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A DEVELOPMENTAL CONTINUUM OF PHONOLOGICAL SENSITIVITY SKILLS

LISA A. PUFPAFF

Ball State University

A large body of evidence supports the link between acquisition of phonological sensitivity skills among young children and their later literacy achievement. This literature review presents a synthesis of the developmental nature of phonological sensitivity skills as assessed among typically developing children over the past 30 years. Phonological sensitivity is composed of both phonological awareness and phonemic awareness, each representing a distinct set of skills that emerge in a general developmental sequence among typically developing children. Yet, insufficient attention is being paid to the developmental nature of phonological sensitivity skills in our efforts to identify and remediate early literacy difficulties among children. This article presents the array of skills that constitute phonological sensitivity, ordered in a developmental continuum based on research evidence in order to create a bridge between scientific evidence and school-based practices.
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There is general consensus that phonological processing skills are critical for literacy development. The past three decades have seen an explosion of publications related to the issue of phonological sensitivity (PS) (Lonigan, 2006), one component of phonological processing. Efforts to stay abreast of this body of literature can result in a confusing array of terminology; skills; measurement procedures; and suggested causes, effects, and relationships. It is important for professionals who work with young children to understand the developmental nature of PS so they can make informed decisions about assessment, literacy instruction, and remediation (Phillips, Clancy-Menchetti, & Lonigan, 2008). When educators understand the order in which young children acquire PS skills, they can better design assessment measures that accurately assess appropriate PS skills in the proper sequence (Anthony, Lonigan, Driscoll, Phillips, & Burgess, 2003). More important, providing instruction in PS skills at appropriate developmental levels will contribute to the prevention of later reading difficulties.

Terminology

Stanovich (1992) first used the term *phonological sensitivity* to describe the array of skills addressed within the research literature when he suggested to the reading research community a need to more accurately define the phonological processing ability related to the manipulation of speech sounds. He stated that the term "phonological sensitivity should be viewed as a continuum ranging from 'deep' sensitivity to 'shallow' sensitivity. Tasks indicating deeper levels of sensitivity require more explicit reports of smaller sized units" (p. 317) (e.g., phonemes vs. syllables). Therefore, PS was proposed as the broad term encompassing both phonological and phonemic awareness. Scarborough and Brady (2002) supported Stanovich's appeal for more consistent use of the "phon" words, suggesting that inaccurate use of terminology and misapplication in assessment and instructional materials may cause confusion for early intervention practitioners.

The term *phonological awareness* has typically been used to refer to the ability to detect and manipulate the sound segments of spoken words. Other terms (e.g., phonologic awareness, phonemic awareness, phoneme awareness) have historically been used interchangeably (Ball, 1993a; Lewkowicz, 1980). Yet, a review of the literature revealed that a number of tasks used to assess phonological awareness actually measure skills that require detection and manipulation of word and syllable level units rather than phonemes. To clarify the different groups of skills, the International

Correspondence to: Lisa A. Pufpaff, Department of Special Education, Teachers College, Room 710, Ball State University, Muncie, IN 47306. E-mail: lapufpaff@bsu.edu

Reading Association issued a position statement in 1998 defining phonological awareness as a set of skills distinct from phonemic awareness skills. *Phonological awareness* refers to the ability to manipulate units of speech larger than the individual phoneme, such as words, syllables, onsets (all consonants prior to the vowel in a word or syllable), and rimes (the vowel and remaining consonants in a word or syllable). *Phonemic awareness*, in contrast, refers to the ability to discriminate and manipulate individual speech sounds—phonemes. Both terms refer to the development of skills that involve attending to, recognizing, discriminating, and manipulating oral language in the absence of print.

PS is now regarded as a continuum of skills (Anthony et al., 2003) that emerge in a developmental hierarchy among typically developing children (Adams, 1990). Along that continuum, phonological awareness skills are easier and generally acquired before phonemic awareness skills. Therefore, more attention is now being given to accurately defining the type of skill being addressed in current research (e.g., Burgess & Lonigan, 1998).

