INTERNATIONAL LITERACY ASSOCIATION READING RESEARCH QUARTERLY

Teaching Beginners to Decode Consonant–Vowel Syllables Using Grapheme–Phoneme Subunits Facilitates Reading and Spelling as Compared With Teaching Whole-Syllable Decoding

Renan de Almeida Sargiani
Universidade de São Paulo, Brazil

Linnea C. Ehri
Graduate Center of the City University of New York, New York, USA

Maria Regina Maluf
Universidade de São Paulo, Brazil

ABSTRACT

In this experiment, we examined whether beginning readers benefit more from grapheme-phoneme decoding (GPD) than from whole-syllable decoding (WSD) instruction in learning to read and write words. Sixty Brazilian Portuguese-speaking first graders (*M* age = 6 years 1 month) who knew letter names but could not read or write words were randomly assigned to one of three conditions. The GPD group was taught to decode 40 consonant-vowel (CV) syllables by sounding out and blending grapheme-phoneme constituents (combinations of 10 consonants and five vowels). The WSD group was taught to decode the same CV syllables as whole graphosyllabic units. The individual grapheme-phoneme (IGP) group was taught the same 15 grapheme-phonemes as single units but no decoding. Groups were taught to a mastery criterion. Results showed that GPD instruction was much more effective than WSD and IGP instruction in enabling beginners to read CV syllables, multisyllabic words, and pseudowords; to learn to read words from memory; to write words; and to segment and blend spoken words phonemically. Also, GPD instruction facilitated phonological memory for spoken pseudowords. Despite receiving much practice in reading whole CV syllables, the WSD group learned few, if any, grapheme-phoneme subunits. Results support theories that reading instruction is most effective when it begins by teaching students to decode with small grapheme-phoneme units rather than with larger syllabic units, even when syllables are salient spoken and written units in the writing system.

Phonological awareness is the ability to manipulate sounds in spoken words. These sounds include phonemes, onsets and rimes, and syllables. There is much evidence that phonological awareness helps beginners learn to decode words across different alphabetic systems (Castles & Coltheart, 2004; Duncan et al., 2013; Ehri, Nunes, Stahl, & Willows, 2001; Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001). However, researchers have disagreed about whether spellings of phonemes, onsets and rimes, or syllables are the optimal orthographic units to teach decoding at the outset of instruction (Christensen & Bowey, 2005; Seymour & Duncan, 1997; Twist, 2004). Small-unit theorists have argued for phonemes, whereas large-unit theorists have favored onsets and rimes, or syllables (Duncan, Seymour, & Hill, 1997; Vazeux et al., 2020; Ziegler & Goswami, 2005). The purpose of

INTERNATIONAL LITERACY ASSOCIATION

Reading Research Quarterly, 57(2)
pp. 629–648 | doi:10.1002/rrq.432

the current study was to contrast these two theories by determining whether initial decoding instruction is more effective when students are taught to decode with small grapheme–phoneme units or larger graphosyllabic units.

Small Versus Large Units

Researchers advocating larger units have pointed out that it is easier for young learners to detect onsets, rimes, and syllables in speech than to detect phonemes (Bryant, 1998; Ferreiro & Teberosky, 1999; Goswami, 1988, 1990; Kerek & Niemi, 2012; Treiman, 1985; Vernon & Ferreiro, 1999). Unlike larger units, phonemes are not separate acoustic segments but rather overlap seamlessly with other phonemes in spoken words, and their duration is brief and ephemeral, making them difficult to distinguish. However, researchers advocating instruction with smaller phoneme-size units have argued that because alphabetic writing systems represent speech at the level of phonemes, students should be taught to detect these units to form connections between graphemes and phonemes to decode and spell words when first learning to read (Duncan et al., 1997; Ehri, 2014; Hulme et al., 2002; Seymour & Duncan, 1997). One purpose of the present study was to determine which type of spoken unit, syllable or phoneme, is more important to represent in print when beginners are taught to decode words.

Graphosyllabic Approach

Portuguese orthography is considered semitransparent (Seymour, Aro, & Erskine, 2003). Spellings are largely phonemic, but some phonemes can be spelled in more than one way, so there is not a perfect one-to-one correspondence between sounds and letters or digraphs. Spellings make use of diacritics to denote stress, vowel height, nasalization, and other sound changes. Because syllables are prominent units in spoken Portuguese, and spellings of syllables are semitransparent (Duncan et al., 2013; Pollo, Kessler, & Treiman, 2005), many educators believe that the syllable is the most important written unit in teaching students to read (Alves Martins & Silva, 2006; de Melo & Correa, 2013; Mousinho & Correa, 2009). Portuguese syllable structure is simpler than English syllable structure. There are fewer monosyllables in Portuguese, and the boundaries between syllables are clearer, so it is easier for beginners to detect the separate syllables in spoken words and map them onto spellings. Syllables are salient written and spoken units not only in Brazilian and European Portuguese but also in French, Spanish, Italian, and Finnish (Seymour et al., 2003).

Some evidence for the benefit of syllabic letter–sound instruction for beginning readers was provided by Vazeux et al. (2020). They studied French-speaking preschoolers who were nonreaders. One group practiced reading eight whole consonant–vowel (CV) syllables composed of four consonants and four vowels, whereas the other group practiced eight single letter–name and letter–phoneme correspondences, the same consonants and vowels studied by the syllable group. Statistical tests showed that students who read whole syllables performed significantly better on a phonemic awareness elision task at the end of training than the single-letter group did. Vazeux et al. interpreted their findings as supporting the syllabic bridge hypothesis, which asserts that acquisition of CV syllable connections provides the knowledge base from which phonemes become accessible, conscious units (Doignon-Camus & Zagar, 2014). Better performance on the elision task showed that the syllable-trained students had acquired superior awareness of phonemes as compared with the single-letter-trained group. Vazeux et al. speculated that this growth in phonemic awareness should mediate successful reading acquisition. Also, they interpreted their findings as raising doubt that students need to be taught individual letter–phoneme correspondences to develop phonemic awareness. The researchers concluded that it is more effective to teach larger, more accessible graphosyllabic than graphophonemic units to support reading development.

In the current study, we conducted a similar comparison between teaching beginners to decode whole syllables and teaching them individual letter–phoneme associations. However, our design differed. Although participants in both studies were nonreaders, our students were 6-year-old beginning first graders rather than 5-year-old preschoolers. Our students were taught individually rather than in small groups, they already knew names of all target letters, they were taught to decode 40 rather than eight CVs composed of 15 rather than eight letter–phoneme relations, and learning continued until students reached a mastery criterion. Thus, our study extended Vazeux et al.'s (2020) study with a stronger design to compare the impact of CV syllable and letter–phoneme training on transfer not only to phonemic awareness but also to reading and spelling outcomes. In addition, we included a third training condition in which students sounded out and blended grapheme–phoneme subunits to decode syllables.

The effectiveness of syllable-decoding instruction has been pursued in other languages besides Portuguese and French. Practice in reading syllables has been studied with older struggling readers to improve word-reading fluency in Italian (Tressoldi, Vio, & Iozzino, 2007) and Finnish (Heikkilä, Aro, Närhi, Westerholm, & Ahonen, 2013; Huemer, Aro, Landerl, & Lyytinen, 2010). Teaching students to decode syllables is especially relevant in Finnish because of its agglutinative property, where multiple syllabic morphemes are combined to form very long words.

Graphophonemic Approach

Learning to decode with small units involves transforming graphemes into phonemes and blending them to pronounce words with recognizable meanings (Beck, 2006). Share (2008b) described decoding as a self-teaching mechanism that readers can apply to unlock the identities of unfamiliar words as they are reading text. Ehri (1992, 1998, 2014) proposed a connectionist theory and presented evidence to show how decoding enables readers to store written words in memory so the words can be read by sight. When readers apply their grapheme–phoneme knowledge to decode new words, connections are formed between graphemes in written words and phonemes in spoken words. This bonds the spellings of those words to their pronunciations and meanings and stores all of these identities together as lexical units in memory. Subsequently, when these words are seen, readers can read the words as single units from memory automatically by sight. Decoding letter by letter is no long needed to read the words.

Ehri (2005) portrayed the development of decoding and sight word reading as a sequence of overlapping phases, each characterized by the predominant type of connection readers form to link spellings of words to their pronunciations in memory. Development begins with small graphophonemic units that later become consolidated into larger syllabic units. In the pre-alphabetic phase, nonphonological visual cues may be formed but are idiosyncratic and easily forgotten. Use of systematic alphabetic cues emerges in the partial alphabetic phase when readers form partial grapheme–phoneme connections, such as initial and final letters, to store words in memory. However, readers in this phase lack the ability to decode novel words. In the full alphabetic phase, knowledge of the major grapheme–phoneme relations and decoding skill are acquired and enable readers to form more complete grapheme–phoneme connections to fully bond spellings to pronunciations in memory. This makes word reading much more accurate. In the consolidated alphabetic phase, grapheme–phoneme subunits are consolidated into larger graphosyllabic and graphomorphemic units that readers can use to decode multisyllabic words and to form connections that secure the words in memory.

There is evidence suggesting that speakers of European Portuguese benefit more from small-unit decoding at the outset of learning to read. It is only after they have acquired experience at this level that they become flexible in decoding with larger units (Vale, 2006; Vale & Bertelli, 2006). Cardoso-Martins and colleagues (Cardoso-Martins, 1995, 2013; Cardoso-Martins & Batista, 2005; Cardoso-Martins, Corrêa, Lemos, & Napoleão, 2006; Cardoso-Martins, Mesquita, & Ehri, 2011; Treiman, Pollo, Cardoso-Martins, & Kessler, 2013) demonstrated that Brazilian preschoolers benefited more from phonemic knowledge than syllabic knowledge in initial reading development. In one study, Cardoso-Martins (2013) compared Ferreiro's (2009) syllabic stage theory with Ehri's (2005) alphabetic phase theory. Cardoso-Martins's evidence showed that alphabetic phases more accurately depicted children's movement into reading than syllabic stages did. Similar results favoring small over large units have been reported in other studies involving transparent writing systems, such as German (Wimmer & Goswami, 1994), Italian (Degasperi, Micciolo, Espa, & Calzolari, 2011), Welsh (Spencer & Hanley, 2003), and Greek (Nikolopoulos, Goulandris, Hulme, & Snowling, 2006).

Additional evidence supporting graphophonemic over graphosyllabic instruction was obtained in a prior study (Sargiani, Ehri, & Maluf, 2018). Brazilian Portuguese-speaking kindergartners received one of three types of decoding training. The grapheme–phoneme decoding (GPD) group was taught to decode words by breaking them into grapheme–phoneme units. Another group received this grapheme–phoneme instruction combined with phonemic awareness instruction (GPD+PA). A third group was taught to decode whole syllables (WSD). On posttests, the GPD+PA group outperformed the other two groups on posttests assessing word reading and spelling. The GPD group outperformed the WSD group in learning to read words. Results were interpreted to favor a graphophonemic approach to beginning literacy over a syllabic approach. However, this study had some limitations. Students lacked much knowledge of letter names. Students were taught in groups rather than individually and were not taught to a mastery criterion. The purpose of the current study was to overcome these limitations and to restrict the focus to a comparison of decoding instruction with grapheme–phonemes versus syllables.

