# Toward a Common Terminology for Talking About Speech and Reading: A Glossary of the "Phon" Words and Some Related Terms

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*Many phonological terms are found in the contemporary literature on reading, and some inconsistencies and disagreements are apparent in how they are used and understood. To clarify the meanings of these words in current usage, and thereby to facilitate communication in the field of literacy, a thematically organized glossary of these terms and related words is provided.*

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Pick up a recent article on reading and you are very likely to encounter terms like *phonological, phoneme, phonological awareness, phonemic awareness, phoneme discrimination, phoneme identification, phonological processing, phonological decoding, phoneme- grapheme correspondences, phonological dyslexia, phonics,* or other *phon* words. The meanings of these many terms have much in common, but in no case are they identical. Some refer to constructs related to oral language and some to processes or practices specifically related to reading and writing. Some are terms for basic language processes and others for the ability to reflect on those processes. Some have their origins in linguistics, some in speech-language pathology, some in education, and some in psychological research on language and reading.

As arguments and evidence both for and against phonological accounts of reading have proliferated, it is essential that anyone seeking to read or contribute to this literature be conversant with phonological terms and their meanings. Increasingly, however, we have noticed that such terms are being used inconsistently, imprecisely, and sometimes just wrongly by researchers and practitioners of all theoretical persuasions. This confusion is not really so surprising, for a variety of reasons. The field of reading is broadly interdisciplinary, and the degree of linguistic training that one receives can vary greatly across disciplines and graduate programs. There also have been historical shifts in how phonological constructs are understood and how they may relate to reading, and the usage of some terms has changed somewhat as a consequence. In addition, many authors (ourselves included) have sometimes neglected to provide precise definitions when using phonological terms, leaving it up to the reader to infer how these words are meant to be construed in interpreting a paper's methods, findings, and conclusions. It is unfortunate that a lack of clarity about phonological terms, much of it unnecessary, has impeded communication in the field of reading.

Our goal in providing this glossary is to define the *phon* words and some related terms. The definitions herein are ones that we think are most widely used by contemporary literacy scholars and researchers from the fields of linguistics, psychology, speech pathology, and education. In certain instances, we trace the origins of current usage and point out important distinctions among similar terms. We also direct the reader to sources that contain more extended discussion of issues and controversies that we mention only briefly in this paper. It is our hope that this glossary will reduce some of the variability and imprecision in the use of key terms and thereby facilitate communication in the literacy community.

In preparing the glossary, we asked 18 experts to serve as consultants by reviewing the definitions for accuracy and objectivity. These individuals were selected not just

**Table 1.** Consultants on the Consensus Meanings of Terms

| Name | Affiliation |
|---|---|
| Hugh W. Catts | Department of Speech-Language-Hearing, University of Kansas |
| Linnea C. Ehri | Department of Educational Psychology, City University of New York |
| Mary Farrell | Learning Disabilities Program, Fairleigh Dickinson University |
| Louis Goldstein | Department of Linguistics, Yale University |
| Franklin R. Manis | Department of Psychology, University of Southern California |
| Cathy Roller | International Reading Association |
| Lawrence D. Shriberg | Phonology Project and Clinic, University of Wisconsin – Madison |
| Linda S. Siegel | Department of Educational Psychology and Special Education, University of British Columbia |
| Carol Stoel-Gammon | Department of Speech and Hearing Sciences, University of Washington |
| Joseph K. Torgesen | Department of Psychology, Florida State University |

*Note: Listed alphabetically.*

because of their familiarity with phonological issues, but also because they represent a diverse set of relevant disciplines (linguistics, speech/ language sciences, psychology, and education) and a variety of specialties within those fields. The 10 who consented to take on the task are listed in Table 1, and their comments and suggestions have been incorporated into the final version of this paper. There was remarkably strong consensus among these experts about how the terms in the glossary are currently defined and used. The few disagreements that arose mainly concerned differences among academic disciplines in how particular words are used; these distinctions are discussed in the definitions of those words in the glossary.

Terminology continually evolves as a natural part and consequence of academic discourse. Indeed, as noted in our definitions, phonological terms have occasionally undergone changes in meaning in the past. New meanings for a few terms have recently emerged, possibly signaling a coming shift in how those words will be construed in the future. For the most part, however, phonological terms are quite technical, precise, and fundamental (akin to words like *molecule* in chemistry and *iambic* in poetry), so there tends to be much less flexibility in their meaning and usage than one encounters for other terms in the literacy field (such as, say, *comprehension*). In light of this, it is not surprising that a close consensus was reached by our consultants. Even so, we want to make clear that our goal is not to dictate how phonological terms must be defined and used, but rather to provide a coherent and useful account of how most scholars currently use them for talking about oral language and literacy. In this regard, it is important to note that the definitions pertain to the English language, and do not necessarily apply to other languages.

