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Spanish Phonological Awareness: Dimensionality and Sequence of Development During the Preschool and Kindergarten Years

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This study describes the dimensionality and continuum of Spanish phonological awareness (PA) skills in 3- to 6-year-old children. A 3 × 4 factorial design crossed word structure of test items (word, syllable, phoneme) with task (blending multiple-choice, blending free-response, elision multiple-choice, elision free-response) to assess 12 PA skills. Over 1,200 Spanish speakers were assessed at 2 points in time. Confirmatory factor analyses found that a 2nd-order unifying ability along with 1st-order task factors well explained children's performances (comparative fit index = .96, Tucker–Lewis index = .96, root-mean-square error of approximation = .03). Confirmatory factor analysis also indicated that test items varied in difficulty and in how well they discriminated individual differences in latent PA. Item parameters were stable across item sets (*r*s = .75–.86) and time (*r*s = .60–1.00), and ability estimates were moderately stable across time (*r* = .64). Finally, test information curves were used to describe the continuum of PA skills. Children were able to first detect blending of sound information, then detect elision of sound information, then blend sounds together to form words, and finally delete sounds from words to form new words. Sequence of skill acquisition along the dimension of word structure was ambiguous. Implications for assessment, early intervention, and cross-linguistic theories of phonological awareness are discussed.

Keywords: phonological awareness, emergent literacy, early childhood, Spanish speakers

Phonological awareness refers to the ability to reflect on the sounds in one's oral language, independent from meaning. Examples of phonological awareness tasks include rhyming, judging whether words contain common sounds, blending sounds together to form words, and deleting sounds from words to create different words. Phonological awareness predicts literacy achievement in most alphabetic languages. For example, phonological awareness has been shown to predict decoding, spelling, and reading comprehension in monolingual English-speaking children, even after controlling for differences in age, intelligence, oral language, memory, letter knowledge, social class, and prior reading abilities (Bryant, MacLean, Bradley, & Crossland, 1990; National Early Literacy Panel, 2008; Wagner & Torgesen, 1987; Wagner, Torgesen, & Rashotte, 1994). Similarly, Spanish phonological awareness has been found to predict Spanish literacy in monolingual and bilingual Spanish-speaking children (e.g., Branum-Martin et al., 2006; Bravo-Valdivieso, 1995; Carrillo, 1994; de Manrique & Signorini, 1994; Signorini, 1997). Relevant to countries like the United States in which there are many Spanish-speaking English language learners, phonological awareness measured in Spanish has also been shown to predict literacy achievement in English (Durgunoğlu, 1998; Durgunoğlu, Nagy, & Hancin-Bhatt, 1993; Gottardo, 2002; Gottardo, Collins, Baciu, & Gebotys, 2008; Lindsey, Manis, & Bailey, 2003; Lopez, 2000; Manis, Lindsey, & Bailey, 2004; Quiroga, Lemos-Britton, Mostafapour, Abbott, & Berninger, 2002; Riccio et al., 2001). Because of the roles that Spanish phonological awareness plays in acqui-

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sition of Spanish literacy and English literacy among English language learners, it is important to uncover the nature and development of this critical set of emergent literacy skills.

Phonological awareness manifests in a variety of skills, which are distinguished by the task performed and size of the unit of sound that is the focus of the task. Examples of phonological awareness skills distinguished by the type of task performed include blending sounds together, separating (segmenting) words into their constituent sounds, recombining sounds of words, and judging whether two words have some sounds in common. Distinctions among phonological awareness skills based on unit of word structure include whether whole words or syllables are the focus of the task or whether smaller intrasyllabic units, like onsets, rimes, or phonemes, are the focus. The *onset* is the initial consonant or consonant cluster present in many, but not all, syllables; the *rime* is made up of the remaining vowel and consonants. For example, in the English word *spin*, *sp* is the onset; *in* is the rime; and /s/, /p/, /I/, and /n/ are the phonemes.

One aspect of the nature of phonological awareness that is important to uncover is its sequence of development because this has significant implications for assessment, curricula, and instruction. The sequence of development of English phonological awareness is generally well understood as two overlapping patterns of development (for reviews, see Anthony & Francis, 2005; Ziegler & Goswami, 2005). First, children become increasingly sensitive to smaller and smaller linguistic units as they grow older. That is, children detect or manipulate words before syllables, syllables before onsets and rimes, and onsets and rimes before individual phonemes within intrasyllabic units (Anthony, Lonigan, Driscoll, et al., 2003; Anthony, Lonigan, & Schatschneider, 2003; Chaney, 1992; Fox & Routh, 1975; Lonigan, Burgess, Anthony, & Barker, 1998; MacLean et al., 1987; Schatschneider, Francis, Foorman, Fletcher, & Mehta, 1999; Treiman & Zukowski, 1991). In other words, children's development of English phonological awareness along the dimension of linguistic complexity follows a hierarchical model of word structure, as proposed by Adams (1990), Goswami and Bryant (1990), and Ziegler and Goswami (2005). These findings are consistent with both the lexical restructuring model (Metsala & Walley, 1998; Walley, 1993) and the psycholinguistic grain size theory (Ziegler & Goswami, 2005) of the development of phonological awareness. Second, children detect similar- and dissimilar-sounding words before they manipulate sounds within words, and children generally blend phonological information before they segment phonological information of the same linguistic complexity (Anthony, Lonigan, Driscoll, et al., 2003; Anthony, Lonigan, & Schatschneider, 2003; Schatschneider et al., 1999; Torgesen & Mathes, 2000; Wagner et al., 1994). Deleting, isolating, and reversing of phonological units appear to be the most demanding cognitive operations (Vallar & Papagno, 1993; Yopp, 1988). Children's development of English phonological awareness along the dimension of task complexity follows a working memory model (Anthony, Lonigan, Driscoll, et al., 2003).

Although the order of mastery of English phonological awareness skills is relatively well researched, such developmental findings cannot be generalized across languages (de Manrique & Signorini, 1994; Jiménez González & Haro García, 1995; Vernon & Ferreiro, 1999). This is because the development of phonological awareness is influenced by a variety of sociolinguistic factors, including linguistic features of the oral language, nature and timing of literacy instruction, and the orthographic nature of a given language (Anthony & Francis, 2005; de Jong & VanDerLeij, 2003; Mann & Wimmer, 2002; Ziegler & Goswami, 2005). For example, children who speak Turkish, Greek, or Italian attain syllable awareness more quickly than children who speak French or English (Cossu, Shankweiler, Liberman, Katz, & Tola, 1988; Demont & Gombert, 1996; Durgunoğlu, & Oney, 1999), which may be due to Turkish, Greek, and Italian having relatively simple syllable structures (few consonant clusters), more limited vowel repertoires, and more clearly marked syllable boundaries than French or English. Similarly, preliterate children who speak Czech are more skilled at isolating initial phonemes from consonant cluster onsets than are preliterate children who speak English, which may be attributed to the higher frequency and greater number of cluster onsets in Czech than English (Caravolas & Bruck, 1993).

Some evidence suggests that Spanish-speaking children master phonological awareness skills in a sequence similar to that of monolingual English speakers (Carrillo, 1994; Cisero & Royer, 1995; Denton, Hasbrouck, Weaver, & Riccio, 2000; Durgunoğlu et al., 1993; Goikoetxea, 2005; Gorman & Gillam, 2003; Jiménez González, 1992; Jiménez González & Haro García, 1995; Jiménez González & Ortiz, 1993). For example, Cisero and Royer (1995) found that, like English-speaking children, Spanish-speaking children could detect rhyme before they could detect initial or final phonemes. Similarly, Durgunoğlu et al. (1993) reported that Spanish-speaking children with limited English proficiency were more successful at syllable segmentation and syllable blending than they were at segmenting and blending onset-rime and individual phonemes. Carrillo (1994) showed that Spanish-speaking children were first able to detect similar and dissimilar sounds in words, followed by the ability to isolate phonemes, then delete phonemes, and finally reverse phonemes in words. In a fine grained analysis of the effects of linguistic complexity, Jiménez González and Haro García (1995) showed that word length, the presence of singleton versus cluster onsets, and certain articulatory features influenced the ease with which Spanish-speaking children isolated initial consonants, just as Treiman and Weatherston (1992) showed with English-speaking children. Collectively, these findings suggest that phonological awareness is acquired in a similar sequence in English and Spanish, with some small exceptions (e.g., little influence of syllable stress in Spanish on children's initial sound isolation; Jiménez González & Haro García, 1995).

Another important concept regarding the nature of phonological awareness is the question of dimensionality. It has been questioned whether phonological awareness is a unified construct that manifests in successively more complex skills across development or if it is a multidimensional construct, such that there are distinct phonological awareness abilities. Large-scale studies using sophisticated statistical techniques have found that children's performances on a variety of phonological awareness tasks are usually well explained by a single underlying ability, thereby supporting a unified phonological awareness construct. This has been convincingly shown to be the case for monolingual English speakers (Anthony & Lonigan, 2004; Anthony, Lonigan, & Schatschneider, 2003; Schatschneider, Francis, Foorman, Fletcher, & Mehta, 1999; Stahl & Murray, 1994; Stanovich, Cunningham, & Cramer, 1984; Wagner & Torgesen, 1987), monolingual Greek speakers (Papadopoulos, Spanoudis, & Kendeou, 2009), and monolingual Dutch speakers (Vloedgraven & Verhoeven, 2009). That this underlying ability is indeed phonological awareness is supported by studies that have shown it to be distinguishable from verbal ability, intelligence, phonological memory, phonological access to lexical storage, and speech perception (Anthony et al., 2006; Anthony, Williams, McDonald, & Francis, 2007; McBride-Chang, 1995, 1996; McBride-Chang & Manis, 1996; Wagner & Torgesen, 1987; Wagner, Torgesen, & Rashotte, 1994).

Another source of evidence in support of a unified phonological awareness construct comes from studies that have shown that phonological awareness skills transfer across languages (Anthony et al., 2009; Bialystok, Majumder, & Martin, 2003; Branum-Martin et al., 2006; Carlisle, Beeman, Davis, & Spharim, 1999; Cicero & Royer, 1995; Comeau, Cormier, Grandmaison, & Lacroix, 1999; Dickinson, McCabe, Clark-Chiarelli, & Wolf, 2004; Durgunoğlu, 1998; Durgunoğlu et al., 1993; Geva & Siegel, 2000; Geva, Wade-Woolley, & Shany, 1997; Leafstedt & Gerber, 2005; Lindsey et al., 2003; Oller & Eilers, 2002; Quiroga, Lemos-Britton, Mostafapour, Abbott, & Berninger, 2002). For example, in a multilevel investigation of 812 bilingual kindergarten children, Branum-Martin et al. (2006) found that children's phonological awareness in their native language (i.e., Spanish) was highly correlated ($r = .93$) with phonological awareness in their second language (i.e., English), after controlling for classroom effects.