Relationship to Literacy Acquisition

The development of PS in young children is strongly related to later reading and spelling abilities, although there is lack of consensus as to whether the relationship is causal, reciprocal, or simply correlational in nature. Some have suggested that the development of early reading skills such as letter recognition contributes to the acquisition of PS skills (Bentin, Hammer, & Cahan, 1991; Ehri, 1984, 1985; Perfetti, 1985). Others have argued that it is the development of PS skills such as rhyming, blending, and segmenting that lays the foundation from which reading and spelling skills develop (Bradley & Bryant, 1983, 1985; Byrne & Fielding-Barnsley, 1993; Lundberg, Frost, & Petersen, 1988; Stanovich, Cunningham, & Cramer, 1984; Yopp, 1988). Still others have suggested that PS skills have a reciprocal relationship with early reading and spelling skills, each contributing to the development of the other (Burgess & Lonigan, 1998; Stahl & Murray, 1994). The undisputed finding from decades of research is that PS is linked to reading achievement and the link persists throughout school (Badian, 2001) and into adulthood (Morais, 1991; Shaywitz, 2003).

This evidence for a link between PS and reading achievement has come from correlational (Wagner, Torgesen, & Rashotte, 1994) and longitudinal (Badian, 1995, 1998, 2001; Wagner & Torgesen, 1987) research wherein PS skills were assessed among nonreading preschoolers and kindergartners. Results were then compared to concurrent and/or subsequent measures of reading and/or spelling achievement among the same children. The general finding is that measures of PS correlate more highly with measures of reading and/or spelling acquisition than do measures of intelligence, expressive language, vocabulary development, reading readiness, or reasoning ability (Burgess & Lonigan, 1998; Mann & Liberman, 1984; Share, Jorm, MacLean, & Matthews, 1984; Shaywitz, 2003; Stanovich, Cunningham, & Cramer, 1984; Stanovich, Cunningham, & Feeman, 1984; Zifcak, 1981).

Evidence for a causal relationship between PS skills and subsequent reading achievement has been developed through experimental training studies. Such studies have demonstrated training in PS skills improved reading and/or spelling achievement in typically developing children (Blachman, Tangel, Ball, Black, & McGraw, 1999; Byrne & Fielding-Barnsley, 1993, 1995; Wagner, Torgesen, Laughon, Simmons, & Rashotte, 1993), as well as in individuals with learning disabilities (O'Connor, Jenkins, Leicester, & Slocum, 1993; O'Connor, Notari-Syverson, & Vadasy, 1996, 1998), specific language impairment (Gillon, 2000, 2002), and mental retardation (Boyle & Walker-Seibert, 1997; Celek, Pershey, & Fox, 2002; Hoogeveen & Smeets, 1988; Hoogeveen, Smeets, & Lancioni, 1989; O'Connor et al., 1996).

Children with reading difficulties, whether diagnosed with a specific learning disability or simply labeled as poor readers by their teachers, have consistently demonstrated PS levels below

those of their same-age peers (Fox & Routh, 1980; Lundberg & Hoien, 1990; Shaywitz, 2003; Stanovich, 1986b). Stanovich (1986a) analyzed the empirical evidence regarding the cognitive processes most linked to reading disabilities. He identified phonological processing as the strongest contributor to reading ability and labeled two distinct subskills of critical importance: (a) ability to discriminate letters, and (b) phonemic awareness skills. "Children must at some point acquire skill at breaking the spelling-to-sound code" (p. 74). Therefore, for children to become readers, they must be aware of the phoneme as the basic unit of speech and be able to match letters and letter sequences to those speech sounds (Rack, 1985; Shaywitz, 2003). This ability is referred to as the alphabetic principal (Adams, 1990) and given the correlation between alphabetic principle and reading acquisition, and the contribution of phonemic awareness to development of the alphabetic principle, it is critical that more precise terminology be used to describe phoneme-level skills.

Factors Affecting the Difficulty of Phonological Sensitivity Skills

A wide variety of tasks have been used to measure PS skills in published research. Only recently have efforts been made to provide an underlying structure to PS by ordering skills along a developmental continuum (Adams, 1990; Anthony et al., 2003). The difficulty level of the skill influences the developmental sequence of PS skills. For example, segmenting a sentence into words is easier than segmenting a word into phonemes.

Vandervelden and Siegel (1995) suggested a comprehensive set of factors that affect the difficulty of PS tasks. The first factor is related to the type and quantity of cognitive processes required to complete a task. Although evidence suggests PS is independent of other abilities, such as expressive language and intelligence (Stanovich, Cunningham, & Feeman, 1984; Wagner & Torgesen, 1987), the format of the task used to measure the PS skill may confound the results. For example, the rhyme oddity task requires a child to hold four words in memory while determining which word does not rhyme with the other three words. This task may place excessive demand on short-term memory (Wagner & Torgesen, 1987), thereby confounding the measurement of rhyming skill with short-term memory.