Figure 1 provides an overview of the glossary's contents, which are organized into four main parts, the first three pertaining to oral language and the last to written language. In each section, we discuss the use of *phon* words and related terms for talking about different matters: speaking and listening (Part 1), metalinguistic skills (Part 2), phonological memory and naming (Part 3), and reading and writing (Part 4).

The glossary items are hierarchically numbered and printed in a sans serif font. Within the definitions of numbered terms, some other words that may be unfamiliar to some readers are also briefly explained. Italics are used for such terms and also for words that serve as examples to illustrate particular ideas; in some cases, the spoken forms of these exemplars are specified in standard phonemic notation (e.g., /tru/; see section 1.12) or their spellings are indicated by letter-by-letter hyphenation (e.g., t-r-u-e). As an aid to readers, an alphabetized appendix lists all terms and the location in the glossary where they are presented.

**Figure 1:** Overview of the Glossary

**Terms Pertaining to Oral Language**

**Part 1. Speaking and Listening**

**Phonological Units and Structures (1.1)**
- phonology
- phonemes
- phones
- rhyming words
- syllable
- onset and rime
- subsyllabic
- segment
- phonological representation, code

**Phonological Skills and Disorders (1.2)**
- speech perception
- phoneme discrimination, speech discrimination
- auditory discrimination
- phoneme identification
- categorical perception
- Central Auditory Processing Disorder (CAPD)
- articulation errors, phonological errors
- phonological processes
- phonological disorders

**Part 2. Metalinguistic Awareness of Phonological Elements (2.1-2.2)**
- phonological awareness
- phonemic awareness
- phonological sensitivity
- metaphonological tasks:
  - rhyming
  - segmentation/analysis
  - categorization
  - identity
  - synthesis/blending
  - manipulation

**Part 3. Phonological Memory and Naming Skills (3.1-3.2)**
- phonological processing
- phonological memory:
  - memory span
  - pseudoword repetition
- naming skills:
  - confrontation naming
  - rapid serial naming

**Terms Pertaining to Written Language (Part 4)**

**Phonological Aspects of Word Recognition and Spelling (4.1)**
- graphemes
- orthography
- alphabetic principle
- phoneme-grapheme correspondences
- regularity
- decoding, phonological recoding
- dual route theories
- automaticity

**Phonological Terms Pertaining to Reading Instruction (4.2)**
- phonological/phonemic awareness training
- phonics
- code-emphasis, code-based instruction
- phonogram
- decodable text
- invented spelling

**Phonological Aspects of Reading Disability (Dyslexia) (4.3)**
- phonological deficit hyphothesis
- double deficit hypothesis
- auditory temporal processing hypothesis
- dysphonetic subtype of dyslexia
- phonological alexia

# Part 1. *Phon* Terms for Talking About Speaking and Listening

## 1.1 Phonological Units and Structures

In the study of linguistics, psycholinguistics, and speech-language disorders, it is customary to divide the language faculty into several major domains. *Syntax* is the domain that governs the systematic structural (grammatical) relations among words, phrases, and sentences. *Morphology* pertains to the construction of words from affixes, roots, and suffixes (called *morphemes*). *Semantics* concerns the meanings of words (which are stored in a mental *lexicon*) and of combinations of words in phrases, sentences, and longer passages. *Pragmatics*, which refers to the usage of language for various purposes (communicative and otherwise), is also sometimes considered a domain. Of most relevance to this glossary is:

**1.11 Phonology.** The domain of language that pertains to the elements of speech and the systems that govern the structural relationships among these elements within and across words. "Elements of speech" refers to both abstract mental representations and their actual spoken output, as discussed below. The term phonology is also used to refer to the branch of linguistics that studies this domain.

Why would an oral language term be of importance for discussing literacy? What sense does it make to talk about phonological aspects of reading and writing? The basic assumption here is that there is a close link between oral and written forms of a language, not just for the phonological domain but for others as well. This notion is captured in virtually all theoretical accounts of literacy development and is embodied in many approaches to literacy instruction. The connection is also made in the minds of young students who are trying to align the two systems as they build on their oral language skills to learn to read and write. Educators who are knowledgeable about, and attuned to, the oral phonological capabilities of their students are thus in a better position to help them in becoming successful readers and writers.

