced the word represented by the letters.

Control measures

To assure the comparability of the two populations we examined short-term memory and rapid automatized naming of colors (RAN, Denckla & Rudel 1974) because these two tests readily lend themselves to the comparison of English- and German-speaking children. Short-term memory was measured using the WISC-R Forward Digit Span (Wechsler 1967), while RAN was measured by asking children to name five rows of five colored dots (with each row presenting a different order of colors). The five colors were the same for the two language groups and each term consisted of a single closed syllable: blue – blau, green – grün, red – rot, brown – braun, black – schwarz. The children were practiced on three rows of these colors. Timing began when the test sheet was displayed and ended when the child had named the last dot on the page.

Phoneme awareness measures

Phoneme identity judgement. The materials appear in Appendix B. As outlined in the Introduction, each item in this test required the child to choose which of two pseudoword alternatives begins in the same way as the target word, for example, "Which word begins in the same way as /flute/? /fidu/ or /lidu/?" To make sure that the children understood this test question, we presented a pre-test training using the same question format for lines of colored dots. After this training, eight practice trials – four with the target word "cow" (German: "Kuh") for the onset condition, four with the target word "cross" (German: "Kreuz") were given to introduce the phoneme identity judgment task. Each target word was presented together with a corresponding picture to reduce memory load. On the first practice trial for each word ("cow" and "cross"), the experimenter demonstrated and explained the correct choice. On the following practice trials, the child chose and the experimenter reinforced or corrected. The test items were then presented without feedback starting with the target words for the onset identity judgements –

"ball" and "fish" (German: "Ball" and "Fisch") – each with 8 judgements. The test trials for the phoneme identity judgements with the target words "bread" and "flute" (German: "Brot" and "Flöte") followed, each with 8 judgements. The assumption was that children might profit from having the same phonemes that were first presented as single consonant onset (i.e., "f" in "fish") also be presented as the initial segment of a two-consonant cluster onset (i.e., "f" in "flute"). The two target words that started with the same sound in the onset and the phoneme identity condition also involved similar pseudoword pairs. The full list of items appears in the Appendix.

Phoneme deletion. The materials for the Phoneme Deletion Task also appear in Appendix B and consisted of 12 words each to be repeated without the first 'sound'. (E.g., "Fire. Fire without the first sound becomes ____?") As a probe to the deletion of onsets vs. phonemes, six of the items started with a single consonant onset, and six started with a two-consonant cluster. As a training device, we again presented a visual analogy of the task using colored dots: four cardboard dots of different colors were grouped in a horizontal line, and children were asked what colors were left once the first dot was removed from the array. This training was followed by eight practice trials with feedback that included four single consonant items and four items with two-consonant clusters. For the 12 test words that followed, no feedback was given. All test words appear in the Appendix.

Procedure

All testing was done between March and July of the academic year. Participants were tested individually in a quiet room in their schools. The RAN test was administered first, followed by the phoneme identity judgement task, the phoneme deletion test, the letter knowledge test, the reading test and the Digit Span. All instructions for all tests were carefully matched between the two languages.

Results

Table 1 lists the means and standard deviations for raw scores on each task, separately for the American and German children at each age. For ease in comparing the two groups, we begin with a discussion of the control measures before proceeding to the measures of phonological awareness and reading ability.

Table 1. Means, standard deviations of the English- vs. German-speaking children on reading and general cognitive measures

	English			German		
Grade level:	K	1	2	K	1	2
Age (months):	74	88	98	75	89	101
Reading						
Letter identification						
Percent correct	94.1	98.0	97.5	28.8	100.0	100.0
SD:	4.7	2.7	2.7			
Time (seconds)	18.7	15.1	13.3		16.5	13.4
SD:	5.0	3.0	2.5		4.5	3.1
Real word decoding						
Percent correct	51.1	94.2	99.7		95.8	99.4
SD:	44.2	12.9	1.2		6.7	1.7
Time (seconds)	12.7	8.0	5.5		10.8	5.3
SD:	12.2	5.8	1.7		7.3	1.5
Woodcock word ID	22.8	45.0	58.6		na	na
SD:	21.2	14.5	10.0			
Nonsense word decoding						
Percent correct	49.7	80.1	85.0		90.8	92.8
SD:	39.4	25.5	14.8		6.1	3.6
Time (seconds)	27.6	17.2	15.8		13.6	13.4
SD:	15.2	9.5	10.6		7.6	3.0
Woodcock word attack	9.3	17.9	25.1		na	na
SD:	10.4	8.6	7.0			
General cognitive						
Digit span	4.4	6.3	5.6	5.4	6.4	7.6
SD:	0.9	2.2	1.3	1.5	1.4	1.6
RAN (seconds)	28.4	21.6	21.8	35.5	25.4	22.3
SD:	17.4	5.7	4.6	11.8	4.5	3.3