The second factor suggested by Vandervelden and Siegel (1995) was speech perception versus speech production. PS skills that address perception of sounds (e.g., "Do *dog* and *deer* begin with the same sound?") are easier than skills that require production of sounds (e.g., "Say the beginning sound of *dog*."). The third factor was called the "completeness dimension" in relation to blending and segmenting skills. PS skills that require partial blending (e.g., */b/ /at/* = *bat*) or partial segmenting (e.g., *bat* = */b/ /at/*) are easier than those that require complete blending (e.g., */b/ /a/ /t/* = *bat*) or complete segmenting (e.g., *bat* = */b/ /a/ /t/*). The final factor was related to the position of the target phoneme within a word, with initial phonemes being easier to identify and manipulate than final phonemes.

Vandervelden and Siegel (1995) validated their dimensions of difficulty by administering six phonemic awareness tasks to children in kindergarten, first, and second grade. There was a consistent hierarchy of difficulty among the six tasks. The easier tasks were those that required a single cognitive process and speech perception rather than speech production. The task that targeted initial phonemes was easier than the task that targeted final phonemes. The most difficult tasks required multiple cognitive processes, complete segmentation, and speech production (see Table 1 for a complete list of the tasks rank ordered by difficulty).

More recently, Anthony and colleagues (2003; Anthony, Lonigan, Burgess, Driscoll, Phillips, & Cantor, 2002) supported the theory that PS skills are developmental in nature and emerge along a continuum of difficulty. Their research provides evidence that not only are PS skills ordered by difficulty, but also within each skill the difficulty is affected by the linguistic complexity of the target stimuli. For example, it is easier to isolate the initial sound of a word beginning with a single consonant (e.g., *sip*) than a word beginning with a consonant cluster (e.g., *strip*).

Table 1
Studies That Explored Difficulty Levels of Phonological Sensitivity Skills

Study	*N*	Age	Skills Ranked from Easier to More Difficult (Spoken Directions Provided to Participants)
Fox & Routh (1975)	10 10 10 10 10	3 years 4 years 5 years 6 years 7 years	• *Sentence segmentation* ("I am going to say something to you and I want you to say just a little bit of it. For example, if I say 'Peter jumps,' you would say 'Peter.' Now, let's try it. I'll say 'Peter jumps.'") • *Syllable segmentation* ("I'm going to say something and I want you to say just a little bit of it. For example, if I say 'Peter,' you would say 'Pete.'") • *Phoneme segmentation* ("I am going to say something to you and I want you to say just a little bit of what I say. For example, if I say 'Pete,' you would say 'Pe.'")
Goldstein (1976)	23	4 years	• *Syllable blending* (If examiner said "/*kan*/ /*ga*/ /*roo*/," participant was supposed to say *kangaroo*.) • *Syllable segmentation* (If examiner said *kangaroo*, participant was supposed to say /*kan*/ /*ga*/ /*roo*/.) • *Phoneme blending* ("What word do you get when you say together /*n*/ /ī/ / *f* /?") • *Phoneme segmentation* ("Here's a picture of a *knife*. What is it? Now you say *knife* funny just like we've been doing.")
Helfgott (1976)	103	K	• *Partial blending CV-C* (no directions available) • *Partial blending C-VC* • *Partial segmentation C-VC* • *Partial segmentation CV-C* • *Phoneme blending of CVC words* • *Phoneme segmentation of CVC words*
Lewkowicz & Low (1979)	137	K	• *Partial phoneme segmentation* (VC & CV) (no directions available) • *Phoneme segmentation* (CVC)
Liberman, Shankweiler, Fischer, & Carter (1974)	46 49 40	Pre K 1st grade	• *Syllable segmentation* (no directions available) • *Phoneme segmentation*
Rosner & Simon (1971)	284	K–6th grade	• *Deletion of final syllable from two-syllable word* ("Say *birthday*. Now say it again, but without the /*day*/.") • *Deletion of initial syllable from two-syllable word* ("Say *toothbrush*. Now say it again, but without the *tooth*.") • *Deletion of final consonant from one-syllable word* ("Say *time*. Now say it again, but without the /*m*/.") • *Deletion of initial consonant from one-syllable word* ("Say *man*. Now say it again, but without the /*m*/.") • *Deletion of first consonant from consonant blend* ("Say *block*. Now say it again, but without the /*b*/.") • *Deletion of medial consonant from one-syllable word* ("Say *smell*. Now say it again, but without the /*m*/.") • *Deletion of medial syllable from multisyllabic word* ("Say *carpenter*. Now say it again, but without the /*pen*/.")
Seymour & Evans (1994)	20 28 32	4 years 5 years 6 years	4-year-olds • *Partial blending* ("I'm going to say a word in a very strange way. I'm going to say it in three parts. It will sound like a robot who can't speak properly. I want you to guess the word the robot is really trying to say.")