The phonological system itself has several components. Here, we are chiefly concerned with the one that describes and governs the internal phonological structure of words. Several levels of structure can be differentiated, including those listed in this section of the glossary. Knowing these terms is important because they describe the phonological units that have been studied most often in research on literacy and are the focus of many instructional activities.

**1.12 Phonemes.** The smallest units into which speech can be divided, and that make a difference to the meaning of a word. For example, the spoken words *miss* and *mist* differ because the latter contains an additional phoneme; *bird* differs from *word* because the first phoneme is different in each; the order of the last two phonemes of *clasp* is reversed in the word *claps*. (Regarding slight phonological differences that do *not* affect meaning, see 1.13 below).

Very few English words are composed of a single phoneme (e.g., a, I, eye, aye, oh). Most are combinations from a set of approximately four dozen phonemes. The exact number depends on the speaker's dialect. For a description of the phonemes of American English, and of the articulatory and acoustic dimensions that differentiate them, see Catford (1988), Johnson (1997), and Ladefoged (2000).

By convention, in phonemic transcription slashes are used to enclose the series of symbols that represent the phonemes. Those symbols are drawn from the

International Phonetic Alphabet (IPA). In IPA notation, most English consonants are represented by a letter that is closely associated with that phoneme in written language. For the rest of the consonants, and most vowels, other symbols are used, the most familiar of which is schwa (ə). For example, *rose* is transcribed as /roz/, *tax* as /tæks/, and *lemon* as /lɛmən/. When necessary, a finer-grained method of transcription can be used (see 1.13 below). Using a specialized notation is helpful for marking distinctions between the sounds and spellings of words. Although primarily a linguistic convention, IPA or another such notation is sometimes used in the classroom for pointing out these connections to students.

Technically, a phoneme is not a speech sound but is a more abstract concept: the speaker's internalized representation of a single speech sound. Hence, our introspections about what happens during listening and speaking do not entirely coincide with what research has revealed about these processes. When a word is spoken, its phonemes are not said separately like beads on a string, but instead are *co-articulated*. For example, consider the position of the lips when one produces the /s/ in *so* versus *see*; in each case, the articulation of /s/ is influenced by the following vowel. Similarly, at any point during a spoken syllable, information about several or all of its phonemes is simultaneously conveyed by the acoustic signal. It is thus impossible to cut up a tape-recording of a spoken word into individual pieces, one for each phoneme of the word. When perceiving speech, however, listeners are usually oblivious to this well-established parallel transmission of phonological information, instead believing that there was an actual sequence of individual speech sounds. For a fuller discussion of this interesting and counter-intuitive phenomenon, see Liberman, Cooper, Shankweiler and Studdert-Kennedy (1967) or Miller (1990).

**1.13 Phones**. Depending on many factors (e.g., the surrounding phonemes, the speaker's dialect), a given phoneme will be produced somewhat differently. These productions are called phones. For example, when /p/ is the first phoneme of a word (as in *pin*), it is produced with a puff of air (aspiration); this can be detected by holding one's hand close to the lips as one speaks. As the last phoneme of *sip*, however, the /p/ is unaspirated. The various phones that can represent a given phoneme are called the *allophones* of that phoneme, so the aspirated and unaspirated versions are two allophones of /p/ in English. (It bears noting, however, that in other languages these can be entirely different phonemes.)

Such variations in the way that phonemes are produced, and the resulting differences in the acoustic signal that the listener hears, usually go unnoticed because they do not affect the meaning of the word. That is, in ordinary listening and speaking, we perceive the phonemes, not the phones. (See also section 1.25 on *categorical perception*.) With training, however, experts can make detailed *narrow phonetic transcriptions* of speech that represent the allophonic details, including articulatory and/or acoustic differences in the production of phones that are not included at the phonemic level. For example, *pin* is transcribed as [pʰɪn] and *sip* as [sɪp], reflecting the difference in aspiration. As can be seen in this example, square brackets are used for phonetic transcriptions. Young children can apparently detect some allophonic variations, as shown by their tendency to represent phonetic features in their attempts to spell words (e.g., by spelling *pin* as *p-h-i-n*). Hence, transcriptions of this sort are occasionally provided in research reports on *invented spelling* (4.26) and other aspects of early literacy.

**1.14 Rhymes, rhyming words.** Words that begin differently but then share a stressed vowel and all phonemes that come after it (e.g., *moon-June*; *city-pretty*; *inspection-connection*). See section 1.16 for a comparison of *rhyme* with *rime*.