The majority of evidence supporting the value of explicit GPD instruction comes from studies with English speakers (Castles, Rastle, & Nation, 2018; Ehri et al., 2001). Critics have suggested that because the English writing system is less transparent and much more complex than other writing systems, research in English may have limited relevance for a universal science of reading (Duncan et al., 2013; Share, 2008a, 2021; Ziegler & Goswami, 2006). Landerl (2000) hypothesized that in more transparent orthographies such as Portuguese, the orthographic structure itself may provide sufficient unequivocal information about the alphabetic writing system to activate students' phonological decoding abilities without explicit instruction in grapheme–phoneme relations and phonics. One purpose of the present study was to test Landerl's claim. Beginning readers were taught to decode a simplified, transparent writing system consisting of 10 consonants and five vowels forming 40 CV syllables. Students practiced reading the CVs as whole syllables to a mastery criterion. The question of interest was whether the students would induce and become aware of the graphophonemic subunits embedded in the syllables as a result of this repeated practice.

Determining the optimal linguistic unit size to enable beginners to learn to read carries significant educational implications. Knowing which level of orthographic mapping to teach is important for the design of effective instruction for beginning readers and those who struggle in learning to read (Brown & Deavers, 1999; Vale, 2006).

The Current Study

We designed the current study to compare graphosyllabic and graphophonemic methods of teaching beginners to read words. We adapted the graphosyllabic approach from a method used in earlier times as the first step in teaching Brazilian Portuguese beginners to read. CV syllables are called simple or canonical syllables in Portuguese. Students were taught to read multiple recombinations of consonants and vowels forming CV syllables. This method has been described as syllabic families, syllabic method, or analytic method (Lemle, 1988).

The current study was conducted with Brazilian Portuguese-speaking first graders in Ehri's (2005) pre-alphabetic phase. They knew names of the 15 target letters that were used to spell syllables in the present study, but could not read or spell words. Students were taught to read 40 CV syllables composed of 10 consonants and five vowels. One group (WSD) practiced decoding the syllables as whole CV units. The other group (GPD) used grapheme–phoneme subunits to decode the syllables. Students were taught to a mastery criterion. A third group was taught individual grapheme–phoneme (IGP) relations in isolation but did not use them to read syllables. Several posttests were given to compare effects of training on taught and untaught skills, including grapheme–phoneme knowledge; syllabic and phonemic awareness; ability to decode syllables, words, and pseudowords and to spell words; ability to learn to read a set of longer words from memory by sight; and phonological memory for spoken pseudowords.

The Portuguese writing system taught to students in the current study was simplified so spellings were transparent and consistent in representing spoken CV syllables and grapheme–phoneme subunits. It did not include complexities such as diacritics and variable grapheme–phoneme correspondences. Hence, we expected findings to be relevant not only to beginning reading instruction in Portuguese but also to other transparent and semitransparent alphabetic writing systems having a similar syllabic structure.

We tested four hypotheses:

1. Students taught to decode grapheme–phoneme subunits to read CV syllables will learn to read the syllables more easily during training than students who are taught to decode graphosyllabic units to read the syllables.
2. GPD training will produce superior performance on literacy posttests as compared with WSD training and IGP training.
3. Students taught to decode CVs with graphosyllabic units will become aware of their grapheme–phoneme subunits by the end of training.
4. Graphosyllabic-trained students will outperform students taught IGP relations on phonemic awareness, reading, and spelling outcomes.

The first two hypotheses tested claims of small versus larger unit theories of beginning reading development. The third and fourth hypotheses tested the syllabic bridge hypothesis and claims of Vazeux et al. (2020) and Landerl (2000). Based on Ehri's (2005) phase theory, we expected that teaching students in the pre-alphabetic phase to decode CV syllables by sounding out and blending grapheme–phoneme constituents would enable these students to read more like readers in the full alphabetic phase, whereas teaching students to decode whole syllables and single grapheme–phoneme relations would limit these students' movement to the partial alphabetic phase.

Method

Participants

Thirty boys and 30 girls between the ages of 5 years 11 months and 7 years participated in the study (M = 6 years 5 months). The participants were regular Brazilian Portuguese students from middle to lower class families and were enrolled in the first grade of a public elementary school in São Paulo, Brazil. Equal numbers of male and female names were drawn randomly from four first-grade classes, each contributing 15 students. Signed consent forms were obtained from parents or guardians. The rate of consent approval was 94%. Oral assent was obtained from participants.

The study was conducted during the first semester of first grade when formal reading instruction began. In kindergarten, students had been exposed to letter names, but reading was not taught. First-grade teachers used a literacy program from the state government that was guided by reading texts of different genres. Teachers recited the alphabet daily, but letter sounds were not taught. No phonemic awareness or phonics instruction was provided. Written language was taught at the syllable and word levels. The curriculum prescribed two 50-minute sessions of literacy instruction per day. First-grade teachers had an undergraduate degree in pedagogy, qualifying them to teach early childhood education up to grade 5.

Students were assessed with several pretests. To qualify for the study, participants had to meet the following criteria, placing them in the pre-alphabetic phase of word-reading development: proficiency in spoken Portuguese based on teachers' evaluations; ability to name 15 uppercase target letters (five vowels and 10 consonants) to be used in the study; limited word-reading ability (i.e., no more than two out of 12 common words); limited phonemic segmentation skill; limited word-writing ability (no more than two out of six words); and normal hearing and vision, no neurological birth or acquired disorders, and no serious emotional or behavioral problems. Three children were dropped because they read and wrote more than two words on the pretest.

Materials and Procedures

Participants who qualified for the study were randomly assigned to one of the three experimental conditions: GPD instruction, WSD instruction, or IGP relations taught with no decoding instruction. Participants were separated into boys (n = 30) and girls (n = 30). Within each gender group, members of randomly formed triplets were randomly assigned to the three conditions. There were 10 boys and 10 girls in each condition.

Students completed one day of pretests and several days of training, followed by two days of posttests to assess training and transfer effects. Each pretest, training session, and posttest was administered individually at the student's school by the first author, a school psychologist and experienced researcher, who followed standardized scripted procedures. Pretests were given during the first 20-minute session to screen students for participation, to assess their level of development as pre-alphabetic, and to verify that treatment groups were equivalent prior to training. One week later, training commenced and included between four and six sessions, each conducted on a successive day. Sessions lasted from five to 20 minutes. The number and length of sessions varied depending on how long it took a student to reach a mastery criterion. Posttests were administered in a single session one day after each student's last training session. An additional delayed spelling memory posttest was given a week later.

Pretests

The pretests were administered in the following order.

Letter-Naming Task

Students named 26 uppercase and 26 lowercase letters printed on two sheets in random order. To participate in the study, students had to name all 15 uppercase target letters (*A*, *B*, *D*, *E*, *F*, *I*, *L*, *M*, *O*, *P*, *S*, *T*, *U*, *V*, and *Z*). These were the target graphemes used to spell CV syllables during the training sessions. Names of the 15 letters all contained the target phonemes; for example, the letter *B* named "Bê" contains /b/. Correct responses were scored.

Letter-Sounding Task

Students were shown the same sheet of 15 uppercase target graphemes and were asked to say their sounds (phonemes). No student knew any target letter sounds.

Word-Reading Task

Students were asked to read four CV syllables and 12 words commonly found in children's books (Pinheiro & Keys, 1987) and to name four animal pictures giving nonreaders some success. The words and syllables were composed of the 15 capital target letters. To qualify for the study, students could not read more than two common words. No participant read more than one word or one syllable.

Syllabic Segmentation

Students listened to 15 spoken words ranging in length from one to five syllables and were asked to segment them into CV syllables. Students first practiced with three words and received corrective feedback on how to segment the words into syllables by raising a finger to mark each syllable. During the task, no corrective feedback was provided. The number of correctly segmented words was scored (15 maximum). Cronbach's alpha reliability was .33. Lower reliability resulted from a very limited range of scores (i.e., 95% of scores ranged from 10 to 13).

Phonemic Segmentation

Students were told to segment spoken words into smaller units than in the previous task. Three practice items with feedback were given, followed by 12 test items ranging from one to four phonemes with no feedback. Students raised a finger to mark each phoneme. The task was stopped if a student made three errors in a row or could not perform the practice items with feedback. No student was able to segment any words into phonemes.

Writing Words

Students were asked to write three CVCV words composed of CV syllables to be taught in the study, and three CVCV words composed of untaught syllables. Students who could write more than two words were dropped from the study. No participant wrote more than one word or one syllable correctly.

Phonological Memory

The Brazilian Children's Test of Pseudoword Repetition (Santos & Bueno, 2003) evaluated phonological memory. Students were asked to repeat 40 spoken pseudowords that varied from two to five syllables. The test was stopped following eight consecutive errors. Scored were the number of correct repetitions (40 maximum). The test–retest reliability reported by Santos and Bueno (2003) is .81.

Experimental Conditions

In the two decoding training conditions, students were taught to read five sets of CV syllables to a mastery criterion, either by sounding out and blending grapheme–phoneme subunits or by decoding syllables as whole units. In the condition with no decoding training, students were taught 15 single grapheme–phoneme relations to mastery, those used to spell syllables in the decoding conditions.

Syllable Sets

The typical instructional strategy in Brazil in earlier times (Lemle, 1988) was to teach students to read syllabic families, which is done by combining a consonant with each of five vowels (e.g., *ma*, *me*, *mi*, *mo*, *mu*; *sa*, *se*, *si*, *so*, *su*). To form CV syllables, we chose the five vowels (*A*, *E*, *I*, *O*, and *U*) and combined them with 10 consonants (*B*, *D*, *F*, *L*, *M*, *P*, *S*, *T*, *V*, and *Z*). All of the letters contain the target phonemes in their names. We selected participants who already knew the names of these 15 target letters, which ensured that they possessed the background letter knowledge to benefit from our decoding instruction, and eliminated the need to teach letter names.

In the two decoding training conditions, students were taught to read five sets of eight CV syllables (40 total). Although some were real words in Brazilian Portuguese, they were taught without meanings. The five sets of training syllables are shown in Table 1.

The eight syllables in each set were spelled with two consonants and five vowels that covered all possible CV combinations except for two CVs that were not taught but were reserved for posttests to assess transfer. For example, set 1 consisted of ME, MI, MO, MU, SA, SE, SI, and SU but not MA and SO. In the traditional syllabic method, students are taught to read the syllables in a fixed sequence following the alphabetical order of the vowels (e.g., BA, BE, BI, BO, BU). However, in the current study, the eight CVs in each set were arranged in four different random orders for students to read across test trials. The syllables were displayed individually in capital letters four inches tall. The five sets were taught in the order listed in Table 1. Each set was taught to a mastery criterion before the next set was taught. After the fifth set, a final 20-item review set consisting of a sample of CV syllables already taught was practiced to a mastery criterion. Unless stated otherwise, test items on the pretests and posttests were composed of the grapheme–phoneme relations and CV syllables that students practiced decoding.