Control measures

The means for the control measures suggest that the German children have an advantage on the digit span test ($F_{1,134} = 5.74$, $p < 0.018$), which interacts with grade ($F_{2,134} = 4.87$). Age differences between the German and American children do not underlie this result; covaried for age, there was still a significant effect of country, ($F_{1,33} = 6.44$, $p < 0.012$), and a country by

Table 2. Means, standard deviations of the English- vs. German-speaking children on measures of phoneme awareness

	English			German		
Grade level:	K	1	2	K	1	2
Phoneme Awareness						
Phoneme judgment	91.6	98.7	98.4	68.5	95.9	99.5
SD:	13.2	2.7	1.9	15.7	7.6	1.5
Single consonant	92.2	99.7	99.7	71.1	96.9	99.4
SD:	14.9	1.4	1.4	17.6	8.7	1.9
Consonant cluster	90.0	97.8	96.9	65.9	95.0	99.7
SD:	13.4	4.7	3.8	18.1	7.2	1.4
Phoneme deletion	48.3	74.2	82.1	17.5	68.7	82.5
SD:	35.8	21.1	14.6	25.8	29.0	21.1
Single consonant	59.2	84.2	85.5	17.1	70.8	90.8
SD:	43.3	23.2	13.5	26.8	38.6	14.8
Consonant cluster	37.5	64.2	78.3	18.8	66.7	74.2
SD:	39.7	32.1	18.8	26.5	34.2	38.4

grade interaction, ($F_{2,133} = 5.13$, $p < 0.007$). Looking at Table 2, the American kindergarteners and second graders have lower average scores than their German counterparts while the first graders are equivalent. The variance is also higher for the American second graders suggesting that there could have been a sampling problem. On the rapid color-naming task, children made virtually no errors hence we have concentrated on the speed of response. There was a slight advantage of the American children ($F_{1,134} = 4.04$, $p < 0.046$), which persists when age differences are controlled, ($F_{1,134} = 4.98$, $p < 0.027$). This did not interact with age.

Literacy

Kindergarten

The mean percentages that appear in Table 1 confirm the expected advantage of the American over the German kindergarten children with regard to letter knowledge, ($F_{1,59} = 16{,}42$, $p < 0.000$). There was hardly any overlap between the two groups: All 20 American kindergarten children read more than 18 of the 22 letters correctly, whereas only 3 of the 40 German child did so. Half of the German kindergarten children read fewer than four letters, with six children unable to read any letters at all. The German kindergarten children also did poorly on the simplified letter recognition test. The mean recognition

score was 69% (guessing rate: 50%). The majority of the children (i.e., 55%) made fewer than 4 correct responses on the 10 letter recognition trials and can be considered to have been guessing. Interestingly, 85% of the German kindergarten children could write their first name correctly, but most often could identify only a few of the letters in their names. The mean for correctly recognized letters in the children's names was 2.5, the mean number of letters in each name was 6.3.

From the mean scores for Word Identification and Word Attack in Table 1 it is evident that a substantial number of the American kindergarten children had acquired some level of reading ability. Thirteen of the 20 American kindergartners (i.e., 65%) could read at least one item correctly on the Word Attack test. In contrast, only 15 of the 40 German kindergartners (i.e., 37%) could read one of the two two-letter sequences (MA and AM or SO and OS). On the 'environmental print' test the German kindergarten children provided the correct label to only 13% of the logos and sight words.