**1.15 Syllable.** A speech unit consisting of a vowel nucleus that can be preceded and/or followed by a consonant or a *consonant cluster* (two or more consonants in succession without an intervening vowel). For example, the word *speech* has just one syllable, whereas the word *phonological* can be broken into five: *pho - no - log - i - cal*. One-syllable words are termed *monosyllabic*, and words with more than one are *multisyllabic* (or *polysyllabic*). Breaking English words into syllables can be a thorny matter, even for experts. Questions often arise as to the location of syllable boundaries (*ar-my* or *arm-y*) and even the number of syllables in some words (such as *chocolate*, in which only two vowels are produced when it is pronounced "chocklit" in colloquial speech). For a fuller discussion, see Gipstein, Brady, and Fowler (2000).

**1.16 Onset** and **rime.** Within a syllable, the portion preceding the vowel is called the *onset*, and the remainder of the syllable is called the *rime*. In the monosyllabic word /spɛnd/ (*spend*), for example, /sp/ is the onset and / ɛnd/ is the rime. Every syllable has a rime, but not necessarily an onset (e.g., the word *end* has just a rime). The rime can also be further subdivided into two parts: the vowel (in our example, /ɛ/) and the final *coda* (/nd/). Sometimes, the rime has no coda (as in the word *tree*), and this is called an *open syllable*.

Although *rime* is defined in terms of oral language characteristics, it is sometimes also used to refer to its counterpart in written words. When this is done, however, it is generally a spelling pattern (rather than a phonological component) that is called a rime; in such instances, an alternative term is *phonogram* (4.24).

Some confusion occurs about when to use the terms *rhyme* (1.14) and *rime* (1.16), perhaps because in addition to being homophones, the two terms refer to the same portions of monosyllabic words; that is, monosyllabic words that rhyme can be defined as having different onsets but the same rime (*e.g.*, *sp-eak* and *fr-eak*; *t-oo* and *bl-ue*). Note that this is not so for multisyllabic words, in which the rhyme extends across more than one syllable. That is, all onsets and rimes that follow the stressed vowel must be the same for the words to rhyme. Hence, *crustacean* and *vibration* are rhymes because they have the same stressed vowel and are identical thereafter. In contrast, *generous* and *venomous* are not rhymes.

**1.17 Subsyllabic**. Pertaining to subdivisions of syllables into onsets and rimes, phonemes, or other units smaller than the syllable. When the level of analysis is the phoneme, however, this is usually specified outright by the term *phonemic*, so *subsyllabic* has come to be used most often, but not exclusively, to indicate an onset-rime level of structural analysis. Note that because the onset can consist of a single phoneme, these units are identical in some syllables; for instance, /b/ is both the onset and the initial phoneme of *bird*. In *blond*, however, /b/ is the first phoneme but not the onset (which is /bl/).

**1.18 Segment**. A phoneme or a phone. A *segmental* analysis is thus one that breaks words into phonemes or phones. When a person is speaking or listening, processing of speech segments generally occurs below the level of awareness.

A related term is *suprasegmental*, which refers to broader phonological characteristics such as prosodic changes in the pitch contours (intonation) or stress patterns of speech.

Note that in the field of metalinguistics (Part 2), the term *segmentation* and the verb *segment* are used more broadly. In that context, they refer not only to phonemic segments but to any intentional subdivision (syllabic or subsyllabic) of words into smaller phonological elements. These terms can also be used nonphonologically (e.g., to refer to the division of sentences into component phrases).

**1.19 Phonological representation, phonological code**. Mentally represented information about the phonological characteristics of a particular word. The mental lexicon includes a phonological representation of each word in a person's vocabulary so that this information can be recognized when the word is heard and can be retrieved and translated into actual speech when the individual chooses to say the word. The phonological representation indicates what speech sounds make up the word, which syllable is stressed, and so forth. Note that phonological codes are abstract mental representations, whereas speech refers to the more tangible translations of those codes into articulatory movements and acoustic signals that occur when a word is actually spoken.

Phonological representations are acquired and refined over the course of language development. When a child is exposed to a new word, a phonological code for what was perceived can be stored along with information about the word's meaning; subsequent exposures to the word serve to increment or modify the stored information about the word. The kind of information contained in phonological codes may change qualitatively as well as quantitatively during childhood (Fowler, 1991; Metsala & Walley, 1998).