GPD and WSD Training

Training in the GPD and WSD conditions was identical except for the decoding procedure. Participants were taught to read each of the five CV sets of eight syllables either by pronouncing the two phonemes corresponding to graphemes separately and then blending them to form a syllable (GPD procedure) or by pronouncing the CV syllable as a whole unit (WSD procedure). The first run through a set of eight CVs was a study trial. Each syllable was displayed; students were told how to decode it, either by sounding out and blending graphemes or by pronouncing the whole syllable; and they copied the response. All subsequent runs through the set were test trials. Each CV was shown, and students tried to read it, either by pronouncing and blending the grapheme–phonemes or by reading the syllable as a single unit. If a syllable was misread in the GPD condition, the experimenter pronounced each grapheme and then blended the phonemes to say the syllable. If a syllable was misread in the WSD condition, the experimenter pronounced the syllable correctly. Students repeated the correct response. In the GPD condition during the test trials, some students began to skip the sounding out and blending step and to pronounce the syllable as a whole. When this occurred, the students were redirected to continue pronouncing the grapheme–phoneme units separately before blending them.

In both the GPD and WSD conditions, students practiced reading each set of CVs repeatedly in mixed-up order for eight test trials. If students had not reached a criterion of two perfect successive readings by the eighth trial, the test trials continued until this criterion was reached, up to a maximum of 24 test trials. Across test trials, syllables in a set were presented in four different orders, which were recycled. The researcher recorded students' responses.

At the end of this training, students reviewed half of the CVs they had been taught. The review set consisted of a mix of 20 syllables extracted from all previous sets (see Table 1). The same test trial procedures with corrective feedback were followed. Test trials continued until students could read all 20 syllables correctly twice in a row up to a maximum of eight trials. Four random orders were practiced and recycled.

IGP Training With No Decoding

The letter–sound training in this condition taught the same 15 grapheme–phoneme relations taught in the GPD condition, but different procedures were used. Students practiced IGP associations but never used the grapheme–phoneme units to read syllables. The grapheme–phoneme relations were taught to accuracy and speed criteria. Two types of practice were interleaved. In one, students saw each letter,

TABLE 1
Five Sets of Consonant—Vowel Syllables That the Grapheme—Phoneme Decoding and Whole-Syllable Decoding Groups Were Taught to Decode, a Final Review Set, and an Untaught Transfer Set

Training syllables	Final review set	Untaught transfer syllables
Set 1: SA, SE, SI, SU, ME, MI, MO, MU	BA, BI, DE, DU, FA, FU, LI, LO, ME, MU, PA, PO, SE, SU, TA, TU, VI, VO, ZE, ZI	BU, DO, FI, LE, MA, PU, SO, TI, VE, ZA
Set 2: FA, FE, FO, FU, ZE, ZI, ZO, ZU		
Set 3: VA, VI, VO, VU, LA, LI, LO, LU		
Set 4: BA, BE, BI, BO, TA, TE, TO, TU		
Set 5: DA, DE, DI, DU, PA, PE, PI, PO		

said its name, and then pronounced its phoneme (e.g., Bê, /b/), followed by corrective feedback. In the next, students heard the experimenter pronounce a letter's sound and then pointed to that letter from an array of five printed letters. Corrective feedback consisted of the researcher saying the letter's name and phoneme and the student repeating them. Letter names were included during instruction as bridges to help students learn letter sounds by detecting the sound in the letters' names. There was no need to teach letter names because students had to show they knew them on the pretest. Across trials, the letters were presented in four different orders. Trials were repeated until students responded immediately and correctly to all 15 graphemes. Students received a minimum of eight test trials and a maximum of 24.

Assessment During Training

In the GPD and WSD conditions, students decoded the eight CVs in each set of syllables repeatedly for a minimum of eight test trials and a maximum of 24. To compare how easily students in the two groups learned to read each of the five sets of CV syllables, the number of test trials completed to reach a criterion of two perfect successive trials was scored as a minimum of 8 and a maximum of 24. On the review set, students were scored on the number of test trials required to read the set of 20 CVs twice in a row perfectly as a minimum of 2 and a maximum of 8.

Posttests

Posttests were given in the following order.

Letter-Sounding Task

The pretest was repeated as a posttest. Although some of the letters represent more than one phoneme in the Portuguese writing system, credit was given only for the 15 phonemes taught. If students gave the names of letters, they were asked for the sounds.

Reading Taught and Untaught Syllables

Two separate lists of CV syllables were presented, and students were asked to read them as whole units. On the first sheet, 20 taught syllables were listed. On the second sheet, the 10 transfer (untaught) syllables were listed twice in mixed-up order. Students received no feedback. The maximum score was 20 correct for each list. Parallel-form reliability calculated on the two lists was .96.

Syllabic Segmentation

The pretest was repeated as a posttest. The Cronbach's alpha reliability was .67.

Phonemic Segmentation

The pretest was repeated as a posttest. To calculate reliability, scores on the phonemic segmentation and phonemic blending posttests were treated as parallel forms of the phonemic awareness construct and yielded a reliability of .88.

Phonemic Blending

This was a new task to assess the effects of training. The experimenter pronounced the isolated phonemes of six CV words and six CVCV words containing taught syllables and asked students to say the words by blending the isolated phonemes. Students first practiced with a CV and a CVCV word. The maximum score was 12 points. The parallel-form reliability for phonemic awareness was .88.

Writing Words

The pretest was repeated as a posttest but with two new words added. Students were asked to write four CVCV words composed of taught syllables and four CVCV words composed of untaught syllables. The number of words (eight maximum) and number of letters (32 maximum) spelled correctly were scored. Parallel-form reliability calculated on letter scores of the four words with taught syllables and four words with untaught syllables was .92.

Phonological Memory

The Brazilian Children's Test of Pseudoword Repetition (Santos & Bueno, 2003) was repeated as a posttest. The test–retest reliability reported by Santos and Bueno (2003) is .81.

Learning to Read Words From Memory by Sight

This task resembled those used by Ehri (2014) and others as a measure of sight word learning. Students were taught to read four CVC, four CVCV, and four CVCVCV real words composed of the 15 target letter sounds that had been taught. The words were longer than the CVs taught during training, hence making them difficult to decode. To succeed, students had to apply their knowledge of grapheme–phoneme connections to remember how to read them. The words were printed in capital letters. The letters *L* and *M* each appeared in the initial position in three words and the letter *P* in two words, and the remainder began with unique letters. The spellings were phonetic rather than conventional. The words contained taught grapheme–phonemes without any diacritics and reflected São Paulo pronunciations. Examples are *paz* (peace) spelled PAS, *fubá* (cornmeal) spelled FUBA, and *lotado* (crowded) spelled LOTADU. The 12 words were presented separately on cards and repeated in four different orders across test trials. During each test trial, the experimenter showed a card, asked the student to read the word, and then provided corrective feedback by saying the whole word. No instruction about how to read the words was given. The task was halted when students read all 12 words correctly twice in a row up to a maximum of eight test trials. The number of correct words per trial and the maximum number of trials were recorded.

Cronbach's alpha reliability based on words read correctly on each of the eight trials was .98.

Memory for Spellings

At the end of the word-learning task, the researcher dictated the 12 taught words, presented in a different order, and asked students to write them. Scores were the number of words (12 maximum), number of CV syllables (24 maximum), and the number of letters (52 maximum) spelled correctly. This same task was repeated seven days later to assess long-term memory for the words. Test–retest reliability calculated on the letters correct scores was .96.

Pseudoword-Reading Task

Students were presented with two lists of unfamiliar pseudowords to decode, one composed of 12 pseudowords containing taught syllables and the other composed of 12 pseudowords containing untaught syllables. Both included four CVC, four CVCV, and four CVCVCV nonwords. Scores were the number of pseudowords decoded correctly on each list. Parallel-form reliability of reading the two lists was low, .31, resulting from many zero scores.

Design and Analyses

In this experiment, we compared three instructional conditions. Pretests were administered to assess entry-level literacy skills and to verify that random assignment of students to the treatment groups rendered them equivalent on these skills prior to treatment. Measures of performance were taken during training and on posttests to compare effects of the training. We calculated analyses of variance (ANOVAs) to assess effects statistically. The independent variable was treatment with three levels: GPD, WSD, and IGP. The dependent variables were training and posttest measures. Nonparametric tests were applied when parametric assumptions were violated.

Results

Students' Performance on Pretests

Table 2 shows the mean age and performance of the three treatment groups on the pretests. Results of statistical tests verified that the three groups did not differ significantly on any of the measures. Selection criteria ensured that all

TABLE 2
Means, Standard Deviations, and Test Statistics Comparing the Grapheme—Phoneme Decoding (GPD), Whole-Syllable Decoding (WSD), and Individual Grapheme—Phoneme (IGP) Treatment Groups on Pretests

	Treatment							
	GPD		WSD		IGP		ANOVA	
Measure	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*
Age (years)	6.34	0.30	6.47	0.29	6.52	0.27	2.22	.12
Uppercase target letter names[a] (15 maximum)	15	0	15	0	15	0		
Uppercase nontarget letter names (11 maximum)	6.75	1.77	6.85	2.76	6.65	2.64	0.03	.97
Lowercase target letter names (15 maximum)	7.25	1.74	7.85	2.64	7.35	2.91	0.34	.72
Lowercase nontarget letter names (11 maximum)	4.75	1.55	4.45	1.93	4.25	2.20	0.35	.71
Target letter sounds (15 maximum)	0	0	0	0	0	0		
Reading words (12 maximum)[ab]	0.30	0.47	0.25	0.44	0.15	0.37		
• Percentage zero scores	70%		75%		85%			
Syllabic segmentation (15 maximum)	11.40	1.43	11.25	1.65	11.35	1.14	0.06	.94
Phonemic segmentation (12 maximum)[a]	0	0	0	0	0	0		
Writing words (6 maximum)[ab]	0.20	0.41	0.10	0.31	0.15	0.37		
• Percentage zero scores	80%		90%		85%			
Writing letters (24 maximum)	7.65	3.10	7.60	3.33	7.53	2.91	0.06	.94
Phonological memory (40 maximum)	33.65	1.76	33.45	2.56	33.60	2.14	0.46	.96

Note. *N* = 10 boys and 10 girls in each treatment condition. ANOVA = analysis of variance. There were no significant differences tested at $p < .05$.
[a]Screeners that were applied to qualify students for the study. [b]Nonparametric Kruskal–Wallis tests comparing treatment conditions were conducted on measures with floor effects; results failed to reject the null hypothesis: *p* (read words) = .53, and *p* (write words) = .93.

participants knew the names of all 15 target letters. However, none knew sounds of the letters. No student was able to read or write more than one word or CV syllable correctly or to segment any words into phonemes. The majority scored zero on the word-reading and writing tasks. Given that participants possessed little, if any, letter–sound knowledge, phonemic segmentation, word-reading, or word-writing ability, they would be considered in the pre-alphabetic phase (Ehri, 2005). Their letter name knowledge would make them ready to move into the partial alphabetic phase.