Furthermore, recent studies suggest that the relation between Spanish and English phonological awareness is bidirectional. For example, Dickinson et al. (2004) assessed the Spanish and English phonological awareness skills of 123 bilingual preschool children in the fall and again in the spring of the same school year. Spring levels of phonological awareness in each language were most strongly related to development of phonological awareness in the other language. In a similarly designed study, Anthony et al. (2009) assessed the Spanish and English phonological awareness skills of 130 bilingual preschool children in the fall and again in the spring. Results indicated there was significant cross-linguistic prediction of phonological awareness after controlling for classroom effects and prior within-language phonological awareness. That Spanish and English phonological awareness skills of bilingual children transfer across languages and are implicated in each other's development is consistent with, but certainly does not prove, a single underlying phonological awareness ability across languages, which would be consistent with Cummins's (1979, 1981) cross-linguistic theory.

Direct investigation of the dimensionality of Spanish phonological awareness with either monolingual or bilingual speakers has not yet progressed beyond the initial exploratory phase. In general, correlations among Spanish phonological awareness tests are in the moderate-to-high ranges (e.g., Carrillo, 1994; Gottardo, 2002). Although potentially consistent with a unidimensional conceptualization of Spanish phonological awareness, these findings do not stem from falsifiable tests of dimensionality or factor structure.

To our knowledge, only two studies have used a confirmatory approach to modeling the covariance among multiple measures of Spanish phonological awareness as a latent phonological awareness ability. Branum-Martin et al.'s (2006) model of Spanish–English bilingual phonological awareness and bilingual word reading included a single Spanish Phonological Awareness factor at the child level that was indexed by three measures. Anthony et al.'s (2006) model of Spanish phonological processing abilities and Spanish emergent literacy included a single Spanish Phonological Awareness factor at the child level that was indexed by two measures. In both studies, the measurement model of Spanish phonological awareness was part of a much larger structural model that fit well, suggesting that the characterization of Spanish phonological awareness as unidimensional was reasonable. However, too few measures of phonological awareness were administered in either study to test alternative models that could specify Spanish phonological awareness as multidimensional.

In contrast, Carrillo (1994) administered 10 different phonological awareness tasks to monolingual Spanish-speaking kindergarten and first-grade children. In each grade, two factors emerged from exploratory factor analysis, and the factors corresponded to the difficulty of the tests, similar to some findings in other languages (Hoien, Lundberg, Stanovich, & Bjaalid, 1995; Stanovich et al., 1984; Yopp, 1988). Results were interpreted as suggestive of multidimensionality. However, the extent to which the two factors were correlated and the extent to which this association could be explained by higher order factor structure was not explored. Additionally, alternative models were not evaluated, and the study was limited by small sample sizes (ns $= 68$ and 52). In summary, research concerning the dimensionality of Spanish phonological awareness is scant, and the studies that have been conducted have not yielded consistent findings.

Simultaneous examination of dimensionality and sequence of development among phonological awareness skills is important because it directly addresses the heterotypic continuity of the construct (Anthony, Lonigan, Driscoll, et al., 2003), which has significant implications for screening, assessment, curricula, and instruction. Heterotypic continuity implies that skills or behaviors that emerge at different points in development are manifestations of the same latent ability or latent trait. For example, the symptomatic expression of depression is different in childhood and adulthood, but both expressions reflect the same genetic liability, and depression in childhood places one at greatly increased risk for depression in adulthood. A number of conditions must be established to assert heterotypic continuity. First, a variety of skills or behaviors must emerge at different points in development of the ability or trait. Second, unidimensionality among skills/behaviors must be evidenced at some point in development of the ability/trait, essentially perfect correlations across development must be obtained among latent abilities/traits that are indexed by different skills/behaviors, or intervention with one skill/behavior must demonstrate generalization to other skills/behaviors.

In the case of English phonological awareness, there is reasonably strong evidence for heterotypic continuity. Numerous studies attest to children of different ages being capable of performing different tasks that measure the same underlying phonological awareness ability (Bryant, Bradley, MacLean, & Crossland, 1989; Chaney, 1992; Fox & Routh, 1975, 1976; Lonigan et al., 1998; MacLean, Bryant, & Bradley, 1987; Stanovich et al., 1984; Treiman & Weatherston, 1992; Treiman & Zukowski, 1991). Unidimensionality among English phonological awareness skills has been demonstrated at single points in time with confirmatory factor analysis and item response theory (Anthony et al., 2002; Anthony, Lonigan, & Schatschneider, 2003; Schatschneider et al., 1999; Stahl & Murray, 1994). Essentially perfect across-time correlations among latent phonological awareness abilities, which were indexed by different phonological awareness skills, were obtained by Anthony and Lonigan (2004); Lonigan, Burgess, and Anthony (2000); and Wagner et al. (1997). Finally, training in phoneme awareness has been shown to generalize to gains in rhyme awareness (Duncan, Colé, Seymour, & Magnan, 2006; Duncan, Seymour, & Hill, 2000).

In the case of Spanish phonological awareness, evidence for heterotypic continuity is quite limited. Spanish speakers indeed demonstrate a variety of phonological awareness skills across their development, and there is some evidence that Spanish speakers master phonological awareness skills in a sequence similar to that of monolingual English speakers (see earlier). However, investigation of the dimensionality of Spanish phonological awareness, both at particular points in development and across development, is scant. In fact, in their review of the literature, Denton et al. (2000) concluded that little was known about the nature of Spanish phonological awareness, and few studies have advanced the understanding of this awareness since then. Moreover, the research that has been conducted has been limited by small sample sizes, exploratory methods, and measures that confound linguistic complexity with task complexity. As such, more research is needed to investigate the nature and sequence of phonological awareness development in monolingual and bilingual Spanish speakers (Gorman & Gillam, 2003).

The twofold purpose of the current study was to describe the dimensionality and continuum of Spanish phonological awareness in monolingual and bilingual children ages 3 to 6 years. As in our prior research with English-speaking children (Anthony, Lonigan, Driscoll, et al., 2003; Anthony, Lonigan, & Schatschneider, 2003), we were particularly interested in studying children's performances on phonological awareness test items as a function of linguistic complexity and task complexity. This study advances prior research on Spanish phonological awareness by systematically varying task and linguistic complexity using methodological controls. Specifically, test items were constructed such that three levels of word structure (i.e., word, syllable, phoneme) were fully crossed with four levels of task complexity (i.e., blending multiple-choice, blending free-response, elision multiple-choice, elision free-response). Thus, the 3×4 factorial design provided for examination of 12 Spanish phonological awareness skills. It was hypothesized that the various Spanish phonological awareness skills would evidence unidimensionality, such that confirmatory factor analysis would demonstrate that the correlations among phonological awareness skills could be well explained by a single, underlying latent ability. It was also hypothesized that the continuum of phonological awareness skills, as described by information curves based on confirmatory factor analysis, would correspond to a hierarchical model of word structure and a working memory model of phonological awareness acquisition. More specifically, the hierarchical model of word structure predicts that the latent ability continuum would show that word-level skills would be mastered before syllable-level skills and that syllable-level skills would be mastered before phoneme-level skills. The working memory model predicts that the latent ability continuum would show that children master recognition of blends first, followed by recognition of the deletion of sounds from words, followed by blending of sounds, followed by deletion of sounds from words.

Method

Study Design

The statistical procedures used to address our hypotheses require a heterogeneous and very large sample. Therefore, the study included children who were enrolled in four different program evaluation projects over 5 consecutive school years. No children were enrolled in more than one project. All four projects involved testing children in the fall and again in the spring of the same school year. No children provided data in more than one school year. Fall data constituted the primary data set used for hypothesis testing because it represented competencies that children had prior to that year's academic instruction and any supplemental intervention with teachers, parents, or children. Spring data were used to cross-validate the final model.

Settings

Two of the projects focused on professional development for teachers of preschool-age children (Landry, Anthony, Swank, & Monsegue-Bailey, 2009; Landry, Swank, Anthony, & Assel, in press). One project focused on teaching shared reading strategies to parents of preschool-age children (Anthony & Williams, 2011). These preschool evaluation projects were carried out in Texas (Houston, Corpus Christi, Richardson, Laredo, Channelview, Humble, San Antonio, San Felipe, and Zapata) and in Florida (Miami). Preschool classrooms were equally divided among public school prekindergarten programs, Head Start programs, and for-profit or nonprofit child care programs. All preschool settings participated in the Texas Early Education Model (Landry et al., in press), which requires integration of personnel and sharing of resources across service delivery systems to reduce systemic inefficiencies, preserve the child care workforce, and expand access to high-quality early childhood education. The Texas Early Education Model is an empirically validated model (Landry et al., 2009, in press) that emphasizes frequent, intensive, and ongoing professional development for early childhood educators, on-site mentoring, regular monitoring of children's academic progress, and research-based curricula. Approximately 90% of the preschool classrooms provided full-day programming. Language of instruction in the preschool classrooms varied from 100% English immersion to 90% instruction in Spanish.

The program evaluation that included elementary-school-age children focused on computerized instruction in literacy or mathematics (Anthony, Williams, Hecht, Clements, & Sarama, 2011). This project was carried out in public school kindergartens in Houston that primarily served economically disadvantaged populations. All kindergarten teachers followed Open Court curriculum and provided full-day programming. Language of kindergarten instruction varied from 100% English immersion to 90% instruction in Spanish.

Participants

Participants included 949 preschoolers and 316 kindergarteners. Approximately 80% to 90% of participating children were from economically disadvantaged backgrounds. Children ranged in age from 3 years, 0 months, to 7 years, 0 months (M = 4 years, 8 months; SD = 8 months), at the time of initial testing. The sample was 99% Hispanic/Latino, 0.3% Caucasian, and 0.7% other ethnicity. The sample was 53% female and 47% male. Only Spanish or both Spanish and English were spoken in the homes of all participants, according to parental report on consent forms.

Procedures

Children were tested individually in relatively quiet locations that school administrators designated for testing. Language screening and phonological awareness testing required approximately 20 to 30 min. All examiners were fluent speakers of Spanish and English. Examiners attended a training workshop to learn how to conduct the assessments and were required to demonstrate competence prior to conducting testing sessions in the schools. Because the purpose of the study was to investigate phonological awareness in Spanish, all testing was conducted in Spanish, including the administration of directions and test items and the provision of feedback. Additionally, only responses provided in Spanish were accepted as correct. Children were given verbal praise, physical praise (e.g., high fives), and tangible reinforcements (e.g., stickers) for participating in the assessments.