(Continued)

Table 1
Continued

Study	*N*	Age	Skills Ranked from Easier to More Difficult (Spoken Directions Provided to Participants)
			• *Phoneme blending* (". . . say it in many parts.") • *Onset-rime blending* (". . . say it in two parts.") • All three segmentation tasks 5-year-olds • *Partial blending* • *Onset-rime blending* • *Phoneme blending* • *Phoneme segmentation* ("This time you will be the robot. I will say a word properly and you say it the way the robot would if he could speak in only many parts.") • *Partial segmentation* (". . . speak in only three parts.") 6-year-olds • *Onset-rime blending* and *partial blending* • *Phoneme blending* • *Phoneme segmentation* • *Onset-rime segmentation* (". . . speak in only two parts.") • *Partial segmentation*
Skjelfjord (1976)	24	Pre	• *Initial phoneme isolation-vowels* (no directions available) • *Initial phoneme isolation-continuant consonants* (e.g., */m/*) • *Initial phoneme isolation-stop consonants* (e.g., */t/*) • *Final phoneme isolation* • *Medial phoneme isolation*
Stahl & Murray (1994)	52 61	K 1st grade	• *Phoneme isolation-initial* (no directions available) • *Phoneme isolation-final* • *Phoneme blending CVC* • *Phoneme deletion-initial* • *Phoneme segmentation CVC* • *Phoneme deletion-final*
Stanovich, Cunningham, & Cramer (1984)	49	K	• *Rhyme creation* ("If I say the word *go*, and then change the first sound by changing it to */n/* the new word will be *no*. Now you try it. Change the first sound in *hang*.") • *Rhyme production* ("I will say a word and you tell me another word that rhymes with it.") • *Rhyme recognition* ("Listen to the word *pet*. Now say the word *pet*. Tell me which of these three words rhymes with *pet—barn*, *net*, *hand*.") • *Word matching: Initial consonant same* ("Listen to the beginning sound in *fan*. Now say *fan*. Tell me which of these three words has the same beginning sound as *fan—sick*, *fed*, *gum*.") • *Word matching: Initial consonant different* ("Say the words *bag*, *nine*, *beach*, and *bike*. Tell me which of these words has a different beginning sound—*bag*, *nine*, *beach*, *bike*.") • *Word matching: Initial consonant not same* ("Say the word *mud*. Now say the words *mice*, *dig*, and *mouth*. Tell me which word did not have the same beginning sound as *mud*.") • *Word matching: Identification of deleted phoneme* ("Say the word *cat*. Now say *at*. What sound do you hear in *cat* that is missing from *at*?")

(Continued)

Table 1
Continued

Study	*N*	Age	Skills Ranked from Easier to More Difficult (Spoken Directions Provided to Participants)
			• *Word matching: Final consonant same* ("Say the word *meat* and listen to the ending sound. If I say the word *meat* and then *fin*, *coat*, *glass*, which word has the same ending sound as *meat*?") • *Word matching: Final consonant different* ("Listen to these four words—*rat*, *dime*, *boat*, *mitt*. Say these words out loud. One of them has a different ending sound. Tell me which word has a different sound at the end of the word.") • *Initial phoneme deletion* ("Listen to the word *task*. If you take away the /t/ sound, what word is left?")
Vandervelden & Siegel (1995)	36 36 36	K 1st grade 2nd grade	• *Initial phoneme recognition* ("Listen for /s/. *Soup*. Does *soup* have a /s/?") • *Final phoneme recognition* ("Listen for /s/. *Miss*. Does *miss* have a /s/?") • *Phoneme location* ("/s/, *sun*. First or last?") • *Phoneme recognition/location identification* ("/s/, *neck*. First, last, or no?") • *Phoneme segmentation* ("Say *puck*. Now say it again slowly so that I can hear all the sounds.") • *Phoneme deletion and substitution* ("Say *bat*. Now say it again but don't say /b/. Say *sad*. Now say it again, but instead of /s/ say /m/.")
Yopp (1988)	104	K	• *Rhyme detection* ("Tell me yes if these two words rhyme and no if they do not rhyme. Listen. *Cat*, *hat*.") • *Phoneme blending* ("Tell me what word we would have if these sounds were put together /c/ /a/ /t/.") • *Word matching: Initial consonant same* ("I'm going to say two words, and you tell me if they start with the same sound—*big*, *baby*.") • *Word matching: Final consonant same* (no directions available) • *Word matching: Vowel same* (no directions available) • *Initial phoneme isolation* ("I'm going to say a word and you tell me what sound it starts with.") • *Final phoneme isolation* (no directions available) • *Medial phoneme isolation* (no directions available) • *Phoneme counting* (no directions available) • *Phoneme segmentation* ("Here's a picture of *dog*. What is it? You say *dog* the funny way just like we've been practicing.") • *Deletion tasks* ("What word would be left if /t/ were taken away from the middle of *stand*? Say *sunshine*. Now say *sunshine* but don't say *shine*.")