First and second graders

On the letter identification task, we found a significant main effect of country on accuracy for first and second graders combined (Mann–Whitney Uz = 4.774, $p < 0.000$, owing to the ceiling performance of the German children), and a main effect of grade on letter identification speed ($F_{1,76} = 11.2$, $p < 0.001$). The German children achieved perfect scores, while the American children made a few errors (<3%); the main effect of grade comes from the trend for second graders to be faster than first graders in general. The tests of word and pseudoword decoding ability were analyzed separately with 2-factor ANOVAS that considered country and age. These indicated effects of age and effects of country. As would be expected, the second graders were significantly more accurate than the first graders on real words ($F_{1,76} = 7.75$, $p < 0.007$); but they showed no advantage in accuracy for pseudoword reading ($p > 0.1$) The reading speed of second graders was faster for both words ($F_{1,76} = 13.8$, $p < 0.004$) and pseudowords ($F_{1,75} = 3.2$, $p < 0.077$). While the German children showed no significant advantage in either accuracy or speed of reading words ($p > 0.1$), perhaps owing to a ceiling level of performance on this test (but the test did at least show effects of age), they did show a strong advantage for both accuracy ($F_{1,76} = 18.3$, $p < 0.000$), and time of pseudoword reading ($F_{1,76} = 8.9$, $p < 0.004$). In light of the greater variance for the American children we also computed nonparametric analysis, which confirmed the German advantage for pseudoword accuracy (Mann–Whitney $Uz = 5.788$, $p < 0.000$) and reading time (Mann–Whitney $Uz = 4.608$, $p < 0.000$).

On the control measures of digit span and automatized color naming, it will be remembered that the German-speaking children excelled on the digit

span and the American children on the RAN. We thus turned to an analysis of covariance to test the possibility that digit span or RAN differences might underlie these differences in reading ability. Both Digit Span (effect size = 0.08; $F_{1,74} = 6.3$, $p < 0.02$) and RAN time (effect size = 0.07; $F_{1,74} = 5.4$, $p < 0.03$) related to reading accuracy in the German-speaking children but not the American ones ($p > 0.1$). This pattern of correlation, together with the German advantage on digit span and disadvantage on RAN makes it unlikely that their reading advantage was due to cognitive ability. Consistent with this line of reasoning, the German advantage in both pseudoword accuracy ($F_{1,73} = 10.5$, $p < 0.002$) and speed ($F_{1,73} = 6.4$, $p < 0.014$) was confirmed in an analysis of covariance which control for differences in age, RAN time and digit span.

In summary, the children from the two cultures conformed to expectation. The American kindergarten children showed consistently higher letter knowledge and a substantially greater number of them had acquired a beginning level of reading ability. In contrast, the majority of the German kindergarten children exhibited very low letter knowledge and few could read. By the first and second grades, the German-speaking children possessed letter identification skills superior to those of their American counterparts (though both groups performed at high levels). As first and second graders, the German children also tended to be superior decoders of pseudowords.

Phoneme awareness

On the phonological awareness tasks, older children performed better, in general and American children averaged higher scores, in general. However, once the kindergartners' data were removed from the ANOVA, the performance of the first and second grade children was virtually the same and any effect of grade was limited to the deletion task ($F_{1,176} = 4.8$, $p < 0.031$). The kindergartners, then, are the primary source of any differences within and between populations. From the means of the combined judgement scores, it is obvious that the American children massively outperformed their German peers, and our analysis will focus upon this result. As the single consonant onset items were easier than the consonant-cluster items for judgement ($F_{1,159} = 11.1$, $p < 0.001$) and deletion ($F_{1,159} = 12.6$, $p < 0.001$), we have considered type of item as a repeated factor in the analyses that follow, except where noted.

Kindergarten

ANOVAS considered country and the single vs. cluster items in each test. On the phoneme judgement task, it is clear from Table 2 that the American children strongly outperformed their German peers, averaging 92%

correct compared to 69% for the German children ($F_{1,58} = 29.5$, $p < 0.000$). Moreover, the advantage of the American children held equally for the single phoneme and consonant cluster items and there was no interaction ($p > 0.1$). A general advantage for single phoneme onsets falls just short of significance ($F_{1,58} = 3.6$, $p < 0.06$) . It is also apparent in Table 2 that, while scores on the deletion task were lower, in general, the American kindergartners had a strong advantage, achieving 48% correct as compared to 18% for the German children. For the deletion task, there was a main effect of country ($F_{1,58} = 17.1$, $p < 0.000$, one-way ANOVA), a significant advantage for the items with single phoneme onsets ($F_{1,58} = 5.7$, $p < 0.021$), and a slight interaction between country and type of item ($F_{1,58} = 4.2$, $p < 0.046$). Post hoc t-tests indicated that the scores of the American children were significantly greater for both single ($t_{26.3} = 3.82$, $p < 0.001$), and cluster items ($t_{45.2} = 4.85$, $p < 0.000$).