Phonological codes are also created, and at least temporarily stored, for speech stimuli that are not in a person's lexicon, such as foreign words and *pseudowords*. Oral pseudowords are meaningless phoneme sequences that are nevertheless pronounceable and do not violate any combinatorial constraints on the ordering of phonemes within English words (called *phonotactic* rules). For instance, it is phonotactically incorrect for an English word to begin with the consonant cluster /kv/, but this sequence is acceptable in Yiddish words like *kvetch*. Examples of pseudowords include /dɑ/ (*dah*), /zok/ (zoke), and /kæntosɪv/ (*cantosive*). Similarly, written pseudowords are decodable letter sequences that adhere to English spelling conventions. (The broader class of nonwords includes pseudowords and also items that are unpronounceable, phonotactically incorrect, or in violation of spelling rules.) Pseudowords are often used for the assessment of oral and written skills in both research and practice. They serve as surrogates for novel real words that have never been encountered before, ensuring that the stimuli or test items are equally unfamiliar to all listeners or readers. By using them, one seeks to evaluate how a listener or reader processes (i.e., perceives, reads, represents, remembers, etc.) unfamiliar words.

## 1.2 Phonological Skills and Disorders

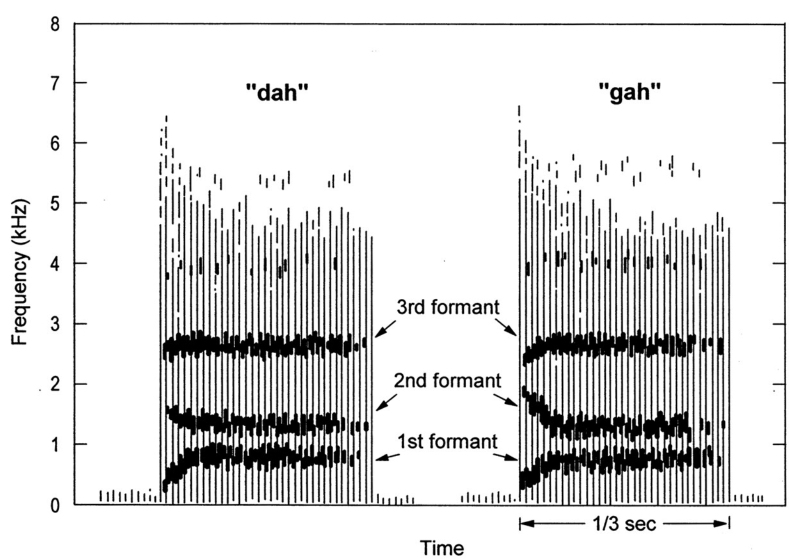
To discuss language skills and disorders, it is helpful to differentiate between *receptive* language (i.e., its perception or comprehension) and *expressive* language (its production). For instance, receptive vocabulary is the ability to understand the meanings of spoken words, whereas expressive vocabulary involves producing an appropriate word to convey a desired meaning. Similarly, for syntax and semantics, receptive skills (often called *listening comprehension*) involve understanding the structural and meaningful relations among words and phrases that one hears, and expressive skills involve producing syntactically and semantically well-formed constructions when one speaks or writes. This distinction is also useful in the phonological domain. Hence, in what follows, we will first define terms for receptive phonological abilities and disorders (1.21-1.26) and then those for expressive ones (1.27-1.29).

**1.21 Speech perception**. A broad term encompassing any and all aspects of receptive phonology, including the following (1.22-1.25).

**1.22 Phoneme discrimination, speech discrimination.** The ability, more fine-grained than in 1.21, to differentiate among spoken words or pseudowords that differ by a single phoneme; e.g., /dʌst/ (dust) vs. /gʌst/ (gust), or /dɑ/ (*dah*) vs. /gɑ/ (*gah*). When phoneme discrimination is assessed, the listener's task is usually to indicate whether two successive stimuli are the same or different. Most often, the phonemes pitted against each other are very similar in articulation. For example, the main difference between /d/ and /g/ is the location at which the flow of air is briefly obstructed by tongue contact with the roof of the mouth; for /d/, the tongue touches the ridge behind the upper front teeth, whereas for /g/ the tongue rises more toward the back of the mouth. This articulatory difference corresponds to a small acoustic difference that can be represented in a *speech spectrograph*, which is schematically illustrated in Figure 2. As shown in the figure, the second *formant* is one of several bands of frequencies (pitches) that are louder (darker in the spectrograph) than others. For /gɑ/, there is a sharp drop in pitch at the start of the second formant, whereas for /dɑ/ there is much less of a change. In other respects, the acoustic signal for the two syllables is very similar.