Measures

Vocabulary. Children were given the Expressive One-Word Picture Vocabulary Test: Spanish–Bilingual Edition (Brownell, 2001) as a language screening measure. Children were presented with colored line drawings that depicted an action, object, category, or concept and were asked to label each drawing. Although the standardized administration procedures allow children to provide answers in Spanish or English, we accepted only responses provided in Spanish. This was because we were interested in quantifying Spanish vocabulary as opposed to general vocabulary knowledge across languages. If children provided an English response, they were instructed to respond in Spanish. The Spanish response was scored according to the test's criteria for Spanish responses. Only children who correctly named more than 10 drawings, which roughly corresponds to an age equivalent of 2 years and 1 month, were administered the Spanish phonological awareness tests.

Phonological awareness. Children's phonological awareness was assessed with two tests from the Spanish Preschool Comprehensive Test of Phonological and Print Processing (SPCTOPPP; Lonigan & Farver, 2002). The Elision test assessed children's ability to identify or produce a target word that resulted from deletion of part of a word. The Elision test had two parts, which required different response formats. The first part consisted of nine multiple-choice items. For each multiple-choice item, an examiner showed a child four pictures and stated the name of each picture (e.g., *talón, flores, medico, pluma*). Next, the examiner named a stimulus word and asked the child to repeat it (e.g., *pantalon*). The child was then instructed to point to the picture that illustrated the stimulus word without a particular sound (e.g., *pantalon sin pan*). The nine multiple-choice items were grouped into three levels of linguistic complexity. Specifically, the first three items required children to point to the picture that illustrated deletion of a one- or two-syllable word from a compound word (e.g., *sacapuntas sin saca*). The middle three items required recognition of deletion of a single syllable from a word (e.g., *piñata sin* /ta/), and the last three items required recognition of removal of a phoneme from a word (e.g., *joya sin* /j/).

The second part of the Elision test consisted of nine items in a free-response format. The stimulus word was presented orally as before, but children were asked to delete a segment of sound from the stimulus word and to produce the new word. There were no pictures associated with this part of the Elision test. The nine free-response items were grouped into three levels of linguistic complexity (word, syllable, phoneme), just like the nine multiple-choice items on the test. As such, the Elision test assessed six phonological awareness skills: elision multiple-choice words, elision free-response words, elision multiple-choice syllables, elision free-response syllables, elision multiple-choice phonemes, and elision free-response phonemes. Three items were used to assess each skill.

Children were provided with feedback about the accuracy of their performance on the two practice items that preceded each part of the test. Corrective feedback was not provided on test items. Children were administered all items from each part of the test, and all items were scored as either pass or fail. The 18-item Elision test demonstrated good internal consistency (split-half correlations = .87 to .93), moderate convergent validity with the Blending test from the SPCTOPPP (r = .44), and discriminant validity with tests of phonological memory and phonological access (rs = .30 to .35; Anthony et al., 2006).

The Blending test assessed children's ability to identify or produce a word that results from the combination of parts of words. Like the Elision test, the Blending test had two parts, which involved different response formats. The first part consisted of 11 multiple-choice items. The four response choices were labeled by the examiner (e.g., *masa, mamá, casa, bebé*), and then children were instructed to point to the picture that illustrated a blended word (e.g., *ca-sa*). The 11 multiple-choice items were grouped into three levels of linguistic complexity, including word-level items (e.g., *super-mercado*), syllable-level items (e.g., *me-sa*), and phoneme-level items (e.g., *g-a-t-o*).

The second part of the Blending test consisted of nine free-response items. These items required children to say the word that resulted from blending together parts of the word (*Qué palabra hacen estos cal-zón?*). The nine free-response items were similarly grouped into three levels of linguistic complexity (word, syllable, and phoneme). As such, the Blending test assessed six phonological awareness skills (e.g., blending multiple-choice words, blending free-response words, blending multiple-choice syllables, etc.), and three to five items were used to assess each skill.

Children were provided with corrective feedback on the two practice items that preceded each part of the test. Corrective feedback was not provided on test items. Children were administered all items from each part of the test, and all items were scored as either pass or fail. The 20-item Blending test demonstrated good internal consistency (split-half correlations = .90 to .95), moderate convergent validity with the Elision test from the SPCTOPPP (r = .44), and discriminant validity with tests of phonological memory and phonological access (rs = .31 to .38; Anthony et al., 2006).

We made some modifications to the SPCTOPPP. The verbal directions were simplified. Higher quality color pictures that more clearly illustrated the stimuli were substituted for all multiple-choice items. One of the response choices was replaced in two

Blending multiple-choice items and in three Elision multiple-choice items. Specifically, we replaced response choices that were either too difficult to illustrate (e.g., *living room, vineyard*), vocabulary that was too advanced for preschoolers (e.g., *vineyard*), or regional Spanish dialect that was not spoken in the area the studies were conducted (e.g., *banano*). Finally, two new syllable-level multiple-choice items were added to the Blending test in an effort to make the test more sensitive.

Results

Descriptive Statistics

Indices of central tendency and distributional characteristics for the total scores obtained on the Blending and Elision tests are reported separately for the fall and spring (see Table 1). Three of the Elision multiple-choice items were excluded from these descriptive analyses and all subsequent analyses because children's performances on these three items were unrelated to their performances on almost all other items in the phonological awareness battery. Specifically, these items' average interitem correlations (i.e., rs = .06 to .07) were much smaller than the average interitem correlation among all remaining items (i.e., .29). These three Elision multiple-choice items were original, unaltered items: One measuring word awareness and two measuring syllable awareness. As can be seen in Table 1, children generally scored higher on Blending than Elision, and spring scores were generally higher than fall scores. The full range of possible scores was obtained on both tests at both administrations.

For descriptive purposes, percentages of correct responses on the 20 Blending items and on the 18 Elision items are reported in Table 2. High percentages of children provided correct responses to the Blending multiple-choice items (mean correct = 76%, SD = 11%) and to the Elision multiple-choice items (mean correct = 69%, SD = 6%). Moderate percentages of children provided correct responses to the Blending free-response items (mean correct = 39%, SD = 9%). Low percentages of children proved correct responses to the Elision free-response items (mean correct = 7%, SD = 3%).

Hypothesis 1: Dimensionality of Spanish Phonological Awareness

Confirmatory factor analyses were performed to evaluate and compare the utility of alternative, a priori models of the dimensionality of Spanish phonological awareness (see Table 3). We performed confirmatory factor analyses of dichotomous data in Mplus (Version 6; Muthén & Muthén, 2010), using weighted least squares estimation with mean- and variance-adjusted chi-square test statistics. Nested models were compared with chi-square difference tests and standardized fit indices (i.e., comparative fit index [CFI], Tucker–Lewis index [TLI], root-mean-square error of approximation [RMSEA]), giving preference to the latter because of the study's large sample size, which inflates chi-square values and their differences (Marsh, Balla, & McDonald, 1988). Nonnested models were compared with standardized fit indices.

Alternative models of Spanish phonological awareness varied in their degree of specification within and across dimensions of word structure and task complexity. Model 1 was the most parsimonious model because it simply included one factor indexed by all items, regardless of word structure or task complexity. This model served as the baseline model against which other, less parsimonious models were tested. The one-factor model did not characterize these data well (e.g., CFI = .80, TLI = .79, RMSEA = .07), given that CFIs greater than .95, TLIs greater than .95, and RMSEAs less than .05 are considered indicative of excellent fitting models (Hu & Bentler, 1999).

Model 2 included three intercorrelated factors, each of which corresponded to a given level of word structure (i.e., word, syllable, and phoneme). This model yielded a reliable improvement in model fit over the one-factor model, $\chi^2_{\text{difference}}(3, N = 1265) = 233$, $p < .0001$.[1] However, the chi-square difference test is overly sensitive with a large sample, and the increment in model fit was actually very small, given that Model 2 still fit quite poorly (CFI = .81, TLI = .80, RMSEA = .07).

Model 3 included four intercorrelated factors, each of which corresponded to a given level of task complexity (i.e., blending multiple-choice, blending free-response, elision multiple-choice, and elision free-response). This four-factor model characterized the data very well (CFI = .96, TLI = .96, RMSEA = .03), and of course it fit reliably better than the one-factor model, $\chi^2_{\text{difference}}(6, N = 1265) = 670$, $p < .0001$.

For the sake of completeness, we also compared the utility of the four-factor model based on task complexity (i.e., Model 3) to that of two other two-factor models that specified more general task complexity factors. Specifically, Model 4 included a Blending factor and an Elision factor, and Model 5 included a Multiple-Choice factor and a Free-Response factor. Models 4 and 5 described the data only moderately well, and they both fit significantly worse than the four-factor model, $\chi^2_{\text{differences}}(5, N = 1265) = 346$ and 390, ps $< .0001$.

Thus far, the four-factor model (Model 3) had provided the best characterization of children's performances on the phonological awareness test items. However, because the four factors were significantly intercorrelated (rs = .39 to .72, ps $< .001$; see Figure 1) and because many theoretical models of phonological awareness pose a single underlying ability, we tested the viability of a unifying second-order factor. In other words, the four-factor model with freely estimated intercorrelations (Model 3; see Figure 1) was compared with a more parsimonious model in which the same four factors loaded on a single, second-order factor (Model 6; see Figure 2). Indeed, the more parsimonious Model 6 explained the data equally well (CFI = .96, TLI = .96, RMSEA = .03). Therefore, Model 6 was judged the most parsimonious, best fitting model of the dimensionality of Spanish phonological awareness.

The first-order factors in Model 6 were generally well indexed by items with moderate-to-high loadings (λs = .49 to .90, zs = 13.29 to 65.89, ps $< .001$). The unifying second-order factor was well indexed by first-order factors with moderate-to-high loadings (λs = .55 to .91, zs = 12.64 to 27.24, ps $< .001$). The one particularly high second-order factor loading ($\lambda = .91$) resulted in a relatively small amount of residual variance in the Blending Multiple-Choice factor that remained statistically significant ($\psi = .17$, $z = 2.38$, $p < .05$). This result implied that most of the shared

[1] Chi-square difference values reported in the text are calculated according to a formula described in Asparouhov and Muthén (2006).