N = number of participants; K = kindergarten; Pre = preschool; C = consonant; V = vowel.

Developmental Continuum of Phonological Sensitivity

To create a comprehensive developmental hierarchy of PS skills, studies were identified that explicitly examined the developmental progression of PS skills among typically developing children. Direct comparison of these studies was not possible due to the variety of age groups, PS skills assessed, research designs, methodologies, and tasks used to measure PS skills, but the evidence supports the notion of a general developmental hierarchy among PS skills based on difficulty level. Table 1 provides a summary of these studies. With few exceptions, the empirical evidence supports Vandervelden and Siegel's (1995) suggested factors that affect the difficulty of PS skills.

Fox and Routh (1975) assessed the ability of 3- to 7-year-olds to segment sentences into words, words into syllables, and syllables into sounds. All age groups were able to segment sentences into

words, and most of the 3-year-olds could segment words into subunits, although not necessarily at syllable boundaries. Children ages 5 to 7 performed near ceiling level on these two tasks. Segmentation of syllables into phonemes was the most difficult task for all age groups. The 3-year-olds could only segment about 25% of the syllables correctly, whereas the 6- to 7-year-old children segmented more than 85% correctly. There was a marked increase in the ability to segment syllables into phonemes between the ages of 3 and 6 that leveled off between 6 and 7. Goldstein (1976) obtained similar results when assessing 4-year-olds on their ability to segment and blend both syllables and phonemes. The children's performance with the syllables was superior to that of the phonemes. Results also indicated that segmentation and blending were easier with two-phoneme words than with three-phoneme words and that blending was easier than segmentation.

Helfgott (1976) examined phonemic awareness skills in relation to word structure among kindergartners. Phoneme blending was compared to phoneme segmentation of CVC (consonant-vowel-consonant) words. Helfgott determined that blending was easier than segmentation and that partial segmentation and blending were easier than complete segmentation and blending. Lewkowicz and Low (1979) also assessed the phonemic awareness abilities of kindergartners, examining segmentation abilities based on word structure. They first trained and then tested two groups of kindergartners on segmentation of either CV or VC words. Children who performed well on the prerequisite test were then assessed on segmentation of CVC words. The results yielded no significant difference in difficulty between CV and VC words, and the authors concluded segmentation of two- and three-phoneme words is within the ability of kindergartners.

Liberman, Shankweiler, Fischer, and Carter (1974) examined the relative difficulty of syllable segmentation compared to phoneme segmentation among children in preschool, kindergarten, and first grade. As expected, syllable segmentation was easier. In fact, none of the children in preschool could segment by phonemes while nearly half (46%) could segment by syllables. Among the kindergartners, only 17% could segment by phonemes, whereas 48% could segment by syllables. Accurate performance increased dramatically in first grade, with 70% successfully segmenting by phonemes and 90% by syllables. This was one of the first studies to empirically demonstrate syllable-level segmentation is easier than phoneme-level segmentation and suggested beginning reading instruction likely contributes to the development of phonemic awareness.

Rosner and Simon (1971) conducted one of the earliest studies examining the relative difficulty of PS skills, but focused only on deletion skills. Among children in kindergarten through sixth grade, the difficulty of various syllable and phoneme deletion tasks was examined. Performance on all tasks increased progressively across grade levels, with the largest increase occurring from kindergarten to first grade. This dramatic increase, which occurred for all seven tasks, caused the authors to suggest that reading instruction may improve deletion abilities or at least the two may have a reciprocal relationship.