First and second graders

Among children in this age range there were no significant differences in either judgement ($F_{1,79} = 0.24$, $p > 0.9$) or deletion performance ($F_{1,79} = 1.8$, $p > 0.08$). Children performed at roughly the same level independent of grade level or country of education. To better understand the relationship between reading and phonological awareness we turn to linear models of reading ability.

Separate step-wise multiple regressions of the German and American children's reading performance (the sum of z-transformed scores on the word and pseudoword reading tests) were conducted using phonological awareness (the sum of z-transformed scores on the phoneme judgment and phoneme deletion tests), Digit Span, and RAN *z*-scores as predictors of variance in reading speed and accuracy. Data were combined across the two grades for the sake of simplicity. Table 3 lists the weights *Beta* scores of each variable and the amount of variance accounted for in each country. Most noticeable was the difference in percent of decoding variance accounted for in the two countries. The English-speaking children's decoding accuracy was quite robustly accounted for by the combined variables ($r^2_{\text{English}} = 0.70$, $p < 0.01$), yet of the three variables, only phonological awareness significantly accounted for reading (*Beta* = 0.79, $p < 0.01$). In contrast, the reading accuracy of the German children was not as strongly accounted for by the three variables ($r^2_{\text{German}} = 0.27, p < 0.01$) and no single variable made a significant contribution. In regard to reading speed, there was once again a greater degree of variance accounted for in the case of the American children's performance ($r^2_{\text{English}} = 0.49$, $p < 0.01$) as compared to the German children ($r^2_{\text{German}} = 0.29, p < 0.01$). For the American children, phonological awareness

Table 3. Prediction of reading ability by phonological awareness, Digit Span and RAN

Accuracy		Beta			r^2	
				English:	0.70**	F(3,56) = 44.3
				German:	0.27**	F(3,36) = 4.5
Phonological awareness						
	English:	0.79**	t(59) = 8.0			
	German:	0.29	t(39) = 2.0			
Digit span						
	English:	0.05	t(59) = 0.7			
	German:	0.29	t(39) = 2.0			
RAN time						
	English:	–0.04	t(59) = –0.5			
	German:	–0.24	t(39) = –1.7			
Speed		Beta			r^2	
				English:	0.49**	F(3,48) = 15.4
				German:	0.29**	F(3,36) = 5.0
Phonological awareness						
	English:	–0.64**	t(51) = –5.6			
	German:	–0.14	t(39) = –1.0			
Digit span						
	English:	0.00	t(51) = –0.01			
	German:	–0.24	t(39) = –1.7			
RAN time						
	English:	–0.15	t(59) = 1.4			
	German:	0.42**	t(39) = 3.0			

*$p < 0.05$; **$p < 0.01$.

was the only independently significant variable (*Beta* = –0.64, $p < 0.01$). for the German children, RAN speed was the only independently significant variable (*Beta* = 0.42, $p < 0.01$).

Discussion

Before discussing the implications of the present research for theories about the emergence of phoneme awareness and its relation to literacy and phonological reorganization, we offer a brief summary of the critical findings and how they relate to data from comparable studies.

First, we found the expected differences in the pacing of literacy education in the two countries. On the one hand, the American kindergarten children showed an earlier progression into literacy. Their letter knowledge

was close to perfect and some of them showed substantial reading ability as well. In contrast, the large majority of German kindergartners knew few letters, and could neither decode the simplest possible letter sequence nor name a substantial number of environmental print patterns. At the same time, the German first and second graders gave evidence of being more successful decoders. By the end of first grade, the German children exhibited more perfect letter knowledge than their American counterparts and superior pseudoword decoding as well.