**Figure 2.** Comparison of the Acoustic Signals for the Syllables "dah" and "gah" as They Would Appear in Speech Spectrographs (see Section 1.22).

The dark horizontal bands indicate the several frequency ranges, called formants, that predominate in speech. Note that these two syllables are acoustically very similar except for the early portion of the second formant.



Phonemes can be similar or different not just in the location where the airflow is obstructed, but also in a host of other ways. For example, the obstruction occurs in the same place for /z/, /n/, and /t/ as it does for /d/, but each of these other phonemes differs from /d/ in a particular way: whether the airflow is interrupted fully (as in /d/) or only partially (as in /z/); whether it is diverted through the nose (/n/) or not (/d/); and whether the obstruction occurs slightly before (/d/), versus simultaneous with (/t/), the vibration of the vocal chords. It is helpful to know about the similarities and differences among phonemes because children tend to have confusion about those that are similar to each other and, by extension, about the letters that represent them. This explains, in part, why vowels are harder for beginning readers to master than consonants, a fact that reading teachers know well. For more detail about the many articulatory and acoustic dimensions that differentiate phonemes, see Borden and Harris (1980), Catford (1988), or Johnson (1997).

Clinical assessment of phoneme discrimination is usually conducted with real words produced by a human speaker. In experimental research on phoneme discrimination, the test items are more likely to be computer-generated (synthesized) speech. By having the stimuli generated electronically, the differences among them can be carefully controlled. Especially when discrimination is measured to study *categorical perception* (1.25 below), several variants of each syllable can be created. For example, if /dɑ/ and /gɑ/ are to be contrasted, the most critical dimension is how much the pitch drops at the start of the second formant, so a series of syllables would be synthesized that had progressively steeper changes in pitch but were otherwise identical. All possible pairings of these variants would be presented to the listener, whose task would be to judge whether the two syllables of each pair were the same or different.

**1.23 Auditory discrimination.** This term is sometimes used to refer to the same processes as those described in section 1.22 but is more general and can be theoretically misleading. It is an extremely broad, nonlinguistic term that refers to making perceptual distinctions between any kinds of sounds, including tones, music, and environmental noises. There is good evidence that the human brain deals differently with nonspeech sounds than it does with speech (e.g., Liberman, 1999). Therefore, use of this term to refer to speech perception is not just imprecise but also implies that speech is processed similarly to nonspeech auditory stimuli. One basis for confusion about this term is that some longstanding measures continue to be described as "auditory" despite their exclusive focus on speech and language, rather than general audiological, abilities.

**1.24 Phoneme identification.** A perceptual task in which the listener hears a series of speech stimuli and for each one must judge what was heard. Often, the choice is limited to two possibilities; e.g., Was it /dɑ/ or /gɑ/? Despite the similarity of terms, this perceptual task should not be confused with metalinguistic *phoneme identity* tasks, discussed in 2.24 below.

In a commonly used version of the phoneme identification task, the listener repeatedly hears many variants of two phonemes, always in the same syllabic context (e.g., many synthesized variants of /dɑ/ intermixed with many of /gɑ/, as described in 1.22 above). After each stimulus syllable is presented, the listener must identify which of the two possibilities was heard. Those with sharper pitch changes at the start of the second formant (see 1.22) will be identified as /gɑ/ by most listeners, and those with flatter transitions will be called /dɑ/. The intermediate point at which this switch in identification occurs is called the *phoneme boundary*.

**1.25 Categorical perception of speech.** The ability to discriminate far better *across* a phoneme boundary (e.g., between /dɑ/ and /gɑ/) than *within* a phonemic category (e.g., between any two variants of /dɑ/). That is, listeners exhibit categorical perception if they hear and label variants of a phoneme as equivalent exemplars of the phoneme in an *identification* task (1.24) and cannot reliably distinguish those variants from one another in a *discrimination* task (1.22). In our example, the listener would accurately discriminate every syllable he had called /dɑ/ (in an identification task) from every syllable he had called /gɑ/, but would be poor at discriminating one variant of /dɑ/ from any other, or one variant of /gɑ/ from any other.

The phenomenon of categorical perception, first studied with normal adults, is contrasted with "continuous" perception of non-speech sounds (such as musical tones), and was initially thought to be unique to speech processing. Although subsequent research on the perception of non-linguistic stimuli has undermined that claim, nonetheless categorical perception is typically exhibited for speech. For a fuller introduction to categorical perception, see Lieberman and Blumstein (1988) or Repp (1984).