Seymour and Evans (1994) explored three different levels of both blending and segmentation skills among 4-, 5-, and 6-year-olds. The children were required to blend and segment monosyllabic CVCC and CCVC words at three levels: onset-rime, initial sound-vowel-final sound, and all four sounds. Results indicated blending was easier than segmenting for all three age groups. Although neither the 4-year-olds nor the 5-year-olds demonstrated success with any of the segmentation tasks, the 6-year-olds performed better on the task requiring full, sequential phoneme segmentation than on the two tasks requiring partial segmentation. This result directly contradicts previous findings (Helfgott, 1976; Lewkowicz & Low, 1979). Seymour and Evans suggested these results indicated (a) the ability to segment at the onset-rime level does not emerge naturally (i.e., without instruction), as suggested by Goswami and Bryant (1990); and (b) reading instruction contributes to the ability to segment by phonemes.

More recently, Stahl and Murray (1994) examined the relative difficulty of four phonemic awareness tasks across four levels of linguistic complexity among kindergartners and first graders. Their results, which did not differentiate between kindergartners and first graders, revealed that phoneme isolation of the initial consonant of CVC words was easier than isolation of the final consonant. They found that phoneme isolation was easier than phoneme blending, and phoneme deletion was easier than phoneme segmentation.

Stanovich, Cunningham, and Cramer (1984) conducted one of the first studies to examine the relative difficulty of both phonological and phonemic awareness tasks. They found rhyming tasks were easier than all phonemic awareness tasks for kindergarten students. Among the phonemic awareness tasks, those that required manipulation of the initial consonant were easier than tasks that required manipulation of the final consonant. The most difficult phonemic awareness task required the children to delete the initial sound of an orally presented word and pronounce the remaining, embedded word. This deletion task required multiple cognitive processes, production of sounds, and partial segmentation, making it a relatively difficult task according to Vandervelden and Siegel's (1995) factors of difficulty.

Yopp (1988) examined the reliability and validity of measures of PS and produced a hierarchical ranking of seven skills based on the performance of kindergartners on the assessment tasks. Rhyme detection was the easiest task followed by phoneme blending, although the phoneme blending score consisted of both partial (e.g., /*f*/ /*at*/) and complete (e.g., /*c*/ /*a*/ /*t*/) items. The hierarchy of the remaining tasks can be seen in Table 1. Deletion was the most difficult task. Unfortunately, the score for the deletion task was confounded by including deletion of one word from compound words; deletion of syllables; and deletion of target phonemes in initial, final, and medial positions of monosyllabic words. Therefore, the score for the deletion task reflected the participants' skill in both phonological and phonemic awareness.

To date, there is little disagreement regarding the general developmental progression of PS among typically developing children. Prior to formal instruction in reading, most children develop an awareness of words as discrete units of speech, then an awareness of syllables as units of words, and finally, an awareness of onsets and rimes (Goswami & Bryant, 1990). It is typically not until after some period of formal reading instruction that children develop an awareness that words are made up of individual phonemes.

The evidence regarding the relative difficulty of PS skills may be used to examine the suggested bidirectionality of the causal correlation with reading (e.g., Bentin & Leshem, 1993; Stanovich, 1986b). The uncertainty over the direction of the causal correlation may be a result of the type(s) of PS skills assessed and/or the age of the study participants. Because PS skills fall along a continuum of difficulty, as one moves along the continuum, the task requirements become increasingly more difficult. Therefore, the causal correlation between PS skills and reading may change, depending on the level of phonological sensitivity skill that is required (Stahl & Murray, 1994). Ball (1993b) suggested the PS abilities represented by the tasks at the lower end of the continuum "may be prerequisite, but not sufficient, to reading" (p. 146). In addition, those skills at the upper end of the continuum may not be prerequisite to reading, but rather a result of learning to read and spell. An additional explanation may be that the early development of PS is not necessarily a prerequisite to reading acquisition, but a "powerful bootstrapping mechanism" to the reading acquisition process (Stanovich, 1986b).

Measurement of Phonological Sensitivity

PS is composed of a heterogeneous set of skills involving several levels of linguistic units (i.e., words, syllables, onsets, rimes, consonant clusters, phonemes). To date, there has been some

debate regarding the number of phonological processes, or constructs, encompassed by the range of PS skills. For example, Stanovich, Cunningham, and Cramer (1984) assessed 10 PS skills among kindergartners and then assessed their reading ability 1 year later. Except for the three rhyming skills, all skills had a strong correlation with the reading measure. Through factor analysis, they found that all skills appeared to measure the same construct. This result laid the foundation for the notion that a common construct underlies the range of PS skills.