Students' Performance During Training

GPD and WSD training consisted of teaching students to read eight CV syllables in each of five sets to a mastery criterion (see the sets in Table 1) over four to six sessions. Table 3 shows the mean number of trials completed by the

TABLE 3
Mean Number of Trials Completed During Training and Percentages of Students Scoring at Various Levels in the Grapheme—Phoneme Decoding (GPD) and Whole-Syllable Decoding (WSD) Treatment Groups

	Treatment				
	GPD		WSD		
Syllable set	*M*	*SD*	*M*	*SD*	Pairwise comparison[a]
Set 1: M *and* S					
Trials completed (24 maximum)	8.80	1.2	17.55	5.1	GPD > WSD
Percentage criterion within 8 trials	55%		0%		
Percentage completing 24 trials	0%		25%		
Set 2: F *and* Z					
Trials completed (24 maximum)	8.35	1.1	16.35	5.0	GPD > WSD
Percentage criterion within 8 trials	85%		5%		
Percentage completing 24 trials	0%		20%		
Set 3: V *and* L					
Trials completed (24 maximum)	8.05	0.2	14.20	5.3	GPD > WSD
Percentage criterion within 8 trials	95%		5%		
Percentage completing 24 trials	0%		15%		
Set 4: B *and* T					
Trials completed (24 maximum)	8.05	0.2	13.55	5.6	GPD > WSD
Percentage criterion within 8 trials	95%		20%		
Percentage completing 24 trials	0%		15%		
Set 5: P *and* D					
Trials completed (24 maximum)	8.05	0.2	12.40	5.0	GPD > WSD
Percentage criterion within 8 trials	95%		40%		
Percentage completing 24 trials	0%		10%		
Review set					
Trials completed (8 maximum)	2.00	0.0	4.35	2.3	GPD > WSD
Percentage criterion within 2 trials	100%		30%		
Percentage read 20 consonant–vowel syllables once perfectly within 8 trials	100%		85%		

Note. N = 10 boys and 10 girls in each treatment condition. All students were required to complete at least eight test trials in learning each of the five syllable sets. Students who did not reach a criterion of two perfect successive trials continued beyond eight trials up to a maximum of 24 trials. Students were required to complete at least two test trials in reading the review set to criterion up to a maximum of eight trials.
[a]Standard deviations between treatments differed greatly, so nonparametric Kruskal–Wallis tests were conducted on measures; the null hypothesis was rejected in all six comparisons at $p < .001$, showing that the distributions of scores were not equivalent.

two groups to learn each set of syllables, the percentages of students who reached criterion within the minimum of eight trials, and the percentages of students who required the maximum of 24 trials. Also, the table shows the mean trials completed to read the review set, the percentages of students reaching the criterion of two perfect successive trials, and the percentages of students requiring the maximum of eight trials. Because the distributions of scores were not normal, we applied nonparametric Kruskal–Wallis tests to compare performance of the two groups. Results revealed that the distributions of scores were statistically different on all six tests (*p*s < .001).

From Table 3, it is evident that the GPD group took many fewer trials on average to learn to read the CV syllables in each set than the WSD group did. In fact, many GPD students reached criterion within the minimum of eight test trials, whereas few WSD students performed this well. In contrast, 10–25% of the WSD students took the maximum of 24 trials to read the syllable sets, whereas none of the GPD students required this many trials. On the final review set, most, if not all, students in both groups were able to read all 20 CVs perfectly, but statistical comparison of means showed that the WSD group required significantly more trials to reach this level. These findings support our first hypothesis and show clearly that teaching students to decode CV syllables by sounding out and blending grapheme–phoneme units is much more effective and efficient than teaching students to decode whole-syllable units.

Observation of students' behaviors revealed how they were managing their learning. Beginning with the second set of CVs, some students in the GPD condition started reading the syllables as wholes rather than sounding out the separate graphemes. This reveals that these students were consolidating the subunits into larger syllabic units. Consolidation was made easier by the fact that CVs were limited to combinations of five vowels and two consonants in each set.

Students in the WSD group were much slower to detect any recurring patterns across sets than GPD students. The WSD group's mean number of trials to learn each set decreased very gradually from set 1 to set 5 (see Table 3). An ANOVA comparing means across the five sets for the WSD group showed a statistically significant decline, $F(4,76) = 11.84$, $p < .001$. Their errors included misreading syllables as real words or guessing random words. Two students adopted a strategy of memorizing syllables by naming each letter and then saying the syllable.

Students in the IGP group were taught to associate 15 single graphemes and phonemes. Test trials with feedback were repeated a minimum of eight times and continued until students responded immediately and correctly up to a maximum of 24 trials. The average was 13 trials ($SD = 3.70$) to reach this criterion. No student required the maximum number of trials.

Students' Performance on Posttests

To assess the effects of training, several posttests were administered. We applied ANOVAs to compare the performance of the three treatment groups. On measures with floor effects indicated by a high percentage of zero scores, we applied nonparametric Kruskal–Wallis tests to assess whether the distributions of scores differed significantly among the treatment groups. Means and test statistics are presented in Tables 4 and 5. Main effects of treatment were statistically significant across all of the outcome measures. Bonferroni pairwise comparisons revealed that the GPD group significantly outperformed both the WSD and IGP groups on most of the measures. These findings support our second hypothesis and show that graphophonemic decoding training was more effective than graphosyllabic decoding training and IGP training in enabling students to acquire grapheme–phoneme knowledge, phonemic awareness, word-reading and spelling ability, and phonological memory.

Letter Sounds

Both the GPD and IGP groups were taught the 15 target grapheme–phoneme associations. The GPD group learned them as part of the procedure to decode syllables, whereas the IGP group learned them in isolation. Mean scores tested statistically showed that the GPD group knew significantly more letter sounds on the posttest (92%) as compared with the IGP group (74%), most likely because the GPD group received much more practice in associating graphemes and phonemes in the course of decoding five sets of CVs to a mastery criterion.

Students in the WSD group received extensive practice in reading the same grapheme–phoneme subunits but embedded in whole syllables. Despite this, 95% were unable to say the sounds of any letters. These results fail to support our third hypothesis. Students who practiced reading whole syllables did not become aware of constituent grapheme–phoneme subunits, despite knowing all the letter names containing the relevant sounds and repeatedly reading the same 15 letter sounds combined and recombined in different CV syllables on average 592 times during training. This provides no support for our third hypothesis. Thus, exposure and repetition in reading whole syllables composed of graphemes and phonemes are not sufficient to teach awareness of grapheme–phoneme subunits.

Reading CV Syllables

One of the posttests asked students to read both taught and untaught syllables. As shown in Table 4, statistical tests showed that the GPD group read significantly more of both types than the WSD group did, who in turn read significantly more than the IGP group did. The GPD and WSD groups read untaught syllables almost as accurately

TABLE 4

Means, Standard Deviations, and Test Statistics Comparing the Grapheme—Phoneme Decoding (GPD), Whole-Syllable Decoding (WSD), and Individual Grapheme—Phoneme (IGP) Treatment Groups on Posttests

	Treatment								
	GPD		WSD		IGP				
Dependent measure	*M*	*SD*	*M*	*SD*	*M*	*SD*	ANOVA $F(2, 57)$ (p)	Partial η^2	Bonferroni pairwise comparisons[a]
Target letter sounds (15 maximum)[b]	13.75	1.41	0.05	0.22	11.15	2.52	379.00 (.001)	.930	GPD > IGP > WSD
• Percentage zero scores	0%		95%		0%				
Reading consonant–vowel syllables									
• Taught (20 maximum)[b]	17.10	3.20	11.45	8.09	4.25	5.60	25.40 (.001)	.471	GPD > WSD > IGP
• Untaught (20 maximum)[b]	15.85	4.08	8.65	6.68	2.40	2.98	38.72 (.001)	.576	GPD > WSD > IGP
Syllabic segmentation (15 maximum)	13.45	1.39	11.95	1.96	12.20	2.07	3.85 (.027)	.119	GPD > WSD
Phonemic segmentation (12 maximum)[b]	7.20	3.19	0.15	0.37	4.70	3.47	34.35 (.001)	.547	GPD > IGP > WSD
• Percentage zero scores	5%		85%		15%				
Phonemic blending (12 maximum)[b]	7.35	4.03	1.30	2.39	3.25	4.12	14.72 (.001)	.341	GPD > IGP > WSD
• Percentage zero scores	10%		60%		45%				
Writing words									
• Correct words (8 maximum)[b]	5.00	2.97	1.05	1.47	0.85	1.90	22.50 (.001)	.441	GPD > WSD and IGP
• Percentage zero scores	15%		50%		70%				
• Correct letters (32 maximum)	25.95	7.44	14.95	7.93	13.15	7.59	16.39 (.001)	.365	GPD>WSD and IGP
• Percentage gain (Posttest − Pretest)	49%	25%	15%	26%	10%	21%			Posttest > Pretest[c]

Note. N = 10 boys and 10 girls in each treatment group. ANOVA = analysis of variance.
[a]Pairwise comparison of means that are not reported did not differ significantly. [b]Nonparametric Kruskal Wallis tests were also conducted comparing treatment conditions on measures with floor effects. All results rejected the null hypothesis at $p < .001$. [c]Scores were converted to percentage of total correct to adjust for the difference in the maximum score. Post hoc *t*-test showed a significant gain from pretest to posttest in each treatment condition at $p < .037$.