Second, we have found that an advance in phoneme awareness accompanied the earlier literacy of the America kindergarten children. This is indicated by their high performance on both the phoneme identity judgement task and the phoneme deletion task. On the judgement task, it is particularly impressive to note the contrast between the near perfect performance of the American kindergarten children and the near chance-level performance of the German kindergarten children. The advantage of the American kindergarten children held for two different tasks, it held whether the focus was upon syllable onsets or upon phonemes, per se. Thus the advantage holds for two levels of awareness and for two different tasks.

Third, despite the strong advantage of the American kindergartners, our testing of older children indicates that, by that time they are completing the first grade, the German children are able to perform phoneme awareness tests as well as the American children. Every first and second grader scored near ceiling on the judgement task whether or not they came from a culture that had stressed literacy exposure before the first grade. On the deletion task, performance is far from ceiling yet the German and American children are comparable. There is room for differences in phonological awareness to emerge (e.g., second graders surpass first graders), but the country-based differences are not there.

Fourth, although they do not appear to be more aware of phonemes, there is some indication that the German children are superior decoders of pseudowords by the end of first grade. We do not replicate previous findings about a German advantage for either the speed or accuracy of reading of words (e.g., Schneider & Naslund 1993; Wimmer & Hummer 1990; Wimmer et al. 1991, 1999), perhaps because the words in our real word test were too easy. We only show that German first and second graders have an advantage for the reading of pseudowords, both accuracy and speed are superior. We might attribute this advantage for pseudoword decoding to the intensity of the German phonics curriculum, given the advantages that Alegria et al. (1982) observed when they compared phonics and basal approaches. But this would seem at odds with Thompson and Johnston's (2000) recent finding that phonics instruction did not improve performance on a phoneme dele-

tion task. These authors suggest that an advantage for pseudoword reading in the face of equivalent phoneme awareness could reflect a superior ability to use lexical knowledge as a source of phonological recording. This view is compatible with our results if we attribute the greater lexical knowledge to the increased regularity of the German orthography. For example, the more transparent German orthography may help to explain our observation that, although the first and second grade German children were equivalent to the American children in performance on phoneme awareness tests, phoneme awareness was more strongly associated with decoding in the case of our American population (as it was in Naslund, Schneider & Van Den Broek 1997). A more regular orthography German may somehow ease the stress on individual differences phoneme awareness (for a similar view, see Frith et al. 1998).

Our primary result concerns phoneme awareness and the strong advantage of the American kindergarten children who also had greater knowledge of letters and greater ability to read. It is interesting to note how closely our results regarding the phoneme awareness tests and letter naming scores resemble those of other researchers. We may first compare our kindergarten results to those of Muter et al. (1998) who observed British preschoolers over a three-year period and used a deletion task very similar to the one we employed. At age 6.3 years, the letter naming (72% accuracy for the entire set of letters) and initial phoneme deletion scores (52% accuracy for single phoneme deletion) of the Muter et al population are virtually identical to the data of our American kindergartners. Like the American kindergartners, the British children tested at this time had completed one year of literacy instruction. At age 5.3 years, the scores of the British children (42% accuracy for letters, 25% accuracy for phoneme deletion) are roughly equivalent to those of our German kindergartners. Like those kindergartners, the five-year-olds were tested before formal literacy instruction began. Elbro and Peterson (1998), who had used the same type of deletion task to examine Danish kindergartners at the beginning of formal instruction, report similar values of 45% correct for letter naming and 16% for phoneme deletion.

Our kindergarten and first-grade results may also be compared to Durongolu and Oeney (1999), who compared the syllable and phoneme deletion skills of American and Turkish children. They report letter accuracy scores (capital letters) of 61% for Turkish kindergartners as compared to 96% for American kindergartners and 99–100% accuracy for all first graders. Phoneme deletion scores for the Turkish children were 43% in kindergarten and 93% in first grade, where scores for American children were 43% in kindergarten and 80% in first grade. As in America, Turkish children are

exposed to literacy instruction beginning in kindergarten, as in America, phoneme deletion scores are superior.

We may compare our first and second grade results to Naslund et al. (1997), who tested German and American children in the first and second grades. Like them, we see equivalence between children in the two countries on the phoneme deletion task. Their American participants had scored 74% correct as first graders and 86% as second graders; their German children had scored 63% as first graders and 89% as second graders. These levels of performance are virtually identical to the levels of performance that we observed. In their study as well, the German children were faster pseudoword decoders and they also report that, while phonemic tasks were related to reading performance in both countries, the relationship was stronger for the American children.