Table 1
Descriptive Statistics for Phonological Awareness Data Gathered in the Fall and Spring

Measure	*N*	*M*	*SD*	Minimum	Maximum	Skewness
			Fall			
Blending	1,262	11.9	4.5	0	20	−0.26
Elision	1,264	5.9	2.7	0	18	0.56
			Spring			
Blending	1,225	14.2	4.5	1	20	−0.41
Elision	1,225	7.59	3.9	0	18	0.75

variance among blending multiple-choice items could be explained by the unifying second-order factor.

Model 6's unifying second-order factor provided not only a parsimonious explanation of the data but also afforded the opportunity to compare like parameters among items that loaded on different task complexity factors, which was necessary to address our second hypothesis. This was accomplished by performing the Schmid–Leiman transformation of Model 6 (Schmid & Leiman, 1957). The Schmid–Leiman solution is a single-trait, multimethod model in which all items load on a single, unifying first-order factor as well as on uncorrelated first-order method factors. In the present case, the single trait reflected unifying phonological awareness ability, and the four method factors reflected different tasks. The Schmid–Leiman transformation of Model 6 converged cleanly, and of course, it fit just as well as Model 6. Thus, Model 7 reflected the configuration for subsequent analyses directed at examination of item characteristics (see Figure 3 and Model 7 in Table 3). Therefore, factor/theta scores and item- and test-information curves discussed in subsequent analyses are derived from estimates from the unifying phonological awareness factor, after controlling for the method-specific factors.

Hypothesis 2: Sequence of Emergence of Spanish Phonological Awareness Skills

Because these data were not well characterized by a single factor, which is assumed in item response theory, we instead used ordinal confirmatory factor analysis to describe the continuum of latent Spanish phonological awareness ability. Specifically, we used confirmatory factor analysis of dichotomous data, using weighted least squares estimation with mean- and variance-adjusted chi-square test statistics. Before testing our second hypothesis, it was necessary to identify the item response model that best characterized these data (Hambleton, Swaminathan, & Rogers, 1991). This was achieved by comparing three falsifiable variations of Model 7.

Evaluation of alternative item response models. The first item response model (Model 8) specified that all 35 items were equally difficult and that all 35 items contributed equally to children's ability estimates. In other words, all item thresholds/difficulties were constrained to equality, and all item loadings/discriminations on the unifying factor were also constrained to equality. Model 8 characterized the data very poorly (e.g., CFI = .57; see Table 3).

The second item response model (Model 9) specified that all items contributed equally to children's ability estimates (i.e., equivalent loadings/discriminations on the unifying factor), but their thresholds/difficulties were allowed to vary. Model 9 provided a good fit (CFI = .96, TLI = .95, RMSEA = .04; see Table 3) that was a significant improvement over that of Model 8, $\chi^2_{\text{difference}}(34, N = 1265) = 12{,}241$, $p < .0001$.

The third item response model of interest allowed both item loadings/discriminations and item thresholds/difficulties to vary. This model, which is actually Model 7, was found previously to provide a very good fit (e.g., CFI = .97, TLI = .97; see Table 3). Moreover, Model 7 fit significantly better than Models 8 and 9, $\chi^2_{\text{differences}}(68, N = 1265) = 3{,}981$ and $\chi^2_{\text{differences}}(34, N = 1265) = 200$, respectively, ps $< .0001$. In summary, test items were found to vary in both difficulty and in how well they indexed the unifying phonological awareness ability. Item difficulties and item discriminations generated from Model 7 with fall data are reported in Table 2.

Validation of selected item response model. Before addressing our second hypothesis, it was necessary to test the stability of the item parameters generated from Model 7. We imposed Model 7 on the spring data, which were gathered from 1,156 of the 1,265 children who constituted the scaling sample. Item difficulties/thresholds obtained from the two data sets were perfectly correlated, $r = 1.00$. Item discriminations/loadings obtained from the two data sets were moderately correlated, $r = .60$.

To examine stability of estimates of children's latent phonological awareness ability that were generated from Model 7, we tested the correlation between the ability estimate that was based on even items from all phonological awareness tests and the ability estimate that was based on odd items from all phonological awareness tests. Ability estimates, or theta scores, are a weighted composite calculated for each child on the basis of the child's responses to items on a given factor, weighted by the loadings of each item on the factor.[2] In this case, the first set of theta scores was calculated on the basis of children's responses to the even-numbered items, weighted by the even-numbered items' loadings on the unifying phonological awareness factor. The second set of theta scores was based on the same children's responses to the odd-numbered items, weighted by the odd-numbered items' loadings on the unifying phonological awareness factor. The correlation was tested with each of the two data sets (i.e., data gathered in the fall and data gathered in the spring). Children's theta scores estimated from

[2] For a technical description of how theta scores are calculated with dichotomous data in Mplus, we refer the reader to Appendix 11 of the Mplus technical appendices (Muthén, 1998–2004).

Table 2
Items' Description, Percentage Correct, Difficulty, and Discrimination

Item no.	Response format	Word structure	Percentage correct	Item difficulty	Item discrimination
		Blending test			
1	multiple-choice	words	67.1	−0.88	0.59
2	multiple-choice	words	72.4	−0.99	0.76
3	multiple-choice	words	54.6	−0.26	0.50
4[a]	multiple-choice	syllables	76.8	−1.56	0.60
5[a]	multiple-choice	syllables	79.2	−1.24	0.90
6	multiple-choice	syllables	86.0	−1.54	1.33
7	multiple-choice	syllables	87.1	−1.84	0.88
8	multiple-choice	syllables	88.4	−1.92	1.20
9	multiple-choice	phonemes	80.1	−1.37	0.90
10	multiple-choice	phonemes	83.9	−1.33	1.31
11	multiple-choice	phonemes	58.8	−0.4	0.67
12	free-response	words	50.5	−0.03	0.84
13	free-response	words	35.7	0.72	0.84
14	free-response	words	40.5	0.46	0.97
15	free-response	syllables	43.3	0.35	0.96
16	free-response	syllables	47.5	0.15	1.02
17	free-response	syllables	47.4	0.14	1.14
18	free-response	phonemes	35.0	0.61	0.88
19	free-response	phonemes	26.6	1.27	0.65
20	free-response	phonemes	27.5	1.23	0.64
		Elision test			
1	multiple-choice	words	45.9	—[b]	—[b]
2	multiple-choice	words	60.2	−0.57	0.63
3	multiple-choice	words	68.9	−1.05	0.64
4	multiple-choice	syllables	34.3	—[b]	—[b]
5	multiple-choice	syllables	68.8	−0.89	0.74
6	multiple-choice	syllables	17.5	—[b]	—[b]
7	multiple-choice	phonemes	77.6	−1.93	0.48
8	multiple-choice	phonemes	65.0	−0.89	0.53
9	multiple-choice	phonemes	75.4	−1.27	0.73
10	free-response	words	3.4	8.21	0.31
11	free-response	words	8.3	2.66	0.90
12	free-response	words	9.8	2.48	1.15
13	free-response	syllables	5.7	2.67	1.58
14	free-response	syllables	4.5	3.69	0.68
15	free-response	syllables	12.7	2.62	1.08
16	free-response	phonemes	8.9	3.52	0.78
17	free-response	phonemes	7.8	3.55	0.59
18	free-response	phonemes	5.3	4.02	0.61

Note. $N = 1{,}265$.
[a] Items were developed by the authors and were not included in the original Spanish Preschool Comprehensive Test of Phonological and Print Processing (Lonigan & Farver, 2002). [b] Items excluded from analyses because children's performances on these items were uncorrelated with their performances on most other items in the phonological awareness test battery.

either the even or odd items were found to be highly correlated in both data sets (rs = .75 and .86, ps $<$ .001, for fall and spring assessment waves, respectively). Another way that we tested the stability of estimates of children's latent phonological awareness was to examine the test–retest reliability of theta scores among the 1,156 children who provided both fall data and spring data (r = .64). These results indicate that the estimates of children's phonological awareness ability that were generated from Model 7 were quite stable across items and only moderately stable across time, which was expected given that children were in a variety of general education and supplemental intervention programs during the school year.

Item parameters as a function of word structure and task complexity. An important characteristic of Model 7 is that, over and above the method-specific abilities, it specified that all items load directly on the single, unifying factor (i.e., latent phonological awareness ability). This creates a situation in which items' relative difficulties are placed on the same scale as that used to assign latent ability scores to individuals. Item difficulties, therefore, reflect the amount of latent ability associated with a 50% chance of correctly answering a given item. Thus, easier items are associated with lower levels of latent ability, and more difficult items are associated with higher levels of latent ability. Considering both item thresholds/difficulties and item loadings/discriminations from the unifying phonological awareness factor, item information curves allow one to examine where along the ability continuum (i.e., theta) items are more or less informative for discriminating among individuals. An item's discriminative information is plotted on the y-axis, and its difficulty is plotted along the x-axis. An item is most informative at the level of theta that corresponds to its

Table 3
Fit Indices for Confirmatory Factor Analytic Models of the Structure of Spanish Phonological Awareness

Model	Description	χ^2	*df*	CFI	TLI	RMSEA
1	One factor: PA	4,360	560	.80	.79	.07
2	Three factors: Word, Syllable, Phoneme	4,164	557	.81	.80	.07
3	Four factors: BMC, EMC, BFR, EFR	1,273	554	.96	.96	.03
4	Two factors: Blending (BMC + BFR), Elision (EMC + EFR)	2,971	559	.87	.87	.06
5	Two factors: Multiple-Choice (BMC + EMC), Free-Response (BFR + EFR)	2,886	559	.88	.87	.06
6	Five factors: BMC, EMC, BFR, EFR, Second Order	1,286	556	.96	.96	.03
7	Schmid–Leiman transformation of Model 6 (item difficulties and discriminations freely estimated)	1,085	525	.97	.97	.03
8	Item difficulties and discriminations constrained to equality	8,745	593	.57	.57	.10
9	Discriminations constrained to equality, difficulties freely estimated	1,382	559	.96	.95	.04

Note. N = 1,265. CFI = comparative fit index; TLI = Tucker–Lewis index; RMSEA = root-mean-square error of approximation; PA = Phonological Awareness factor indexed by all items; Word = factor indexed by items involving blending or elision of words; Syllable = factor indexed by items involving blending or elision of syllables; Phoneme = factor indexed by items involving blending or elision of individual phonemes; BMC = factor indexed by 11 Blending multiple-choice items; EMC = factor indexed by six Elision multiple-choice items; BFR = factor indexed by nine Blending free-response items; EFR = factor indexed by nine Elision free-response items.

difficulty level. An item becomes less and less informative the further away one moves from the difficulty parameter, regardless of whether one is moving up or down the continuum of theta. This creates the bell shape of item information curves. In other words, an item is most useful for discriminating individuals who have values of theta (i.e., ability estimates) that are close to the item's difficulty. Conversely, an item is of little use for discriminating individuals who have values of theta either far above or far below the item's difficulty, because these are places along the ability continuum where floor or ceiling effects are likely.