TABLE 5
Means, Standard Deviations, and Test Statistics Comparing the Grapheme—Phoneme Decoding (GPD), Whole-Syllable Decoding (WSD), and Individual Grapheme—Phoneme (IGP) Treatment Groups on Transfer Tasks

	Treatment								
	GPD		WSD		IGP				
Dependent measure	*M*	*SD*	*M*	*SD*	*M*	*SD*	ANOVA *F*(2, 57) (*p*)	Partial η^2	Bonferroni pairwise comparisons[a]
Word learning									
Trials to criterion (8 maximum)	5.85	2.58	7.90	0.45	7.80	0.89	T 10.46 (.001)	.269	GPD > WSD and IGP
Percentage reaching criterion[b]	75%		5%		5%				
Words correct/trial (12 maximum)	9.71	3.25	3.78	3.06	3.66	2.42	T 32.37 (.001)	.532	GPD > WSD and IGP
							R 66.12 (.001)	.537	
							T × R 3.80 (.004)	.118	
Memory for spellings									
Words correct (12 maximum)[b]	8.35	3.60	2.05	2.87	1.65	2.91	Reject ($p < .001$)[b]		GPD > WSD and IGP
• Percentage zero (immediate)	0%		40%		55%				
Syllables correct (24 maximum)	20.50	3.80	10.65	6.15	9.80	5.20	T 24.23 (.001)	.459	GPD > WSD and IGP
Letters correct (52 maximum)	45.48	7.51	23.98	14.26	23.35	11.63	T 25.77 (.001)[c]	.475	GPD > WSD and IGP
• Immediate test	46.15	6.65	24.55	13.26	23.05	11.36	DL 0.66 (.419)[c]	.011	
• 7-day delayed test	44.80	8.37	23.40	15.26	23.65	11.90	T × DL 0.63 (.535)[c]	.022	
Reading pseudowords									
Contain taught syllables (12 maximum)[b]	6.40	4.75	1.40	3.14	0.05	0.22	Reject ($p < .032$)[b]		GPD > WSD > IGP
• Percentage zero	25%		70%		95%				
Contain untaught syllables (12 maximum)[b]	6.10	4.48	1.40	2.68	0.00	0.00	Reject ($p < .013$)[b]		GPD > WSD > IGP
• Percentage zero	20%		65%		100%				
Phonological memory (40 maximum)									
Posttest	36.95	2.11	34.80	2.12	34.75	2.40			
Gain (Posttest − Pretest)	3.30	2.58	1.35	2.37	1.15	1.98	T 5.23 (.008)	.155	GPD > WSD and IGP

Note. N = 10 boys and 10 girls in each treatment group. ANOVA = analysis of variance; DL = immediate versus delayed posttest; R = trials effect; T = treatment effect.
[a]Pairwise comparison of means that are not reported did not differ statistically. [b]Nonparametric Kruskal–Wallis tests comparing treatment conditions were conducted on measures with floor or ceiling effects; all results rejected the null hypothesis at $p < .001$ except as noted. [c]Test statistics in the ANOVA of the letters correct measure.

as taught syllables, indicating that training generalized beyond the taught units. Students in the IGP group had received no syllable reading practice. Although half of these students read no syllables, 40% were able to read over 11 of the 40 syllables correctly. This indicates that knowledge of grapheme–phoneme relations generalized to a CV-reading task for some of the students.

Phonological Awareness

Three oral phonological awareness posttests assessed syllable segmentation, phoneme segmentation, and phoneme blending. Results are shown in Table 4. On the syllable posttest composed of words with one to five syllables, mean scores tested statistically showed that the GPD group segmented significantly more spoken words into syllables than the WSD group did. Surprisingly, the WSD group performed no better than the IGP group, despite all the practice in reading syllables the WSD group received during training.

Statistical tests applied to mean scores on the phoneme segmentation and blending posttests revealed that the GPD group significantly outperformed the other two groups. Also, the IGP group segmented and blended significantly more phonemes than the WSD group did. Given that phonemic segmentation pretest scores were zero, results show that training in single grapheme–phoneme relations enhanced students' phonemic awareness. In contrast, decoding whole syllables exerted little impact on phonemic awareness. Mean posttest scores of the WSD group were very low, with a high percentage of zero scores (see Table 4). This evidence fails to support the syllabic bridge hypothesis (Doignon-Camus & Zagar, 2014) claiming that learning to read whole CV units provides the knowledge base from which phonemes become accessible, conscious units. Also, results fail to replicate and are in fact the opposite of those reported by Vazeux et al. (2020), who found that WSD improved phonemic awareness more than single grapheme–phoneme training.

Spelling Words

Writing words was not part of training, and students spelled no words correctly on the pretest. As shown in Table 4, statistical comparison of mean scores on the posttest assessing transfer revealed that students in the GPD group wrote significantly more words and more letters correctly than did students in the WSD and IGP groups who did not differ significantly. Whereas 85% of the GPD students spelled at least one word correctly, only half of the WSD students and only 30% of the IGP students performed this well. These findings show that decoding training exerts the strongest impact on writing when students are taught to decode CVs using grapheme–phoneme subunits.

Reading and Spelling Words and Reading Pseudowords

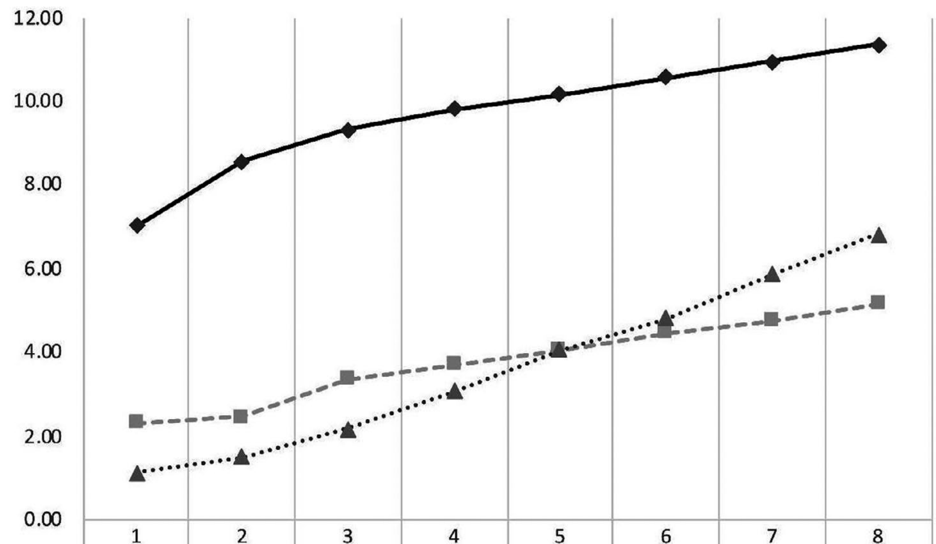
Several posttests were given to determine whether the three forms of training would transfer and enable students to read longer real words and pseudowords composed of the CV syllables.

Reading Words From Memory by Sight

A word-learning posttest examined how quickly students learned to read four CVC, four CVCV, and four CVCVCV words. Because the words were longer and harder to decode, success required applying grapheme–phoneme or graphosyllabic connections to remember how to read them. The set of words was read repeatedly over several test trials with corrective feedback until all were read perfectly twice in a row up to eight trials maximum. In one ANOVA, trials to criterion was the dependent variable. In a second ANOVA, trials (1–8) was a repeated measure, and words correct per trial was the dependent variable. As shown in Table 5, statistical tests revealed that the GPD group significantly outperformed the WSD and IGP groups, who did not differ in trials to criterion. Whereas the majority (75%) of GPD students reached criterion in reading all 12 words by the eighth trial, only one WSD and one IGP student achieved this level of success. On the words correct per trial measure, main effects of treatment and trials and the interaction were statistically significant. As shown in Figure 1, all three groups improved their performance over trials, with the GPD group reading well above the other two groups. Regarding the source of the statistically significant interaction, the IGP group read fewer words earlier during learning than the WSD group but caught up on the fifth trial and exceeded the WSD group by the final trial. These findings show the superior transfer value of GPD training over WSD training for remembering how to read a set of words. Also, findings suggest that knowing IGP relations may contribute more to reading words from memory in the long run than knowing how to decode larger CV units learned without analysis of grapheme–phoneme subunits.

During the word-learning task, students' errors were suggestive of the processes used to read the words. Some students in the WSD group produced semantic associates of the words unrelated to letters in spellings. For example, FUBA was misread as "bolo" (cake). *Fuba* means cornmeal commonly used to make cakes in Brazil, called *bolo de fuba*. Such nonalphabetic misreadings are found among students in the pre-alphabetic phase (Ehri, 2005). Some students in the IGP group tried to pronounce the sounds of the letters they had been taught, but blending proved difficult. For example, one student started to decode FUBA correctly, saying "fu," but when he reached the letter *B*, he forgot about "fu" and said "fab." Such errors are characteristic of students in Ehri's partial phase who lack decoding skill.

FIGURE 1
Mean Number of Words Read Correctly From Memory (12 Maximum) on Each of Eight Test Trials in the Sight Word—Learning Task by Students Who Received Grapheme—Phoneme Decoding (GPD) Training, Whole-Syllable Decoding (WSD) Training, and Individual Grapheme—Phoneme (IGP) Training



	1	2	3	4	5	6	7	8
GPD	7.00	8.55	9.30	9.80	10.15	10.55	10.95	11.35
WSD	2.30	2.45	3.35	3.70	4.05	4.45	4.75	5.15
IGP	1.10	1.50	2.15	3.05	4.05	4.80	5.85	6.80

Spelling Words From Memory

The sight word–learning task was followed by two spelling memory tests, one conducted at the end of learning and another given seven days later. Students wrote the 12 newly learned words to dictation. We conducted ANOVAs on three dependent measures: words, CV syllables, and letters spelled correctly. The independent variables were treatment and time of test. We conducted a nonparametric Kruskal–Wallis test on the words correct measure. Main effects of treatment were statistically significant. However, neither time of test nor the interactions was significant. Test statistics were consistent across analyses and are shown on the letters correct measure in Table 5. No drop in performance occurred on the delayed spelling test, showing that spellings were remembered a week later.

As shown in Table 5, according to statistical tests, students in the GPD group wrote significantly more words, syllables, and letters correctly than the other two groups, who did not differ. The advantage was especially large in spelling words. On average, GPD students wrote 70% of the words correctly, whereas WSD students wrote only 17% correctly and IGP students 14%, with many spelling no words correctly. The WSD and IGP groups' recall of partial spellings was much better, with WSD students writing 47% of the letters correctly and IGP students 44%. These findings reveal that the spelling performance of students who received GPD training conformed to Ehri's (2005) full alphabetic phase, whereas the spellings of WSD and IGP students fit the partial alphabetic phase.

Reading Pseudowords

Students were given two lists of pseudowords to read without any practice or feedback. Nonparametric Kruskal–Wallis tests comparing the distributions of scores across groups showed that the GPD group significantly outperformed the WSD group, who significantly outperformed the IGP group. As evident in Table 5, GPD-trained students were able to decode on average half of the nonwords, whereas many WSD and most IGP students failed to decode any nonwords. These findings indicate that training in the use of grapheme–phoneme subunits to read syllables was the only type that transferred and enabled students to decode pseudowords.

Phonological Memory

To determine whether the three forms of training improved students' ability to repeat spoken pseudowords, the phonological memory pretest was repeated as a posttest. An ANOVA compared mean gain scores, with treatment as the independent variable (see Table 5). The main effect of treatment was statistically significant, showing that all three groups improved from pretest to posttest. Bonferroni tests showed that the GPD group made significantly greater gains than the other two groups who did not differ. The small gains found in the WSD and IGP groups could have resulted from repetition of the test. The significantly larger gain shown by the GPD group very likely reflects the impact of GPD training on improving phonological memory.