Turning to a principal concern, which is the relationship between phoneme awareness and the onset of literacy exposure, we note that poor phoneme awareness performance among German kindergarten children has been observed before, in other samples (e.g., Schneider, Roth & Ennemoser 2000; Wimmer et al. 1991). However, in these other studies more traditional phoneme awareness tasks were used, which require explicit segmentation or manipulation of phonological forms. We reasoned that these tasks may depend on letter knowledge and reading and writing competencies and that the present phoneme identity judgement task could assess phoneme awareness in a way that is less dependent on early literacy. Nevertheless the German kindergarten children achieved lower scores on both the phoneme identity judgement task and the more traditional judgement task. The task demands on the judgement task were simple and the children were carefully introduced to the task. The German kindergarten children had no difficulty with the nonverbal pre-training items and appeared to understand the test question which required only that they match words on the basis of their beginnings (e.g., "Which word begins in the same way as /fish/? /fidu/ or /lidu/?") The saliency of the segments was kept high by having the judgement involve the beginnings of the to-be-matched words and for half of the items (e.g., in /fish/) the judgement involved the full syllable onset. We made efforts to employ a perceptual matching task that should have been particularly easy, yet the German children nonetheless erred.

The widespread failure of the German kindergarten children to achieve above chance performance on the phoneme identity judgement task has two implications. One is that the task apparently demands more than simple perceptual matching. The most plausible interpretation is that appreciating the identity of the segments at the beginning of /fish/ and /fidu/ or of /flute/ and /fidu/ requires that the child possess a conception of phonological structure

and that the low-literacy German kindergarten children had not yet acquired such a conception at the level of their American counterparts.

From this first implication follows the second one, namely that the poor performance of the German kindergarten children on the phoneme identity judgement task speaks against a strong version of the phonological reorganization hypothesis. As explicated in the Introduction, this hypothesis assumes that phoneme awareness arises due to a change from syllable-based to phoneme-based word representations, a change that is triggered by the demands of increasing vocabulary size. Since the present German kindergarten children were about 6 years old, the major spurt in vocabulary growth must be well under way and with it the change towards phoneme-based phonological representations. Their digit span scores, which we expect to correlate with vocabulary scores (Gathercole et al. 1997, 1999), are actually superior to those of the American kindergartners. If vocabulary growth leads to phoneme awareness then the present German kindergarten children should have experienced no more difficulty with the phoneme identity judgement tasks than their American counterparts. Obviously, this was not the case. Neither on phonemes that comprise the onset of a syllable nor on phonemes at the onset of a cluster did the German kindergartners equal the performance of their American counterparts. Neither our manipulation of task difficulty nor of level of phonological structure altered the difference between kindergartners in the two countries.

The present findings, at the group level, are most consistent with the literacy hypothesis on phoneme awareness: American kindergartners show an advantage but at the end of first grade, both the German and the American children showed more or less perfect phoneme judgement performance. In general, the kindergarten results correspond with the proto-literacy hypothesis of Barron (1991), in showing that the critical level of literacy for the inducement of phonemic awareness may be rather low. The American kindergarten children could read only half of the words and pseudowords yet still achieved a significantly higher level of phoneme awareness. However, we would not claim strong support for a view that letter knowledge and not reading ability is the critical aspect of literacy for the initial stages of phoneme awareness. For our American population, we actually noted that both phoneme judgment and phoneme deletion were slightly more correlated with reading ability on the Woodcock tests (pearson correlations between 0.48 and 0.80) than with letter identification (correlations between 0.42 and 0.43), analogous to Bowey (1994). Nor would we claim that either knowledge of the alphabet or decoding skill is the sole basis of individual differences in phoneme awareness. For example, one German child without any letter knowledge or reading ability, exhibited perfect performance on the phoneme

judgement task. Such variation has been noted by Mann (1986) who found some Japanese children surprisingly adept at phoneme manipulation tasks despite a lack of alphabetic literacy or a Kana-based strategy.