Information curves can also be graphed for groups of items. These test information curves (TICs) illustrate the amount of discriminative information provided by a group of items along the range of ability measured by an assessment tool. In the current study, TICs were examined to identify where along the continuum of phonological awareness ability groups of items were and were not useful for discriminating individuals' abilities. Once we identified where along the ability continuum floor and ceiling effects were evidenced by items grouped by word structure and/or task, we were able to infer the order in which particular skills were learned and mastered.

To examine the main effects of task, we graphed four TICs (see Figure 4). To form the TICs, test items were first grouped by method of assessment, regardless of word structure, and then their parameters were averaged. For example, the shortest TIC reflects the average item information for the six Elision multiple-choice items. The shortness of this TIC indicates that on average, the six elision multiple-choice items were not very useful for discriminating individuals' latent phonological awareness abilities. In contrast, the three tall TICs indicate that the 11 Blending multiple-choice items, 9 Blending free-response items, and 9 Elision free-response items provided information that was more useful for quantifying individuals' latent phonological awareness abilities.

Shifting focus from the height of the TICs in Figure 4 to the location of the TICs along the *x*-axis, one can examine the main effect of method of assessment on item difficulty. For example, the leftmost TIC reflects the average item information for the 11 Blending multiple-choice items. That this TIC is furthest to the left indicates that the Blending multiple-choice items were the easiest items in the phonological awareness battery. This group of items was sensitive to differences among individuals who ranged in phonological awareness ability from about −3.5 to about 1.0.

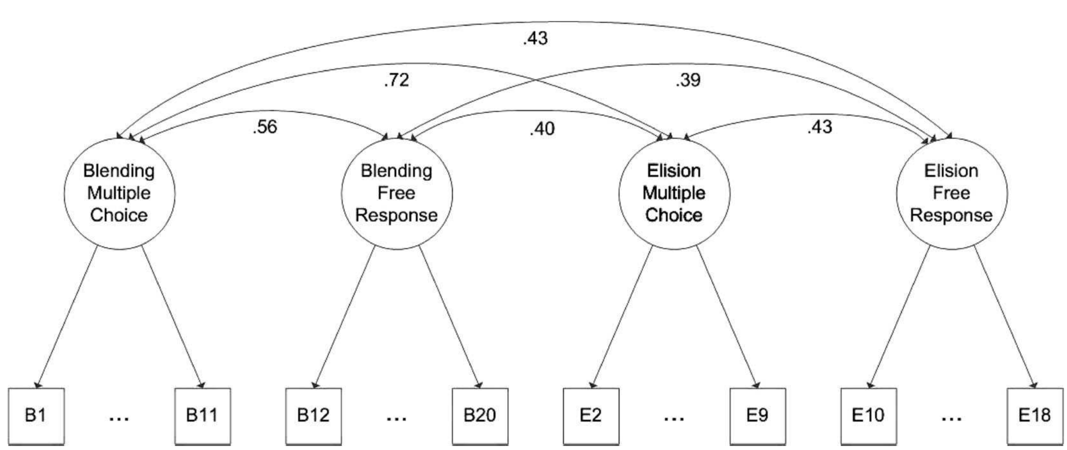

Figure 1. Four-factor confirmatory factor analysis model. B = Blending; E = Elision.

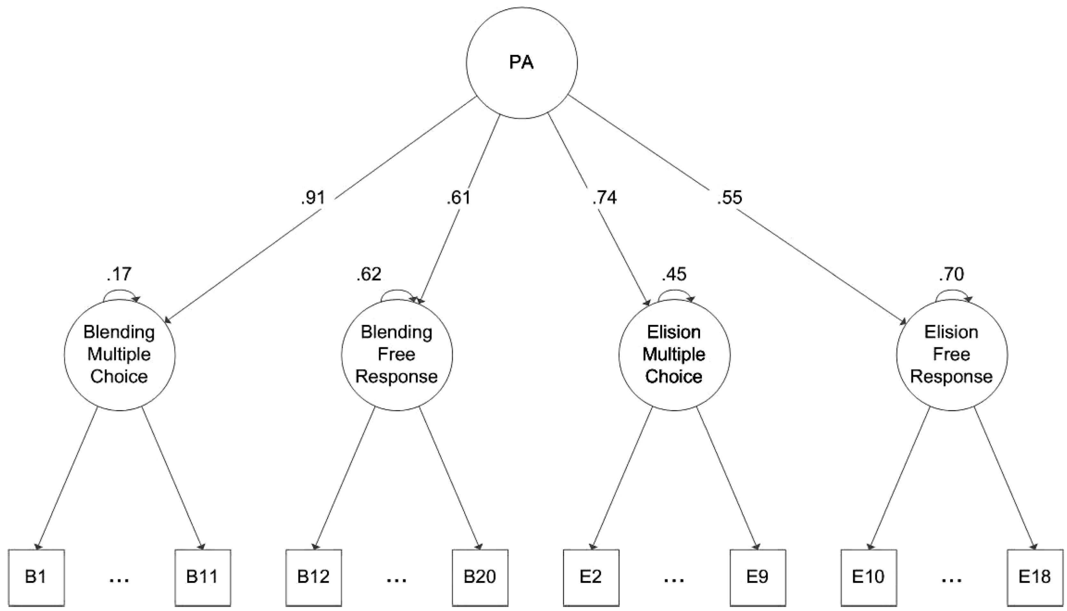

Figure 2. Four-factor, second-order confirmatory factor analysis model. All correlations between first-order factors are fixed to zero. All loadings are significant at $p < .001$. PA = phonological awareness; B = Blending; E = Elision.

Individuals with phonological awareness ability greater than about 1.0 were likely to show ceiling effects on Blending multiple-choice items.

Next, the tall TIC in the middle of Figure 4 indicates that Blending free-response items were moderately difficult. This TIC shows that Blending free-response items were sensitive to differences among individuals who ranged in ability from about −2.0 to about 3.0. Individuals with phonological awareness ability less than −2.0 were likely to show floor effects on Blending free-response items, and individuals with phonological awareness ability greater than 3.0 were likely to show ceiling effects on Blending free-response items.

Finally, the TIC for the group of Elision free-response items is to the right in Figure 4, indicating that the Elision free-response

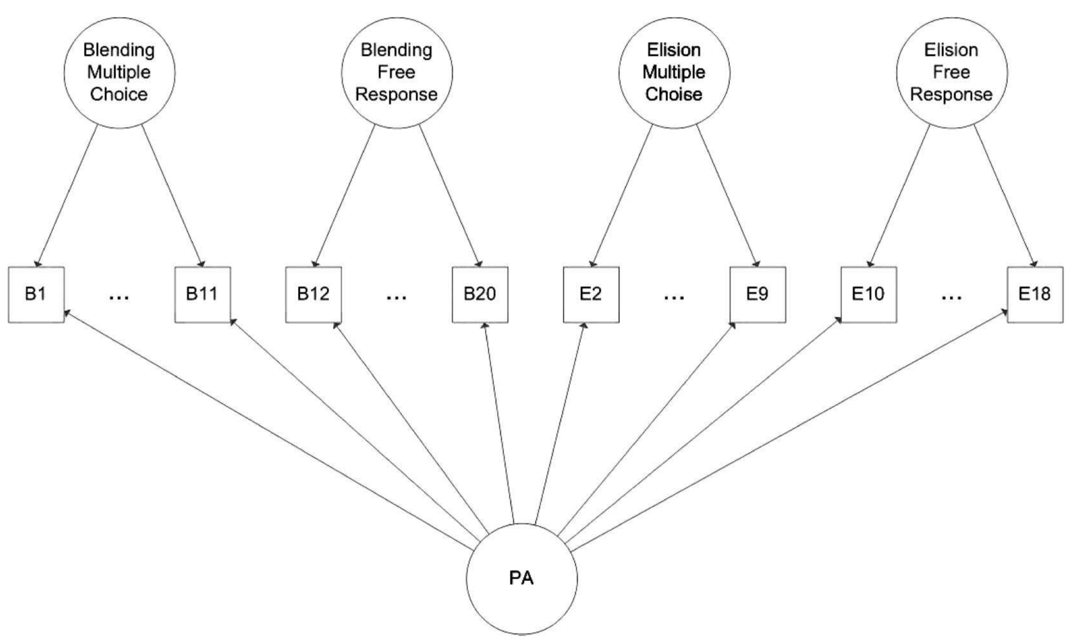

Figure 3. Five-factor, single-trait, multimethod confirmatory factor analysis model. B = Blending; E = Elision; PA = phonological awareness.

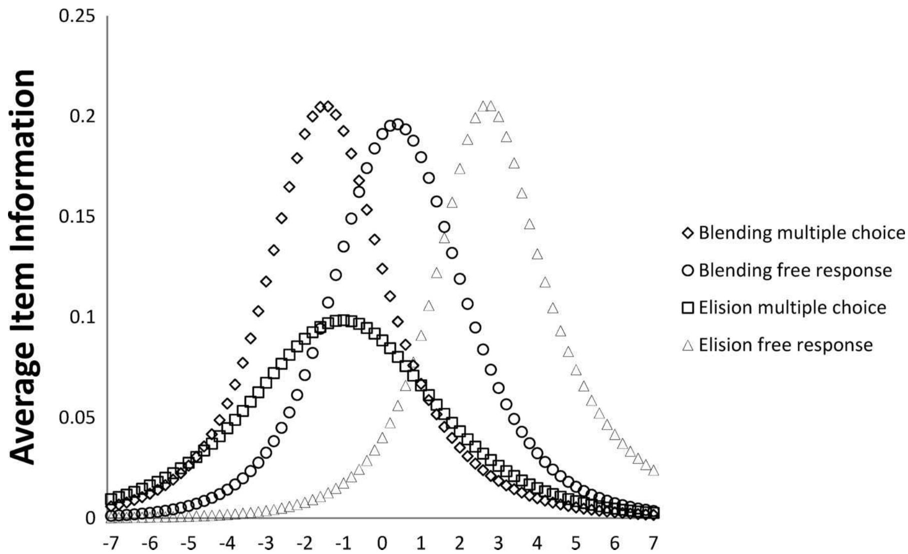

Figure 4. Information functions for different methods of assessment.

items were on average the most difficult items in the battery. This group of items was sensitive to differences among individuals who ranged in phonological awareness ability from about 1.0 to about 5.0. Individuals with phonological awareness abilities less than 1.0 were likely to show floor effects on Elision free-response items, and individuals with phonological awareness abilities greater than 5.0 were likely to show ceiling effects on Elision free-response items. One can extrapolate from the location of the TICs in Figure 4 that, in general, Blending multiple-choice skills emerged first, followed by Blending free-response skills, and finally by Elision free-response skills.