Discussion

Training Effectiveness

The first hypothesis tested was that students taught to decode CV syllables using grapheme–phoneme subunits (GPD group) would learn to read these syllables more easily than students taught to decode the CVs as whole graphosyllabic units (WSD group) would. Results were overwhelmingly supportive. The majority of students receiving GPD instruction reached mastery in reading each of the five sets of syllables within the minimum of eight learning trials, whereas students receiving WSD instruction took much longer (see Table 3). These findings show that teaching students to decode using small grapheme–phoneme units was much more efficient than teaching students to decode using larger syllabic units.

Our findings bear on the controversy over whether reading instruction should begin with small grapheme–phoneme units or larger syllabic spelling–sound units (Ehri, 2005; Hulme et al., 2002; Seymour & Duncan, 1997; Ziegler & Goswami, 2005). Whereas syllables are easier to detect in spoken words than phonemes are, phonemes are the basic units systematically represented in written alphabetic languages. Present findings show that teaching reading most effectively involves giving beginners access to the basic written graphophonemic units to decode words, even though access to corresponding spoken phonemic units might be more difficult.

These findings question traditional views about effective reading instruction that predominated among Brazilian educators in earlier times (Soares, 2016). Because spoken syllables are salient features of Portuguese spoken words, this has led educators to favor graphosyllabic units in teaching students to read, despite the fact that the basic units of the writing system are graphemes mapping phonemes (Weisz, 2004). Current findings suggest that decoding instruction with syllabic units needs to be grounded in graphophonemic subunits and integrated into one instructional procedure.

Impact of Training on Posttests

The second hypothesis tested was that GPD training would produce superior performance on posttests assessing literacy skills including letter–sound knowledge, phonological awareness, word reading, and word spelling as compared with graphosyllabic decoding training and letter–sound training. Results were supportive. Statistical tests showed that the GPD training group significantly outperformed one or both of the other groups on all of the posttests (see Tables 4 and 5).

It was surprising that WSD training did not support better performance during training and on posttests. The CV units were structured systematically so grapheme–phoneme vowels recurred within and across the five sets of syllables and were combined and recombined with only two consonants in each set (see Table 1). Students knew the names of all 15 letters forming the syllables, and the letter names contained the relevant phonemes. Students received as much practice as they needed in reading and rereading the syllables with feedback until they could read them perfectly. The WSD group did not perform more poorly on posttests because they did not learn to read the syllables to the same criterion as the GPD group. In fact, all but three of the WSD students reached criterion within 24 trials. Moreover, they practiced reading and rereading many more syllables to reach this criterion than GPD students did. Repetition of the statistical analyses without these three students yielded the same results, significantly favoring the GPD group.

These findings reveal the broad transfer power conferred by GPD instruction. Although GPD-trained students did not practice these skills, they were able to read and write longer words and pseudowords. In contrast, graphosyllabic decoding instruction yielded much less transfer. WSD students showed little, if any, grapheme–phoneme knowledge, phonemic awareness, pseudoword-decoding ability, or word-spelling ability, although they showed small improvement in producing partial spellings of words. Students who were taught IGPs showed some transfer in segmenting and blending phonemes, writing partial spellings of words, phonemic awareness, and remembering how to read words with practice.

A transfer task was given to assess whether the GPD and WSD groups would be able to read CV syllables that were not practiced during training. Results showed that both groups read untaught CVs almost as well as taught CVs (see Table 4), indicating that training generalized beyond the syllables practiced. Our findings conform to the learning process referred to as recombinative generalization, showing that it is only necessary to teach a subset of exemplars to enable learners to read untaught recombinations of the subunits comprising the exemplars (Hübner, Gomes, & McIlvane, 2009).

The third and fourth hypotheses tested whether students taught to decode graphosyllabic CVs composed of recombinations of grapheme–phoneme subunits would become aware of the grapheme–phoneme subunits by the end of training and whether this would transfer and improve their phonemic awareness, word reading, and spelling more so than students who received IGP training. These hypotheses received no support. On the posttest requiring students to say the sounds of target letters, 95% of students in the WSD group scored zero. On the phonemic segmentation and blending posttests, their mean scores were very low, if not zero, and statistically lower than those of IGP students who were taught single grapheme–phonemes explicitly. The WSD and IGP groups did not differ on several word-reading and spelling measures.

These findings fail to support the syllabic bridge hypothesis (Doignon-Camus & Zagar, 2014), proposing that teaching beginners to decode syllables provides the knowledge base from which phonemes become accessible conscious units. Also, our findings are the opposite of those reported by Vazeux et al. (2020). Whereas we found that IGP training improved phonemic awareness more than WSD training did, Vazeux et al. found that WSD training improved phonemic awareness more than IGP training did. One possible explanation for the difference in findings is that their syllable training may not have been limited to decoding whole syllables but may have included some instruction in grapheme–phoneme subunits. Closer inspection of Vazeux et al.'s whole-syllable training procedure reveals that this may be so, and it may have activated students' awareness of grapheme–phonemes in written syllables to facilitate their phonemic awareness.

Also, our findings fail to support Landerl's (2000) suggestion that when orthographic structure is fully transparent, it may provide sufficient unequivocal information about the writing system to activate students' knowledge of grapheme–phoneme relations and phonological decoding ability without explicit systematic instruction. Current findings raise doubt. At least in our relatively short-term controlled experiment, we found that knowledge about the graphophonemic alphabetic system and its use for reading and writing words was not acquired when students were given extensive practice in decoding whole CV syllables written in a highly transparent, recombinant spelling system.

Grapheme—Phoneme Connections and Their Impact on Sight Word Reading and Spoken Language

Grapheme–phoneme knowledge is considered foundational, enabling beginners to learn to read words. According to Share's (2008b) self-teaching hypothesis, grapheme–phonemes are applied to decode unfamiliar words. According to connectionist theories, grapheme–phonemes serve to connect graphemes in spellings to phonemes in pronunciations and store them in memory to enable students to remember how to read words by sight (Ehri, 1992, 2014; Perfetti, 1992; Perfetti & Hart, 2002). Present findings support these views. Students taught to use grapheme–phonemes to read CV syllables far outperformed the other two groups on posttests in decoding longer pseudowords, in remembering how to read a set of 12 longer words over several learning trials, and in recalling their spellings more accurately. Being able to store written words in memory to read them immediately as whole units is central in becoming a fluent reader of text. This enables readers to focus on and comprehend the meaning of a text while words are recognized automatically.

According to Ehri (2014, 2020), when readers acquire knowledge of the grapheme–phoneme writing system and its use to read and spell, this knowledge exerts an impact on spoken language. In the current study, this impact was evident on the phonological memory task. Statistical tests showed that the GPD-trained students made significantly greater gains from pretest to posttest in repeating spoken pseudowords than the other groups did. This effect was also found in a study by Boyer and Ehri (2011), in which performance on Gathercole and Baddeley's (1996) phonological memory task was boosted in students who received grapheme–phoneme instruction to represent the sounds in words, but not in untreated students. One explanation is that when grapheme–phoneme connections penetrate the phonological representational system as a result of CV decoding or spelling instruction, this enhances the distinctiveness of phonemes in spoken words and improves memory for their pronunciations.

Studies examining the impact of spellings on vocabulary learning have shown that readers remember the pronunciations of novel words better after exposure to their spellings during learning than when students have only practiced pronunciations without seeing spellings (Chambré, Ehri, & Ness, 2017; Ricketts, Bishop, & Nation, 2009; Rosenthal & Ehri, 2008). Orthographic facilitation of memory for spoken words is especially strong when students actively decode the words during learning (Chambré, Ehri, & Ness, 2020). These findings show that the benefits of GPD instruction extend beyond literacy tasks to include spoken language and that phonological memory is not independent of literacy skill. When students learn to read, knowledge of the writing system infiltrates their phonological processing ability. This is supported by the findings of research using functional magnetic resonance imaging technology to study brain processes. Findings show that when students learn to read, written language engages areas of the brain allocated for speech (Frost et al., 2009; Yoncheva, Wise, & McCandliss, 2015).

Theories of Reading Development

Present findings support the sequence of phases portraying the development of word reading proposed by Ehri (2005, 2014), consisting of the pre-alphabetic, partial alphabetic, full alphabetic, and consolidated alphabetic phases. According to this theory, the full phase emerges when students can apply grapheme–phoneme subunits to decode words. The consolidated phase emerges subsequently when recurring sequences of grapheme–phoneme subunits become consolidated to form larger units representing syllables and morphemes. In other words, small grapheme–phoneme units emerge first and are needed to form larger syllabic units. Present findings provide evidence for development from smaller to larger units. The consolidation process was evident among some GPD students during training. As they practiced decoding CVs by sounding out grapheme–phoneme subunits before blending them, some students started dropping this routine and reading the CVs as whole units. On posttests, GPD students far outperformed WSD students in reading longer words and pseudowords by combining the grapheme–phonemes and syllables they had been taught. Our findings support teaching grapheme–phoneme units first so readers can consolidate them into graphosyllablic units subsequently. In this way, grapheme–phoneme units become nested within syllabic units to facilitate the reading and spelling of words.

Performance on posttests in the current study revealed that GPD training enabled students to perform more like full phase readers, whereas WSD and IGP training limited students to the partial phase. All of the students began the study in the pre-alphabetic phase. Although they knew all 15 target letter names, they lacked knowledge of grapheme–phoneme relations, phonemic awareness, and word-reading ability. GPD instruction enabled students to use the grapheme–phonemes and CV syllables that they had been taught to read longer words and pseudowords, to write more complete spellings, to learn to read words from memory, and to remember their spellings. In contrast, students receiving WSD and IGP instruction performed like partial phase readers. They wrote partial spellings of words. Their memory for complete spellings of words they had practiced reading was poor, as well as their phoneme segmentation and blending skills and pseudoword reading. Learning to decode whole syllables provided little advantage over learning single grapheme–phoneme relations.

Strengths, Limitations, and Future Research

We conducted the current study as a controlled experiment. Internal validity was maintained by the use of screeners to limit participation to students who could benefit from instruction, by random assignment of students to treatment conditions, by the use of standardized scripts and procedures throughout training and testing, by administration of pretests to verify that treatment groups did not differ prior to instruction, by teaching students to a mastery criterion to ensure that learning occurred, and by administration of posttests to assess effects of the treatments on skills that were taught and on transfer to untaught skills. The sample consisted of 20 students in each of three conditions, yielding sufficient statistical power. Instruction was conducted with individual students. These features enabled us to attribute superior performance on outcome measures to the greater effectiveness of GPD instruction as compared with WSD and IGP instruction.

External validity was limited to typically developing Brazilian first graders (5–6 years old) from low to middle-class backgrounds, obtained from one public elementary school in São Paulo, Brazil. These students met specific criteria to qualify for the study, enabling us to identify characteristics of the population for whom findings are likely to generalize. Learning was conducted in a simplified transparent version of the Portuguese writing system. Future studies might examine whether findings generalize to other populations of first graders, to older struggling readers, and to beginners learning to read in other alphabetic writing systems in which syllables are salient spoken units, such as Finnish, Spanish, Italian, and French.