In contrast, some studies (Hoien, Lundberg, Stanovich, & Bjaalid, 1995; Yopp, 1988) identified two or more constructs encompassed by a range of PS skills. Yopp also assessed 10 PS skills among kindergarten students, and then tested the same students on reading ability when they were in first grade. The PS measures correlated highly with one another and had moderate to high correlations with the reading measure. A factor analysis revealed a dichotomy among the phonemic awareness skills with divergent loading on two separate factors. Phoneme blending, phoneme segmentation, phoneme counting, and phoneme isolation all appeared to measure one construct, whereas phoneme deletion and word-to-word matching seemed to measure another.

Stahl and Murray (1994) took exception with Yopp's (1988) theory of multiple constructs. They suggested that linguistic complexity within measures of PS skills may confound scores. They conducted a post hoc analysis of Yopp's data, assigning a linguistic complexity weight to each item within a task and then averaging those weights to develop an overall difficulty rating for each task. They then correlated the difficulty rating with the reported scores and found a correlation of $r = 0.95$, suggesting that linguistic complexity of items used to measure PS may have confounded the scores.

Anthony et al. (2002) compared preschoolers' performance on a variety of PS tasks to early reading skills. They concluded that a single construct encompasses all PS skills, children acquire proficiency at PS skills along a developmental continuum, and measurement of PS among children used to predict later reading achievement should encompass a range of PS tasks across the continuum. Their conclusion addresses many of the discrepant results across research examining the developmental hierarchy of PS:

> What is most important, therefore, is that the assessment tool or tools be developmentally appropriate for any given child. The obvious implication is that children's phonological sensitivity would be indexed best by performance on multiple measures of phonological sensitivity that span the task demands and levels of linguistic complexity that have not yet been completely mastered to those that have recently emerged. Unfortunately, many assessment batteries used in studies of children's phonological processing skills have not incorporated this developmental perspective through inclusion of items that vary in task demands and linguistic complexity such that they span the entire ability distribution. (p. 88)

This evidence further demonstrates that PS represents a continuum of increasing awareness of progressively smaller units of spoken language with phonological awareness skills developing prior to phonemic awareness skills.

Educational Implications

There is no doubt that the acquisition of PS skills contributes to later achievement in reading and spelling. By gaining a better understanding of the developmental nature of PS, practitioners can improve the measurement of such skills among children to better target both instruction and remediation efforts. In these times of limited resources compounded by increased urgency to reduce reading failure, it is imperative that children who may be at risk for reading difficulties be identified as early as possible. With early identification, more time will be permitted for remediation and limited resources can be targeted toward children who need them most (Lonigan, 2006). The goal of assessing PS skills among young children is to identify those at risk before they fail in order to focus on prevention of reading difficulties rather than the more costly remediation of reading problems as they get older.