To examine potential interaction effects of task with word structure, we graphed the four TICs that reflected items grouped by assessment method within each unit of word structure. The left-to-right pattern among TICs that was observed in Figure 4 replicated within each level of word structure (see Figures 5, 6, and 7). This finding supports a main effect of task complexity on item difficulties/thresholds, such that Blending multiple-choice items were easiest, followed by Blending free-response items, followed by Elision free-response items.

With the exception of Elision multiple-choice, which provided very little information at all levels of word structure, the effects of task on item discriminations/loadings varied as a function of word structure. For example, the Blending multiple-choice task provided good amounts of information when tapping syllable awareness and phoneme awareness, but it provided very little information when used to measure word awareness (see heights of Blending multiple-choice TICs in Figures 5, 6, and 7). In contrast, the Blending free-response

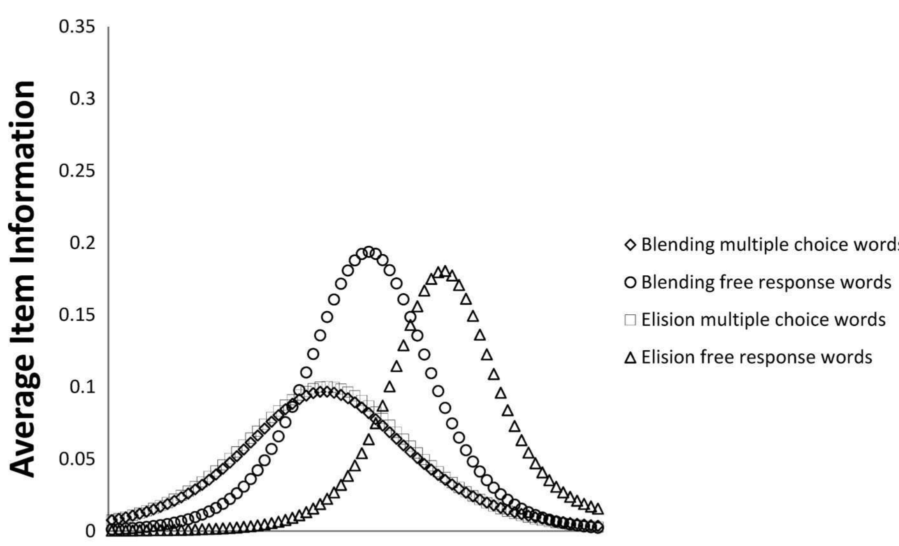

Figure 5. Information functions for different tasks involving compound words.

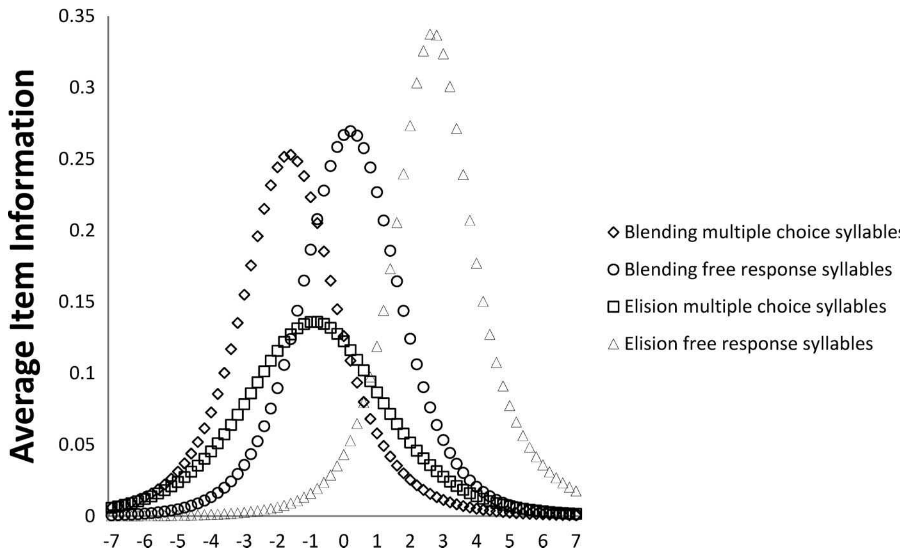

Figure 6. Information functions for different tasks involving syllables.

task provided reasonable amounts of discriminative information when tapping word awareness and syllable awareness, but it provided little information when used to measure phoneme awareness (see heights of Blending free-response TICs in Figures 5, 6, and 7). Similarly, the Elision free-response task provided good amounts of discriminative information when used to measure word awareness and syllable awareness.

To examine potential main effects of word structure, we graphed TICs for items grouped by level of word structure, regardless of method of assessment (see Figure 8). Investigating first the effects of word structure on item difficulty, TICs for each level of word structure were very wide. These results indicate that each level of word structure assessed a very broad range of children's phonological awareness abilities. Moreover, TICs for items grouped by word structure generally spanned the same range of difficulty (see Figure 8). These results refute a main effect of word structure on item difficulty, and they indicate that all three levels of word structure provided nearly the same coverage of ability levels. Moreover, this was found to be the case within each method of assessment (see overlapping TICs in Figures 9, 10, and 11). As such, a clear main effect of word structure on the continuum of phonological awareness was not evidenced.

Examination of the effects of word structure on item difficulty as a function of method of assessment elucidated an interaction between word structure and task complexity. Syllable items and word items were equally difficult when used with Blending free-response and Elision free-response tasks (see widths of TICs for syllable and word items in Figures 9 and 10). However, word items were slightly more difficult than syllable items when used with the Blending multiple-choice task (see Figure 11). Because the Blend-

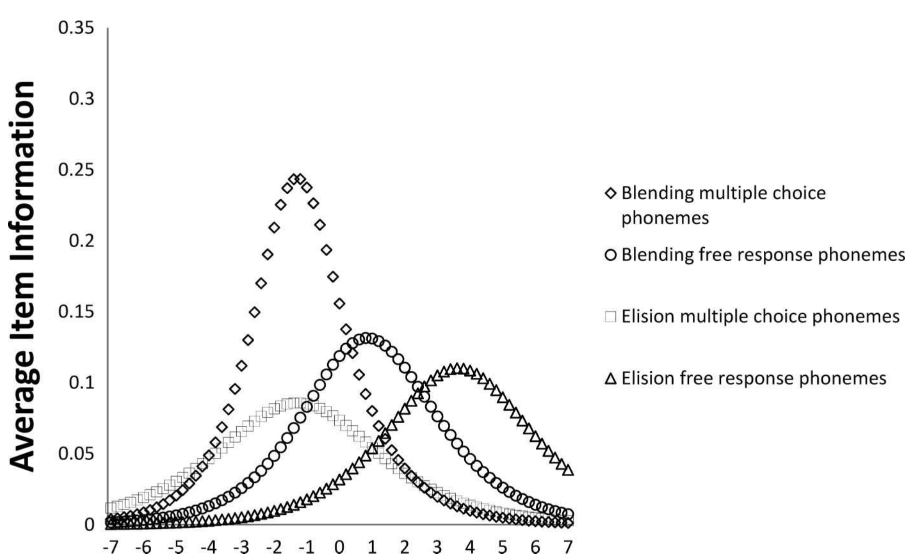

Figure 7. Information functions for different tasks involving phonemes.

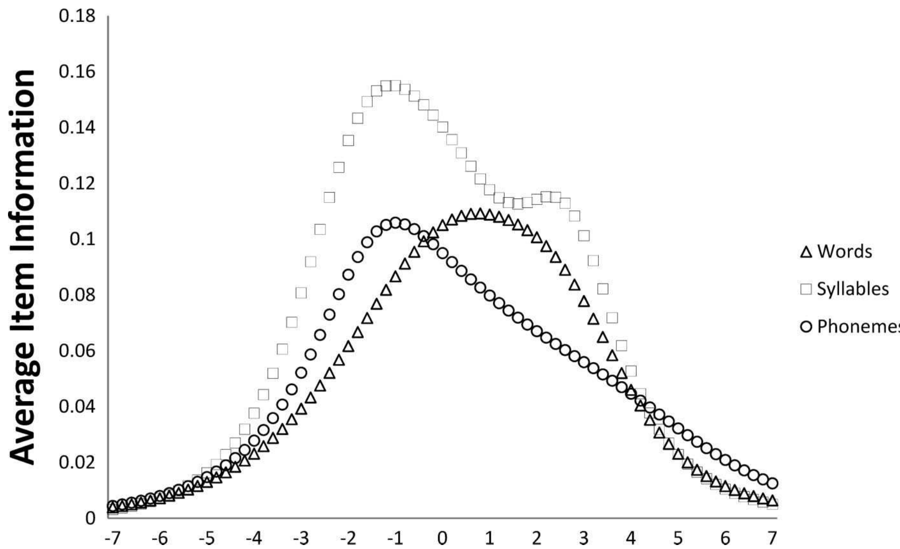

Figure 8. Information functions for different units of word structure.

ing multiple-choice task provides most of the coverage in the lower range of ability (see Figure 4), this interaction between word structure and task complexity explains why the word-level items in Figure 8 provided less coverage at lower levels of ability. In contrast, there was no interaction with phoneme items, as phoneme items were more difficult than syllable items in each of the three methods of assessment that provided useful information (see Figure 9 for Blending free-response, Figure 10 for Elision free-response, and Figure 11 for Blending multiple-choice).

Interaction effects between word structure and task complexity were more evident on item discriminations. For example, items involving compound words provided good amounts of discriminative information when used with Blending free-response and Elision free-response tasks; however, word items provided much less discriminative information when used with the Blending multiple-choice task (see relative heights of TICs for word items in Figures 9, 10, and 11). Phoneme items provided good amounts of discriminative information when used with the Blending multiple-choice task; however, phoneme items provided much less discriminative information when used with the Blending free-response and Elision free-response tasks (see relative heights of TICs for phoneme items in Figures 9, 10, and 11). In contrast, syllable items provided good amounts of discriminative information when used with all three informative tasks (see tall TICs for syllable items in Figures 9, 10, and 11).