There are some possible limitations of the present study. One researcher administered training to all the students and then posttested them. A maximum of three weeks elapsed between the pretests and posttests. During this time, students received literacy instruction in their classes at school, but it did not include phonics. If this instruction influenced performance on posttests, the influence would be expected to affect scores equally across treatment conditions. Reliability values were high on most tests. However, our method of calculating test–retest and parallel-form reliabilities might be regarded as unconventional, although the procedures we used conformed to the reliability constructs. Students in the pre-alphabetic phase were taught to decode a simplified, transparent orthography consisting of 15 grapheme–phonemes combined to form all possible CV syllables. Although this approach provided an effective entrée into reading acquisition, it ignored all the complexities of the writing system left to be learned. Future research is needed to examine whether this initial form of instruction shows long-term benefits.

Implications for Instruction

We conducted the current study as a laboratory experiment with individual students. Future research is needed to design and evaluate a curriculum that adapts GPD instruction for teachers working with students who have not yet learned to read. Based on the current study, beginners would be taught a limited set of graphemes whose names contain the relevant phonemes. Then, students would practice and receive feedback using the grapheme–phoneme subunits to sound out and blend multiple sets of CV syllables to mastery levels. As they consolidate grapheme–phoneme subunits into whole graphosyllable units, students would receive practice in using these to read and spell longer words containing the taught syllables in and out of texts. Our findings suggest that this approach might be effective as a first step in introducing students to the alphabetic principle and its use to decode words. With additional instruction and practice in learning the full orthographic system and its complexities to read words in and out of text and to spell words, such an approach holds promise in helping beginners become skilled readers.

Current findings carry pedagogical implications for improving beginning reading instruction not only in Portuguese but also in other transparent and semitransparent alphabetic writing systems with a similar syllabic structure. When words in the spoken language are composed primarily of simple CV syllables and these syllables are written with grapheme–phoneme subunits, present findings suggest that reading instruction is most effective when it begins by teaching students to decode and blend the grapheme–phoneme subunits in the syllables. Teaching beginners to read whole CV syllables from the outset of instruction without explicit instruction in grapheme–phoneme subunits may show limited effectiveness. Our findings revealed that even though the WSD students knew letters and their names containing the target phonemes, these students did not discover the grapheme–phoneme subunits forming the CV syllables. Despite much systematic practice, the students continued to try to learn the syllables as unanalyzed whole units and failed to learn any grapheme–phoneme correspondences. To accommodate these findings, teachers who favor the teaching of syllables or syllable families would need to modify their instruction only slightly by front-loading instruction in grapheme–phoneme subunits and their use to form consolidated graphosyllabic units.

NOTE

Conduct of this research was supported by a postdoctoral scholarship (grant 15/2384-2) from the São Paulo State Research Support Foundation (FAPESP).

REFERENCES

Alves Martins, M., & Silva, C. (2006). The impact of invented spelling on phonemic awareness. *Learning and Instruction*, *16*(1), 41–56. https://doi.org/10.1016/j.learninstruc.2005.12.005

Beck, I.L. (2006). *Making sense of phonics: The hows and whys*. New York, NY: Guilford.

Boyer, N., & Ehri, L.C. (2011). Contribution of phonemic segmentation instruction with letters and articulation pictures to word reading and spelling in beginners. *Scientific Studies of Reading*, *15*(5), 440–470. https://doi.org/10.1080/10888438.2010.520778

Brown, G.D., & Deavers, R.P. (1999). Units of analysis in nonword reading: Evidence from children and adults. *Journal of Experimental Child Psychology*, *73*(3), 208–242. https://doi.org/10.1006/jecp.1999.2502

Bryant, P. (1998). Sensitivity to onset and rhyme does predict young children's reading: A comment on Muter, Hulme, Snowling, and Taylor (1997). *Journal of Experimental Child Psychology*, *71*(1), 29–37. https://doi.org/10.1006/jecp.1998.2455

Cardoso-Martins, C. (1995). Sensitivity to rhymes, syllables, and phonemes in literacy acquisition in Portuguese. *Reading Research Quarterly*, *30*(4), 808–828. https://doi.org/10.2307/748199

Cardoso-Martins, C. (2013). Existe um estágio silábico no desenvolvimento da escrita em Português? Evidência de três estudos longitudinais [Is there a syllabic stage in the development of writing in Portuguese? Evidence from three longitudinal studies]. In M.R. Maluf & C. Cardoso-Martins (Eds.), *Alfabetização no século XXI: Como se aprende a ler e a escrever* [Literacy in the 21st century: How to learn to read and write] (pp. 82–108). Porto Alegres, Brazil: Penso.

Cardoso-Martins, C., & Batista, A.C.E. (2005). O conhecimento do nome das letras e o desenvolvimento da escrita: Evidência de crianças falantes do Português [Knowledge of the name of the letters and the development of writing: Evidence of Portuguese-speaking children]. *Psicologia: Reflexão e Crítica*, *18*(3), 330–336. https://doi.org/10.1590/S0102-79722005000300006

Cardoso-Martins, C., Corrêa, M.F., Lemos, L.S., & Napoleão, R.F. (2006). Is there a syllabic stage in spelling development? Evidence from Portuguese-speaking children. *Journal of Educational Psychology*, *98*(3), 628–641. https://doi.org/10.1037/0022-0663.98.3.628

Cardoso-Martins, C., Mesquita, T.C.L., & Ehri, L.C. (2011). Letter names and phonological awareness help children to learn letter–sound relations. *Journal of Experimental Child Psychology*, *109*(1). 25–38. https://doi.org/10.1016/j.jecp.2010.12.006

Castles, A., & Coltheart, M. (2004). Is there a causal link from phonological awareness to success in learning to read? *Cognition*, *91*(1), 77–111. https://doi.org/10.1016/S0010-0277(03)00164-1

Castles, A., Rastle, K., & Nation, K. (2018). Ending the reading wars: Reading acquisition from novice to expert. *Psychological Science in the Public Interest*, *19*(1), 5–51. https://doi.org/10.1177/1529100618772271

Chambré, S.J., Ehri, L.C., & Ness, M. (2017). Orthographic facilitation of first graders' vocabulary learning: Does directing attention to print enhance the effect? *Reading and Writing*, *30*(5), 1137–1156. https://doi.org/10.1007/s11145-016-9715-z

Chambré, S.J., Ehri, L.C., & Ness, M. (2020). Phonological decoding enhances orthographic facilitation of vocabulary learning in first graders. *Reading and Writing*, *33*(5), 1133–1162. https://doi.org/10.1007/s11145-019-09997-w

Christensen, C.A., & Bowey, J.A. (2005). The efficacy of orthographic rime, grapheme–phoneme correspondence, and implicit phonics approaches to teaching decoding skills. *Scientific Studies of Reading*, *9*(4), 327–349. https://doi.org/10.1207/s1532799xssr0904_1

Degasperi, L., Micciolo, R., Espa, G., & Calzolari, S. (2011). Phonemic not syllabic awareness is linked to literacy in Italian children with Down syndrome. *Journal of Pediatric Neurology*, *9*(3), 325–332. https://doi.org/10.3233/JPN-2011-0496

de Melo, R.B., & Correa, J. (2013). Consciência fonológica e a aprendizagem da leitura e escrita por adultos [Phonological awareness and learning to read and write by adults]. *Estudos e Pesquisas em Psicologia*, *13*(2), 460–479.

Doignon-Camus, N., & Zagar, D. (2014). The syllabic bridge: The first step in learning spelling-to-sound correspondences. *Journal of Child Language*, *41*(5), 1147–1165. https://doi.org/10.1017/S0305000913000305

Duncan, L.G., Castro, S.L., Defior, S., Seymour, P.H.K., Baillie, S., Leybaert, J., … Serrano, F. (2013). Phonological development in relation to native language and literacy: Variations on a theme in six alphabetic orthographies. *Cognition*, *127*(3), 398–419. https://doi.org/10.1016/j.cognition.2013.02.009

Duncan, L.G., Seymour, P.H.K., & Hill, S. (1997). How important are rhyme and analogy in beginning reading? *Cognition*, *63*(2), 171–208. https://doi.org/10.1016/S0010-0277(97)00001-2

Ehri, L.C. (1992). Reconceptualizing the development of sight word reading and its relationship to recoding. In P.B. Gough, L.C. Ehri, & R. Treiman (Eds.), *Reading acquisition* (pp. 107–143). Hillsdale, NJ: Erlbaum.

Ehri, L.C. (1998). Grapheme–phoneme knowledge is essential for learning to read words in English. In J.L. Metsala & L.C. Ehri (Eds.), *Word recognition in beginning literacy* (pp. 3–40). Mahwah, NJ: Erlbaum.

Ehri, L.C. (2005). Learning to read words: Theory, findings, and issues. *Scientific Studies of Reading*, *9*(2), 167–188. https://doi.org/10.1207/s1532799xssr0902_4

Ehri, L.C. (2014). Orthographic mapping in the acquisition of sight word reading, spelling memory, and vocabulary learning. *Scientific Studies of Reading*, *18*(1), 5–21. https://doi.org/10.1080/10888438.2013.819356

Ehri, L.C. (2020). The science of learning to read words: A case for systematic phonics instruction. *Reading Research Quarterly*, *55*(S1), S45–S60. https://doi.org/10.1002/rrq.334

Ehri, L.C., Nunes, S.R., Stahl, S.A., & Willows, D.M. (2001). Systematic phonics instruction helps students learn to read: Evidence from the National Reading Panel's meta-analysis. *Review of Educational Research*, *71*(3), 393–447. https://doi.org/10.3102/00346543071003393

Ferreiro, E. (2009). The transformation of children's knowledge of language units during beginning and initial literacy. In J.V. Hoffman & Y. Goodman (Eds.), *Changing literacies for changing times: An historical perspective on the future of research reading research, public policy, and classroom practices* (pp. 61–75). New York, NY: Routledge.