Performance by poor readers on identification and discrimination tasks is sometimes interpreted as showing "less categorical" perception of speech, but this claim is inaccurate because they typically show the normal pattern of discriminating better between than within phonemic categories. The overall accuracy in speech discrimination is lower for some poor readers, however, especially under difficult listening conditions. For a review, see Brady (1997).

**1.26 Central Auditory Processing Disorder (CAPD).** An impaired ability to understand speech, especially in challenging listening situations such as the noisy environment of the average classroom. CAPD is hypothesized to stem not from peripheral hearing loss but instead from a deficit at higher levels of auditory processing in the brain (Katz & Wilde, 1994). No universally accepted standard for diagnosing CAPD has been adopted (American Speech-Language-Hearing Association, 1996). The term is used primarily in the speech-language pathology field, and the disorder has been hypothesized to underlie some learning disabilities.

**1.27 Articulation errors; phonological errors.** Incorrect productions of spoken words that may involve deleting a speech sound, substituting one sound for another, distorting one or more features of a sound, or adding a sound. Some common examples are *dwive* for *drive* and *srimp* for *shrimp*. The term *articulation error* implies that such errors occur at a peripheral level (i.e., from moving the articulatory musculature incorrectly). Because such errors may also arise at a higher level, speech pathologists now prefer terms like *phonological errors* or *phonological processes* (1.28 below) unless there is a known structural or functional deficit causing the error (e.g., an unrepaired cleft of the palate).

Some individuals whose speech is virtually error-free under ordinary conditions may make errors in imitating or producing unfamiliar words, pseudowords, or complex phonological sequences (like “tongue twisters”). In particular, poor readers are more likely than better readers to make such errors (Catts, 1989; Snowling, 1981), which may be indicative of difficulty in representing or remembering phonological information. Notably, misarticulations in these contexts do not include the types of speech sound distortions that occur in speakers with productive phonological disorders.

**1.28 Phonological processes**. Classes of speech production errors, such as cluster reduction (omitting one of the consonants of a cluster; e.g. *‘ruck* for *truck*, *skewdiver* for *screwdriver*), fronting (substituting the target phoneme with a similar one that is produced by obstructing the airflow at a more forward position in the mouth; e.g., *det* for *get*, *dut* for *duck*), and so forth. Note that this term refers to tendencies to misarticulate groups of phonemes in systematic, rather than idiosyncratic, ways. For additional information, consult Edwards and Shriberg (1983) or Lund and Duchan (1983).

The foregoing definition of phonological processes is used primarily within the speech-language pathology community. It is important to note that the term *phonological processing* (see 3.11) has a much different meaning in the fields of cognitive psychology and literacy.

**1.29 Phonological disorder, speech disorder/delay, functional articulation disorder.** Delay or deviance in the development of speech. When not associated with an identifiable cause such as hearing impairment or pervasive developmental disability, the first three terms are often accompanied by the phrase "of unknown origin." For a discussion of prevalence and subtyping issues, see Shriberg (1997).

# Part 2. "*Phon*" Terms for Talking About Metalinguistic Awareness of Phonological Elements

## 2.1 Metalinguistics

Most adolescents and adults not only can use language effectively for communication and other purposes, but in addition can treat language as something that can be intentionally thought about, judged, played with, and manipulated in various ways. This ability to reflect consciously on the nature of language is called *linguistic awareness* or *metalinguistics*. In the latter term, the initial morpheme *meta* conveys the notion that this ability is *above and beyond* the basic knowledge and uses of language. Although metalinguistic abilities are exhibited in all domains of language (e.g., metasyntactic judgments about whether or not a sentence is grammatically well-formed), our focus is on terms pertaining to metalinguistic abilities in the phonological domain.

**2.11 Phonological awareness, metaphonological ability.** The broad class of skills that involve attending to, thinking about, and intentionally manipulating the phonological aspects of spoken language, especially the internal phonological structure of words. See also *phonological sensitivity* (2.13). Behaviors indicative of the attainment of phonological awareness are described in section 2.2 below.

Note that the terms *phonological awareness* and *phonemic awareness* (2.12, below) are sometimes confused with *phonics* (4.22), which refers instead to instruction in and processing of print, not just oral language.

As discussed in Section 1.1 above, the phonological structure of words can be analyzed at different levels: syllables, subsyllabic units (onset, rime), and phonemes. The terms *phonological awareness* and *metaphonological ability* are general, and can refer to awareness of any or all such levels of phonological structure.