Discussion

The twofold purpose of this study was to describe the dimensionality of phonological awareness in 3- to 6-year-old Spanish-

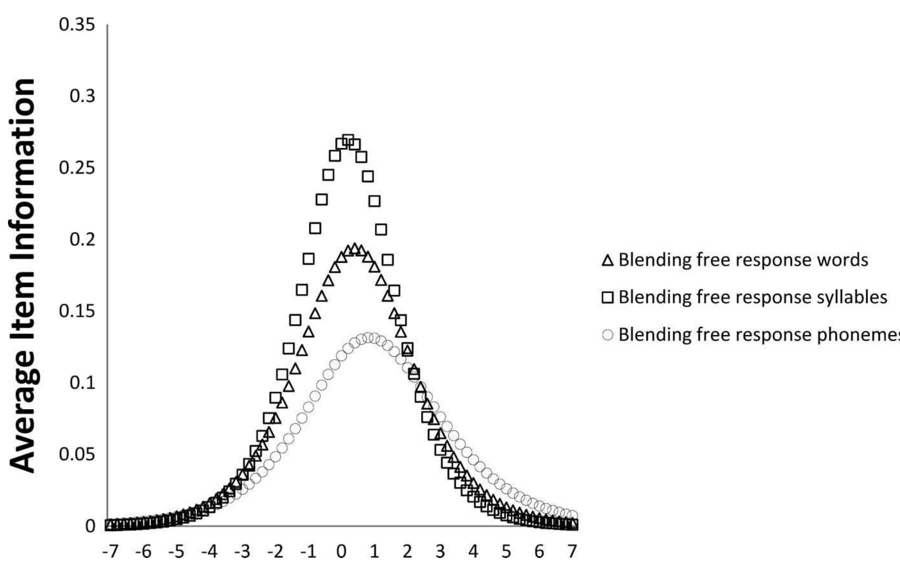

Figure 9. Information functions for different levels of word structure within Blending free-response task.

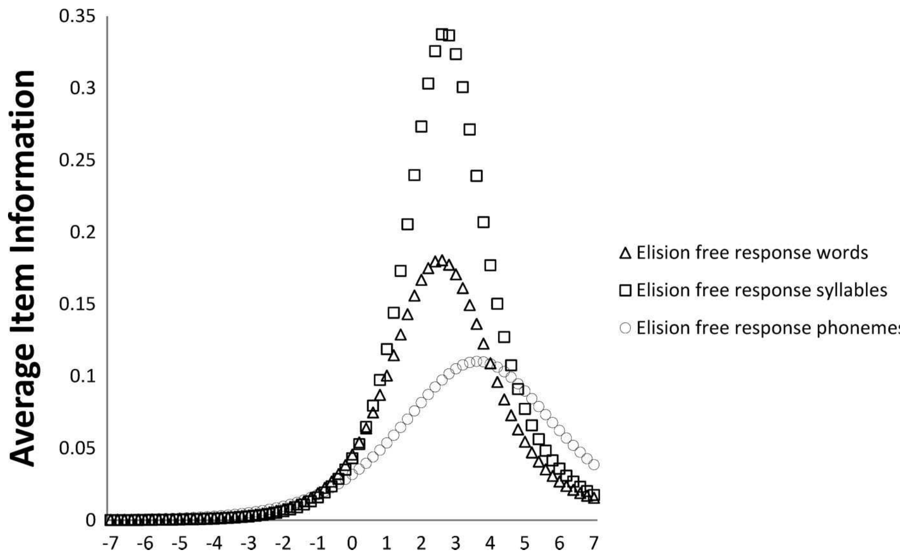

Figure 10. Information functions for different levels of word structure within Elision free-response task.

speaking children and to examine the relative influences of linguistic complexity and task complexity on the continuum of Spanish phonological awareness skills. Regarding the dimensionality of phonological awareness, as our theoretical models of the development of literacy become more complex and as our frameworks for measurement of relevant constructs become more sophisticated, an increasing amount of attention must be dedicated to issues of dimensionality to isolate the effects of constructs from those of measurement artifacts. In the present study, we found that children's performances on Spanish phonological awareness measures were largely explained by a single, second-order phonological ability. This finding is consistent with studies that have investigated the dimensionality of phonological awareness in English (Anthony & Lonigan, 2004; Anthony et al., 2002; Anthony, Lonigan, & Schatschneider, 2003; Schatschneider et al., 1999; Stahl & Murray, 1994), Greek (Papadopoulos et al., 2009), and Dutch (Vloedgraven & Verhoeven, 2009). The current finding is also reassuring, given that prior studies using latent variable methods have presumed a unidimensional phonological awareness ability in their modeling of Spanish phonological awareness as it relates to bilingual word reading (Branum-Martin et al., 2006) and Spanish emergent literacy (Anthony et al., 2006, 2009).

However, a caveat to our general conclusion is warranted, as nontrivial amounts of method or task variance were also identified in the current study. That is, test items that involved the same cognitive operation (blending or elision) or the same response format (multiple-choice or free-response) covaried in ways that were independent of latent Spanish phonological awareness. The nature and magnitude of this finding were consistent with the findings of Branum-Martin et al. (2006), who found that Spanish

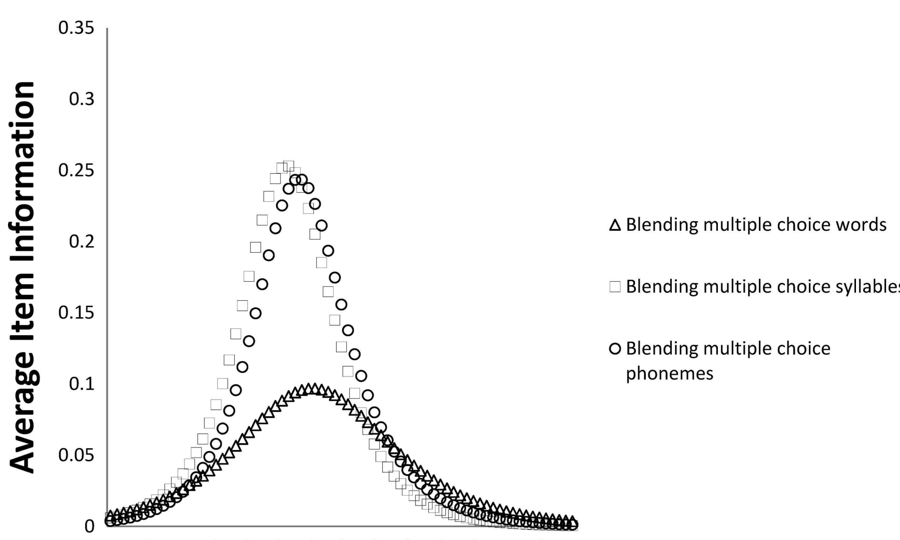

Figure 11. Information functions for different levels of word structure within Blending multiple-choice task.

and English versions of measures that used the same cognitive operations reliably shared small amounts of method or task variance that were independent of latent phonological awareness (residual *r*s = .12 to .23; Branum-Martin et al., 2006). Similarly, Carrillo's (1994) exploratory factor analysis of 10 Spanish phonological awareness tests suggested some influence of shared task variance in the factor structure of Spanish phonological awareness. Collectively, these studies indicate that Spanish phonological awareness measures do include some method or task variance independent of the unifying latent phonological awareness ability. The implication of this finding is that researchers and practitioners should always use multiple measures of Spanish phonological awareness and should attend to the covariation among measures rather than to raw scores obtained on a single phonological awareness test that includes only a single task. Fortunately, our follow-up analyses demonstrated that the small amount of task variance embedded in our measures did not have a substantially negative impact on the measures' validity when we attended to the covariation among all items, as reflected by stability of item parameters and latent ability estimates across time.

The finding that word structure generally had little impact on the difficulty of Spanish phonological awareness items and, by inference, on sequence of emergence of phonological awareness skills was surprising in light of findings with English-speaking children that show English phonological awareness development follows a hierarchical model of word structure (Anthony & Francis, 2005; Anthony, Lonigan, Driscoll, et al., 2003; Anthony, Lonigan, & Schatschneider, 2003; Treiman & Weatherston, 1992; Ziegler & Goswami, 2005). In the present study, it was found that all levels of word structure (word, syllable, and phoneme) could be used to assess essentially the same range of Spanish phonological awareness ability. These results, however, should not be interpreted as necessarily falsifying theories of phonological awareness development that assert a role of linguistic complexity (e.g., lexical restructuring theory, psycholinguistic grain size theory), as word structure is only one of many determinants of linguistic complexity. Other determinants of linguistic complexity, such as word length, syllable structure, stress pattern, phoneme position, phonotactic probability, and articulatory gestures of voicing, manner, and placement, have all been found to influence rate of development of phonological awareness. As such, it is quite possible, even within the range of abilities of our sample, that small effects of Spanish word structure may have been overshadowed by effects of other determinants of linguistic complexity, such as word length, which were not controlled.

As discussed in the introduction, there are many differences between English and Spanish that are likely to influence the rate and pattern of development of phonological awareness and could explain why the word structure effects evidenced in English were not replicated with the present sample of Spanish speakers. Gorman and Gillam (2003) identified key linguistic features in Spanish that could lead to different rates and patterns of phonological awareness development, including differences in syllable stress and structure, word shapes, sound systems, and the orthographic depth of each language. For example, monosyllabic words are relatively common in English with the bulk being content words. By contrast, polysyllabic words in Spanish are more frequently content words, with monosyllabic words generally denoting functions, articles, conjunctions, prepositions, and adverbs (Gorman & Gillam, 2003). Content words or nouns in Spanish, therefore, generally have more syllables and phonemes than their English counterparts (e.g., *pants–pantalon, shirt–camisa*). The Spanish words chosen on both the Elision (e.g., *rompecabeza, balóncesto*) and the Blending (e.g., *caracol, supermercado*) tests at the compound word and syllable level have significantly more syllables and phonemes than words that you might find on a similar test in English (e.g. *seashell, butterfly*). The increased word length of Spanish words and compound words, relative to English words and compound words, probably causes a relative increase in demands on working memory (Jiménez González & Haro García, 1995) in compound word-level and syllable-level items, making such items with simple word structures more difficult and thereby diluting the effects of word structure on item difficulty. Experimental studies are needed to systematically test the effects of word length on Spanish phonological awareness, extending the excellent work of Jiménez González and Haro García (1995) to an examination of word length effects on syllable-level and compound word-level test items.