Ferreiro, E., & Teberosky, A. (1999). *Psicogênese da língua escrita* [Psychogenesis of written language]. Porto Alegre, Brazil: Penso.
Frost, S.J., Landi, N., Mencl, W.E., Sandak, R., Fulbright, R.K., Tejada, E.T., … Pugh, K.R. (2009). Phonological awareness predicts activation patterns for print and speech. *Annals of Dyslexia*, *59*, 78–97. https://doi.org/10.1007/s11881-009-0024-y
Gathercole, S., & Baddeley, A. (1996). *The Children's Test of Nonword Repetition*. London, UK: Harcourt Brace.
Goswami, U. (1988). Children's use of analogy in learning to spell. *British Journal of Developmental Psychology*, *6*(1), 21–33. https://doi.org/10.1111/j.2044-835X.1988.tb01077.x
Goswami, U. (1990). A special link between rhyming skill and the use of orthographic analogies by beginning readers. *Journal of Child Psychology and Psychiatry*, *31*(2), 301–311. https://doi.org/10.1111/j.1469-7610.1990.tb01568.x
Heikkilä, R., Aro, M., Närhi, V., Westerholm, J., & Ahonen, T. (2013). Does training in syllable recognition improve reading speed? A computer-based trial with poor readers from second and third grade. *Scientific Studies of Reading*, *17*(6), 398–414. https://doi.org/10.1080/10888438.2012.753452
Hübner, M.M.C., Gomes, R.C., & McIlvane, W.J. (2009). Recombinative generalization in minimal verbal unit-based reading instruction for pre-reading children. *Experimental Analysis of Human Behavior Bulletin*, *27*, 11–17.
Huemer, S., Aro, M., Landerl, K., & Lyytinen, H. (2010). Repeated reading of syllables among Finnish-speaking children with poor reading skills. *Scientific Studies of Reading*, *14*(4), 317–340. https://doi.org/10.1080/10888430903150659
Hulme, C., Hatcher, P.J., Nation, K., Brown, A., Adams, J., & Stuart, G. (2002). Phoneme awareness is a better predictor of early reading skill than onset-rime awareness. *Journal of Experimental Child Psychology*, *82*(1), 2–28. https://doi.org/10.1006/jecp.2002.2670
Kerek, E., & Niemi, P. (2012). Grain-size units of phonological awareness among Russian first graders. *Written Language and Literacy*, *15*(1), 80–113. https://doi.org/10.1075/wll.15.1.05ker
Landerl, K. (2000). Influences of orthographic consistency and reading instruction on the development of nonword reading skills. *European Journal of Psychology of Education*, *15*, 239–257. https://doi.org/10.1007/BF03173177
Lemle, M. (1988). *Guia teórico do alfabetizador* [Theoretical teacher's guide]. São Paulo, Brazil: Ática.
Mousinho, R., & Correa, J. (2009). Habilidades lingüístico-cognitivas em leitores e não-leitores [Linguistic-cognitive skills in readers and nonreaders]. *Pró-Fono Revista de Atualização Científica*, *21*(2), 113–118. https://doi.org/10.1590/S0104-56872009000200005
Nikolopoulos, D., Goulandris, N., Hulme, C., & Snowling, M.J. (2006). The cognitive bases of learning to read and spell in Greek: Evidence from a longitudinal study. *Journal of Experimental Child Psychology*, *94*(1), 1–17. https://doi.org/10.1016/j.jecp.2005.11.006
Perfetti, C.A. (1992). The representation problem in reading acquisition. In P.B. Gough, L.C. Ehri, & R. Treiman (Eds.), *Reading acquisition* (pp. 145–174). Hillsdale, NJ: Erlbaum.
Perfetti, C.A., & Hart, L. (2002). The lexical quality hypothesis. In L. Verhoeven, C. Elbro, & P. Reitsma (Eds.), *Precursors of functional literacy* (pp. 189–213). Amsterdam, Netherlands: John Benjamins.
Pinheiro, A.M.V., & Keys, J.K. (1987). *A word count in Brazilian Portuguese*. Dundee, Scotland: University of Dundee.
Pollo, T.C., Kessler, B., & Treiman, R. (2005). Vowels, syllables, and letter names: Differences between young children's spelling in English and Portuguese. *Journal of Experimental Child Psychology*, *92*(2), 161–181. https://doi.org/10.1016/j.jecp.2005.01.006
Rayner, K., Foorman, B.R., Perfetti, C.A., Pesetsky, D., & Seidenberg, M.S. (2001). How psychological science informs the teaching of reading. *Psychological Science*, *2*(2), 31–74. https://doi.org/10.1111/1529-1006.00004
Ricketts, J., Bishop, D.M., & Nation, K. (2009). Orthographic facilitation in oral vocabulary acquisition. *Quarterly Journal of Experimental Psychology*, *62*(10), 1948–1966. https://doi.org/10.1080/17470210802696104
Rosenthal, J., & Ehri, L.C. (2008). The mnemonic value of orthography for vocabulary learning. *Journal of Educational Psychology*, *100*(1), 175–191. https://doi.org/10.1037/0022-0663.100.1.175
Santos, F.H., & Bueno, O.F.A. (2003). Validation of the Brazilian Children's Test of Pseudoword Repetition in Portuguese speakers aged 4 to 10 years. *Brazilian Journal of Medical and Biological Research*, *36*(11), 1533–1547. https://doi.org/10.1590/S0100-879X2003001100012
Sargiani, R., Ehri, L.C., & Maluf, M. (2018). Orthographic mapping instruction to facilitate reading and spelling in Brazilian emergent readers. *Applied Psycholinguistics*, *39*(6), 1405–1437. https://doi.org/10.1017/S0142716418000371
Seymour, P.H.K., Aro, M., & Erskine, J.M. (2003). Foundation literacy acquisition in European orthographies. *British Journal of Psychology*, *94*(2), 143–174. https://doi.org/10.1348/000712603321661859
Seymour, P.H.K., & Duncan, L.G. (1997). Small versus large unit theories of reading acquisition. *Dyslexia*, *3*(3), 125–134. https://doi.org/10.1002/(SICI)1099-0909(199709)3:3<125:AID-DYS85>3.0.CO;2-4
Share, D.L. (2008a). On the Anglocentricities of current reading research and practice: The perils of overreliance on an "outlier" orthography. *Psychological Bulletin*, *134*(4), 584–615. https://doi.org/10.1037/0033-2909.134.4.584
Share, D.L. (2008b). Orthographic learning, phonology and the self-teaching hypothesis. In R. Kail (Ed.), *Advances in child development and behavior* (pp. 31–82). Amsterdam, Netherlands: Elsevier.
Share, D.L. (2021). Is the science of reading just the science of reading English? *Reading Research Quarterly*, *56*(S1), S391–S402. https://doi.org/10.1002/rrq.401
Soares, M.B. (2016). *Alfabetização: A questão dos métodos* [Literacy: The question of methods]. São Paulo, Brazil: Contexto.
Spencer, L.H., & Hanley, J.R. (2003). Effects of orthographic transparency on reading and phoneme awareness in children learning to read in Wales. *British Journal of Psychology*, *94*(1), 1–28. https://doi.org/10.1348/000712603762842075
Treiman, R. (1985). Onsets and rimes as units of spoken syllables: Evidence from children. *Journal of Experimental Child Psychology*, *39*(1), 161–181. https://doi.org/10.1016/0022-0965(85)90034-7
Treiman, R., Pollo, T.C., Cardoso-Martins, C., & Kessler, B. (2013). Do young children spell words syllabically? Evidence from learners of Brazilian Portuguese. *Journal of Experimental Child Psychology*, *116*(4), 873–890. https://doi.org/10.1016/j.jecp.2013.08.002
Tressoldi, P.E., Vio, C., & Iozzino, R. (2007). Efficacy of an intervention to improve fluency in children with developmental dyslexia in a regular orthography. *Journal of Learning Disabilities*, *40*(3), 203–209. https://doi.org/10.1177/00222194070400030201
Twist, J. (2004). Beginning literacy: The small-unit versus large-unit debate continues. *New Zealand Annual Review of Education*, *13*, 205–224.
Vale, A.P. (2006). Aprender a ler em português: O tamanho das unidades usadas na descodificação [Learning to read in Portuguese: The size of the units used in decoding]. In F.L. Viana, M. Martins, & E. Coquet (Eds.), *Actas do 6o encontro nacional (4o internacional) de investigação em leitura, literatura infantil e ilustração* [Proceedings of the 6th national meeting (4th international) of research in reading, children's literature and illustration] (pp. 1–12). Braga, Portugal: Universidade do Minho.
Vale, A.P., & Bertelli, R. (2006). A flexibilidade de utilização de diferentes unidades ortográficas na leitura em língua Portuguesa [The flexibility of using different orthographic units when reading in Portuguese]. *Psicologia Educação Cultura*, *10*(2), 461–476.
Vazeux, M., Doignon-Camus, N., Bosse, M.-L., Mahé, G., Guo, T., & Zagar, D. (2020). Syllable-first rather than letter-first to improve phonemic awareness. *Scientific Reports*, *10*, Article 22130. https://doi.org/10.1038/s41598-020-79240-y
Vernon, S.A., & Ferreiro, E. (1999). Writing development: A neglected variable in the consideration of phonological awareness. *Harvard Educational*

Review, *69*(4), 395–416. https://doi.org/10.17763/haer.69.4.p4116 67586738x0w
Weisz, T. (2004). Didática da leitura e da escrita: Questões teóricas [Didactics of reading and writing: Theoretical issues]. *Pátio: Revista Pedagógica*, *28*, 57–62.
Wimmer, H., & Goswami, U. (1994). The influence of orthographic consistency on reading development: Word recognition in English and German children. *Cognition*, *51*(1), 91–103. https://doi.org/10.1016/0010-0277(94)90010-8
Yoncheva, Y.N., Wise, J., & McCandliss, B. (2015). Hemispheric specialization for visual words is shaped by attention to sublexical units during initial learning. *Brain and Language*, *145*(146), 23–33. https://doi.org/10.1016/j.bandl.2015.04.001
Ziegler, J.C., & Goswami, U. (2005). Reading acquisition, developmental dyslexia, and skilled reading across languages: A psycholinguistic grain size theory. *Psychological Bulletin*, *131*(1), 3–29. https://doi.org/10.1037/0033-2909.131.1.3
Ziegler, J.C., & Goswami, U. (2006). Becoming literate in different languages: Similar problems, different solutions. *Developmental Science*, *9*(5), 429–436. https://doi.org/10.1111/j.1467-7687.2006.00509.x

Submitted October 11, 2020
Final revision received May 4, 2021
Accepted May 6, 2021

RENAN DE ALMEIDA SARGIANI was a postdoctoral fellow in the Institute of Psychology at the Universidade de São Paulo, Brazil, at the time of this study and is now an assistant professor in the Department of Psychology at the University Cruzeiro do Sul, São Paulo, Brazil; email sargiani@gmail.com. He is also the founder and president of the Institute for Evidence-Based Education, whose mission is to improve the quality of education and literacy in Brazil through research evidence.

LINNEA C. EHRI (corresponding author) is Distinguished Professor Emerita in the PhD Program in Educational Psychology at the Graduate Center of the City University of New York, New York, USA; email lehri@gc.cuny.edu. She has conducted many research studies to clarify how young students learn to read and how instruction can be made more effective.

MARIA REGINA MALUF is a professor emerita in the Institute of Psychology at the Universidade de São Paulo, Brazil, and is now also a professor in the Graduate Program in Educational Psychology at Pontifícia Universidade Católica de São Paulo, Brazil; email marmaluf@gmail.com. She conducts research on the training of psychologists in Latin America and on Brazilian Portuguese literacy.