The general point following from the support for the literacy hypothesis is that, for most children, a conception of phonemes as perceptual-categorical segments of speech arises from something above and beyond the experiences that support primary language development. It is most often a consequence of some extra stimulation. As stressed by the literacy hypothesis, this extra stimulation typically comes from learning to read an alphabetic writing system, which makes a conception of phonemes mandatory. Evidence to this effect can be seen in Mann's (1986, Experiment 3) finding that American first graders surpass their Japanese peers in performance on both phoneme counting and phoneme deletion tasks. Of course, the extra stimulation could also consist of phoneme awareness training without letters, as is provided in some forms of language play, for example. Our point is that, for the majority of children, phoneme awareness must be triggered by something above and beyond the experiences that are sufficient to support primary language development, otherwise we are at loss to explain the poor performance of the German kindergartners.

In the Introduction we pointed out that one major strength of Fowler's (1991) phonological reorganization hypothesis and Elbro's (1996) 'Distinctness Hypothesis' is the natural way they integrate findings about the phoneme awareness deficits of dyslexic children with findings about dyslexic children's more general language problems. A conclusion that a metacognitive conception of phonemes arises from some stimulation above and beyond the requirements of spoken language development misses this integrative feature and is in need of explaining the dyslexia findings. Here it becomes important to distinguish between what triggers a metalinguistic awareness of phonemes and what is responsible for differences in the ease with which such an awareness is induced. Our data indicate that the initial push towards a conception of phonemes comes from outside of spoken language development (typically from alphabetic literacy). Yet we would follow the spirit of Elbro, Fowler, Walley and their colleagues in recognizing that that the child's response to such a push is nevertheless dependent on the state of phonological representations. The lexical and phonological restructurings that they speak of may be essential for making phoneme-sized segments available for the inducement of phoneme awareness. If the initial contact with literacy (e.g., learning some letter sounds) meets a system of advanced, phoneme-based representations, then phoneme awareness may quickly follow. In contrast, no phoneme awareness may be induced when letter-sound information, word play, etc. hits a system of largely syllable-based or otherwise impoverished

representations. Other theoretical accounts have been offered to explain how the language system responds to alphabetic literacy (for example, Ehri & Wilce 1980). It is beyond the scope of our work to evaluate their success. We merely suggest that while the inducement of phoneme awareness requires more than the experience of spoken language development, the maturational status of phonological representations may also be critical. Our empirical contribution has been to show that aspects of literacy experience do indeed influence phonemic awareness in normally developing children whose ages suggest that restructuring has taken place.

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Appendix A
Word decoding test

Content words	
English:	German:
one	kind (child)
high	brot (bread)
home	oma (grandma)
school	maus (mouse)
boy	auto (car)
bird	mutter (mother)
play	esel (donkey)
yellow	wasser (water)
birthday	torte (tart)
Function words	
English:	German:
my	der
them	mit
about	bis

all	und
your	was
when	du
how	sind
out	es
many	wer

Nonsense words (bilingual)

Monosyllabic	*Disyllabic*
ol	ebol
mu	abi
tis	rela
ak	awit
su	edu
kep	soti
ip	orus
ko	uki
dus	mipu

Appendix B
Phoneme identity judgement task

Single consonant onset items

Target: ball (German: Ball)	Target: fish (German: Fisch)
Items: pesa-besa	Items: fime-pime
bopi-wopi	seimo-feimo
dilu-bilu	foka-schoka
bako-mako	fidu-lidu
bafo-safo	fetu-wetu
liwa-biwa	gimo-fimo
schomu-bomu	nalo-falo
bemo-remo	dosa-fosa

Phoneme cluster onset items

Target: bread (German:Brot)	Target: flute (German: Flöte)
Items: pase-base	Items: pemi-femi
wipo-bipo	fomei-somei
buli-duli	schako-fako
moka-boka	ludi-fudi

sofa-bofa	wute-fute
bawi-lawi	fomi-gomi
bumo-schumo	fola-nola
rome-bome	faso-daso

Phoneme deletion task

Single phoneme onsets:	*Phoneme cluster onsets:*
Items: dolphin/dolphin	Items: dragon/drache
fire/feuer	friend/freund
foot/fuss	flat/flach
garden/garten	glacier/gletscher
goose/gans	green/grun
thief/dieb	three/drei

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