Some researchers and linguists argue that syllables are the most salient level of analysis in Spanish. For example, adult readers of Spanish focus more on the syllable unit than individual phonemes when reading (Gorman & Gillam, 2003). In the present study, test items involving sensitivity to or manipulation of syllables were generally quite informative for quantifying individual differences in underlying phonological awareness, regardless of method of assessment. In fact, children's facility with elision of syllables was more indicative of their underlying phonological awareness ability than facility with elision of phonemes. Of course, this conclusion should be generalized only to other individuals who fall within the same range of phonological awareness ability as our sample. It may very well be that one could design a phoneme elision task beyond the abilities of our sample, such that it would be more difficult than a similar syllable elision task (e.g., elision of a phoneme from a medial consonant cluster vs. elision of a medial syllable). However, given the transparency of Spanish orthography, it is unlikely that individual differences in such advanced phoneme awareness will be found important for skilled reading in Spanish.

Many tests of phonological awareness include test items with compound words in an effort to avoid floor effects and to be sensitive to individual differences among very young children or children with delayed phonological awareness. However, this strategy seems of little use for tests of Spanish phonological awareness. Test items involving manipulation of Spanish compound words were no easier than test items involving manipulation of syllables. Moreover, compound word items in the context of a Spanish blending multiple-choice task were actually more difficult than syllable and phoneme items used with the same task. Therefore, in light of findings that using compound words does not provide any additional coverage of lower levels of phonological awareness ability and findings that items with compound words are generally less informative than those with syllables or phonemes, there seems to be little need for compound word items in Spanish phonological awareness tests.

Although contrary to expectation from a hierarchical model of word structure, the finding that compound word items in the context of blending multiple-choice were more difficult than syllable and phoneme items used in the same task was quite reasonable given certain aspects of the Spanish language. Compound words occur infrequently in Spanish, and they tend to be quite long, in terms of number of syllables and number of phonemes. For example, the compound word items on our Blending multiple-choice test included 4.0 syllables and 9.0 phonemes on average. In contrast, the syllable items on that test included 2.2 syllables and 4.6 phonemes on average, and the phoneme items included 2.0 syllables and 4.0 phonemes on average. Thus, given that word length is positively correlated with item difficulty on both tests of English phonological awareness (Treiman & Weatherston, 1992) and tests of Spanish phonological awareness (Jiménez González & Haro García, 1995), it is likely that the reason why compound word items in Spanish are not easy is because they tend to be so long. However, experimental studies are needed to substantiate this.

Our hypothesis concerning the sequence of emergence of phonological awareness skills along the dimension of task complexity was confirmed. Specifically, children were first able to point out a picture that illustrated a word formed by blending two parts of a word together. Next, children learned to actually blend parts of words together for themselves. Finally, only the most developed children in the sample were able to delete sounds from words to create new words. In other words, the Blending multiple-choice task was easiest, followed by Blending free-response, and then by Elision free-response. In fact, variation in task complexity was primarily responsible for the broad coverage of the assessment battery. This order of task difficulty and, by inference, this order of emergence of phonological awareness skills was replicated within each level of word structure examined. Such findings are consistent with prior research conducted on English- and Spanish-speaking children (Anthony et al., 2003; Carrillo, 1994). An important implication of this finding is that one level of linguistic complexity could be chosen (e.g., syllables) and the task varied among multiple-choice, free-response, blending, and elision to cover a broad range of ability levels with good power to discriminate among individuals' abilities. This implies that even young preschool-age children and those with delayed development of phonological awareness could still be accurately assessed if administered developmentally appropriate phonological awareness tasks. As for instructional implications, future research will need to examine if educators can guide children through development of Spanish phonological awareness most efficiently if they systematically introduce different tasks in the order that phonological awareness skills naturally develop. Furthermore, educators may want to capitalize on the salience of syllables in the Spanish language when introducing different phonological awareness tasks.

The Elision multiple-choice task was essentially uninformative, regardless of children's ability levels and regardless of whether children were asked to elide words, syllables, or phonemes. Interestingly, Anthony, Lonigan, and Schatschneider (2003) reported similar results from their item response theory analysis of the English phonological awareness data reported in Anthony, Lonigan, Driscoll, et al. (2003). Although it would be tempting to conclude from these two studies that the Elision multiple-choice task may be of little value for assessing phonological awareness in Spanish or in English, other studies have reported more success with this task (Anthony et al., 2002; Lonigan, Burgess, & Anthony, 2000; Lonigan, Burgess, Anthony, & Barker, 1998). A noteworthy difference between the Elision multiple-choice tests used in those earlier studies was the number of response choices. The earlier and more promising versions of the measure included only three response choices. In the later version, four response choices were used in an effort to improve internal consistency of the measure and reduce the effect of chance responding. However, maybe the combination of four response choices with the cognitive requirements of an elision task is so taxing on young children's working memory that it renders the task almost invalid as a measure of phonological awareness.

Two of the Elision multiple-choice items stood out as particularly poor items. Thoughtful review of these items found three possible explanations for their poor performances. For the item *Chaparro sin rro,* it could be that the difference in stress pattern between *chaparro,* where the second syllable is stressed, and *chapa,* where the first syllable is stressed, results in distinctly articulated vowel sounds in the second syllable, thereby making this a poor item. However, Jiménez González and Haro García (1995) showed that stress has little influence on native Spanish-speaking children's ability to segment words. Thus, a more likely reason for why this item performed poorly may be that both *chaparro* and *chapa* are relatively low-frequency words, especially in Mexican dialects. As such, our sample of children, most of whom lived in Texas and most of whom spoke a Mexican dialect, may not have been very familiar with these words. Word frequency may also account for why *Rompecabeza sin rompe* performed poorly, albeit by a different means. Our clinical and research experience with Spanish-speaking English language learners has found that some previously learned Spanish words are quickly replaced with English counterparts if they are academic vocabulary or if the English words are easier to pronounce. *Puzzle* is both academic vocabulary and much shorter and easier to pronounce than *rompecabeza.* As such, we have observed many families who primarily speak Spanish in the home refer to this toy as a *puzzle,* which may reduce children's exposure to the word *rompecabeza* and negatively influence the validity of the item in question. Future studies should systematically test the effects of word frequency on the validity of Spanish phonological awareness items within specific populations.

The current findings have important implications for the development of assessment and screening tools and for testing of young children's competence in Spanish phonological awareness. Our findings suggest that to provide adequate coverage of 3- to 6-year-olds' abilities, a good Spanish phonological awareness test will need to include a number of tests that use different tasks that vary in difficulty. Unfortunately, this may increase the amount of time needed for assessment, given that each test will need to have a new set of instructions and corrective feedback during demonstration items so that children understand the requirements of each task. This is quite different from assessment of English phonological awareness, in which a single test that uses one task could still provide adequate coverage as long as the item content varied in word structure.

Although Spanish assessments including multiple tasks may take more time to administer, the benefit should be improved accuracy in identifying young Spanish-speaking children who are experiencing delays in phonological awareness development. Improved early identification and consequent targeted intervention is particularly important given the high incidence of poor reading outcomes in this population (Garcia & Miller, 2008; Snow, Burns, & Griffin, 1998). There is increasing evidence that native language instruction early on has the potential to improve long-term reading outcomes in English (Rolstad, Mahoney, & Glass, 2005; Slavin & Cheung, 2005). However, valid and reliable assessment in Spanish is a necessary prerequisite to inform the development of interventions that address the most relevant skills in Spanish.

Increasing evidence in support of cross-linguistic transfer of phonological awareness, such that higher phonological awareness skills in Spanish predict improved reading abilities in both Spanish and English, indicates that measuring a Spanish-speaking child's phonological awareness in Spanish is important not only to guide Spanish literacy instruction but also to understand children's potential reading outcomes in English (Cardeñas-Hagan, Carlson, & Pollard-Durodola, 2007; Cobo-Lewis, Eilers, Pearson, & Umbel, 2002; Dressler & Kamil, 2006; Hammer, Lawrence, & Miccio, 2007). Therefore, these findings are relevant to both Spanish literacy development and English literacy development among English language learners.

It is important to note the limitations of the present study. First, it was not comprehensive in its inclusion of phonological awareness tasks. For example, it did not include sound matching, rhyming, alliteration, onset-rime blending, or segmentation tasks. Additional studies that include such tasks are needed to further investigate the dimensionality and continuum of Spanish phonological awareness. We did not include any onset-rime level items as Spanish onset-rime awareness remains controversial. English onset-rime awareness is known to be a significant predictor of English literacy, but Spanish onset-rime awareness appears to be less relevant to Spanish literacy (Gorman & Gillam, 2003; Jimenez & Ortiz, 2000). As Jimenez and Ortiz (2000) explained, this may be because of Spanish's shallow orthography, clear syllabic boundaries, and relatively small number of monosyllabic words in which rime units tend to have particular salience. However, some argue that because Spanish speakers in the United States will be expected to read in English, they should still be taught onset-rime awareness, even in Spanish (Gorman & Gillam, 2003).

Additionally, little is known about how bilingualism or the language of classroom instruction may influence the rate or pattern of phonological awareness development in young simultaneous and sequential bilinguals. There is evidence that the language of instruction (i.e. Spanish or English) does influence the early literacy development of Spanish speakers (Barnett, Yarosz, Thomas, Jung, & Blanco, 2007; Cardeñas-Hagan et al., 2007; Durán, Roseth, & Hoffman, 2010; Freedson, 2005), but the contributions of classroom instructional language and extent of bilingualism have yet to be included as mediating variables in any analysis explaining variations in rates or patterns of Spanish phonological awareness development. Unfortunately, the methods used in some of the evaluation projects that comprised this study precluded examination of the effects of contextual variables and children's fluency in English on the dimensionality and continuum of Spanish phonological awareness.

In conclusion, research indicates that Spanish-speaking children acquire phonological awareness in some ways that are similar to and in some ways that are different from monolingual English speakers. Much work still needs to be done with Spanish-speaking English language learners in the United States before we can adequately describe the phonological development of this growing population, which is at risk for literacy problems in the United States. Thoroughly understanding the nature and development of phonological awareness in this population is important as it may have significant implications for curriculum and assessment development and early identification practices. Unfortunately, linguistic differences between Spanish and English, bilingual home and school environments, bilingual instruction, and an emphasis on becoming literate in English all complicate this effort. Nonetheless, we believe this study provided some important initial evidence to help guide the development and implementation of improved assessment practices in this area. In addition, with improved assessment, we hope to aid early identification of English language learners who are at risk for literacy problems so that targeted early intervention can potentially improve their reading and academic outcomes.

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