Table 2
Phonological Sensitivity Skills in Developmental Sequence

Skill	Example
Phonological Awareness	
Rhyme detection	"Does *dog* rhyme with *log*?"
Rhyme creation	"Change the first sound in *dog* to make a word that rhymes with *dog*."
Rhyme production	"Tell me a word that rhymes with *dog*."
Rhyme recognition	"Which word rhymes with *dog*? *Cup-sit-log*."
Rhyme oddity[a]	"Which word does not rhyme with the other words: *fan-cat-mat-hat*."
Syllable blending	"What word is this? Listen. /*ta*/ /*ble*/."
Sentence segmentation	"Tell me how many words you hear in this sentence. Listen. *The boy has a blue hat*."
Syllable segmentation	"Count the syllables in this word. Listen. *Elephant*."
Syllable deletion-compound word	"Listen. *Cowboy.* Say *cowboy.* Take away *cow*. What word is left?"
Syllable deletion-multisyllabic word	"Listen. *Carpenter*. Say *carpenter*. Say it again without *car*."
Phonemic Awareness	
Phoneme blending	"What word is this? /*b*/ /*a*/ /*t*/."
Sound-to-word matching	
Initial phoneme recognition	"Does *fat* start with /*f*/?"
Final phoneme recognition	"Does *miss* end with /*s*/?"
Phoneme location	"Listen for /s/. *Sun*. Is /*s*/ the beginning or ending sound?"
Phoneme recognition and location	"Listen. /*s*/, *neck*. First, last, or no?"
Word-to-word matching	
Initial consonant same	"Does *dog* start with the same sound as *deer*?"
Initial consonant different	"Listen. *Dog*. Which word has a different beginning sound from *dog*? *Deer – top – down*."
Identification of deleted phoneme	"Say *card*. Say *car*. What sound is missing from *car* that you hear in *card*?"
Final consonant same	"Does *dog* have the same ending sound as *hug*?"
Final consonant different	"Listen. *Dog*. Which word has a different ending sound from *dog*? *Hug – leg – sit*."
Phoneme isolation	
Initial phoneme isolation	"What is the beginning sound in *dog*?"
Final phoneme isolation	"What is the ending sound in *dog*?"
Medial phoneme isolation	"What is the middle sound in *sheep*?"
Phoneme counting	"How many sounds do you hear in the word *dish*?"
Phoneme segmentation	"Say *man* one sound at a time."
Phoneme deletion	
Final phoneme deletion	"Listen. *Train*. Say *train*. Now say it without the /*n*/."
Initial phoneme deletion	"Listen. *Meat*. Say *meat*. Now say it without the /*m*/."
Delete first consonant of a blend	"Listen. *Tray*. Say *tray*. Take away /*t*/. What word is left?"
Medial phoneme deletion	"Listen. *Sleep*. Say *sleep*. Take away /*l*/. What word is left?"
Phoneme substitution	"Say *sad*. Now say it again, but instead of /*s*/ say /*m*/."
Phoneme reversal	"Listen. *So*. Say *so*. Now change the /*s*/ and the /*ō*/ around."

[a]The rhyme oddity task was not included in studies that explored the relative difficulty of PS skills, but was included here because it is frequently used for both assessing and training rhyming skills among young children. It was inserted in this hierarchy in a logical location based on the factors of difficulty described by Vandervelden and Siegel (1995).

The inconsistent use of terms related to PS in both research and commercially available assessment and intervention materials has likely led to confusion among educators attempting to implement scientifically based practices. It is imperative that practitioners understand the developmental sequence of PS and its contribution to later literacy acquisition. Practitioners must be cautious

consumers of materials targeted for early literacy instruction and must be aware of what skills they are teaching or assessing and why.

In an effort to assist practitioners in translating research to practice, Table 2 contains a compilation of PS skills ranked according to relative difficulty based on published evidence. Although children are different and may demonstrate variations in the order of acquisition of PS skills, Table 2 provides a general developmental hierarchy. It is important to keep in mind that evidence suggests children acquire PS skills in overlapping stages rather than as discrete skills (Anthony et al., 2003). Therefore, both assessment and intervention of PS should encompass groups of skills rather than individual skills taught to mastery. In addition, the acquisition of PS is likely affected by instruction in early reading and spelling skills. Hence, the skills listed in Table 2 cannot be applied universally to all children in a lock-step fashion. Educators must use assessment outcomes to design intervention appropriate to children's individualized areas of need.

Professionals must also be cautious about the linguistic structure of the stimuli used within PS tasks because this can greatly increase or decrease the difficulty level of tasks. Commercially available assessment tools may include wide variation among linguistic complexity of the stimuli used within a single assessment task, which may confound a student's performance. For example, when assessing the ability of a kindergarten student to count phonemes, the student is likely to perform better when all target words consist of two or three phonemes with a CVC structure (e.g., cat, toe, log, book, up). Whereas the same student may perform poorly when presented with target words composed of four or more phonemes that also include consonant clusters (e.g., broom, paste, clock, sand, black). Lack of attention to the linguistic structure of assessment stimuli may lead to misdiagnosing children as either having mastered a skill or as needing remediation.

The most important educational implication derived from the body of research reviewed here is that children should be taught PS skills sequentially beginning with word-level skills, moving on to syllable-level skills, and then to phoneme-level skills. Yet, research suggests that PS instruction does not need to be provided in a lock-step fashion and individual skills do not need to be taught to mastery (Anthony et al., 2003) before introducing a developmentally more complex skill. The importance is in helping children initially understand that spoken language can be broken into parts, recognizing similarities and differences in those parts, and then manipulating those parts before teaching children to hear and manipulate individual sounds in words. In general, children must acquire the lower-level phonological awareness skills before they will be successful with higher-level phonemic awareness skills. In addition, within each unit of analysis (e.g., word, syllable), children are generally able to recognize phonological information before they can manipulate it, blend phonological information before they can segment it, and manipulate initial sounds before final sounds.

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