Studies of metaphonological development in young children have shown that an appreciation that words have phonological as well as semantic/syntactic attributes may begin to emerge at an early age (e.g., as an appreciation of rhyme) and become increasingly sophisticated during the late preschool and school years. For many children, an awareness of syllables, rhymes, and alliteration is acquired prior to school. Without explicit instruction, however, noticing and thinking about individual phonemes is less likely to be attained by preschoolers (Adams, Treiman, & Pressley, 1998; Liberman, Shankweiler, Fischer, & Carter, 1974). Indeed, research has even shown that few illiterate adults exhibit this fine-grained level of phonological awareness (e.g., Morais, Cary, Alegria, & Bertelson, 1979).

Attaining explicit awareness of the existence of phonemes is an important refinement of metaphonological skill, because learning to read involves realizing that phonemes are the elements of spoken words that the letters of the alphabet usually represent. This insight is called the *alphabetic principle* (4.13). Because of its close relationship to reading acquisition, the special case of phonological awareness of individual phonemes is of particular interest for both theory and practice. It is therefore more precise and useful to refer to this later-emerging ability with a more specific term, namely:

**2.12 Phonemic awareness, phoneme awareness.** The particular kind of phonological awareness that involves attending to, thinking about, and intentionally manipulating the individual phonemes within spoken words and syllables. This appreciation of phonemic structure develops later than the more general appreciation of larger phonological units such as syllables, onsets, and rimes. Phonemic awareness is acquired gradually over time; for instance, initial phonemes may be attended to and isolated before medial or final segments can be. As will be discussed in section 4.21, kindergartners and sometimes even younger children can be trained in phonemic awareness, and such training has been shown to facilitate learning to read.

**2.13 Phonological sensitivity.** At present, this term is being defined in two ways. On the one hand, it is often used as a synonym for *phonological awareness* (2.11) (i.e., as referring to awareness of any level of phonological structure). On the other hand, it is sometimes used more narrowly to refer only to nonphonemic awareness (i.e., only to an appreciation of rhymes, syllables, and/or subsyllabic elements such as onsets and rimes); when used this way, *phonological sensitivity* and *phonemic awareness* are treated as contrasting (and developmentally sequenced) subsets of *phonological awareness*. Both uses of this term continue to be encountered in contemporary papers, producing some confusion.

## 2.2 Phonological and Phonemic Awareness Skills and Their Assessment

A person's awareness of the phonological or phonemic structures of a spoken word (or pseudoword) is reflected in the ability to do various things with speech elements. Hence, metaphonological skill can be exhibited numerous ways. Informally, for instance, appreciating the humor of a pun requires the insight that the same phonological form can stand for more than one word, and speaking Pig Latin requires rearranging the phonemes within words. In research and educational practice, more formal assessments are based on a variety of methods, the most common of which will be briefly described in this section.

With regard to testing procedures, it is important to note, first, that practice trials with feedback are usually administered to insure that the participant understands what he or she is being asked to do. Also, to insure that errors do not arise simply from dialect differences or misperceptions of the stimuli, the participant may be asked to repeat back each item upon hearing it, prior to carrying out the metaphonological operation; this cautionary step is not always taken, however, by all researchers and examiners, leaving the results more difficult to interpret. In what follows, "E" will refer to the examiner and "P" to the participant(s).

**2.21 Rhyming**. Producing a spoken response that rhymes with a particular target spoken by the examiner, or recognizing that two spoken words (or pseudowords) rhyme. For young children, rhyme generation is often harder than rhyme recognition, although the difficulty of rhyme recognition can vary considerably depending on the similarity of the alternative items. Because children may know the concept of rhyme but not the term *rhyme*, it is customary to give instructions that demonstrate what is meant by rhyming before administering the test items.

*E:* Can you tell me a word that rhymes with *sock*?

*P:* Rock.

*E* (easy foils): Which of these words rhymes with *cat: seal, hat, five*?

*P:* Hat.

*E* (difficult foils): Which of these words rhymes with *cat: cab, fat, kit*?

*P:* Fat.

**2.22 Segmentation or analysis.** Breaking a stimulus into component elements (syllables, onsets/rimes, phonemes), or isolating a single element. Segmentation skill can also be assessed by asking the participant to count the speech elements in stimulus items.

*E:* Say just a little bit of *snake*.

*P:* /s/

*E:* Tell me all the little sounds you hear in *blimp*, one by one.

$P_1$ (responding at the onset-rime level): /bl/, /ɪmp/.

$P_2$ (responding at the phonemic level): /b/, /l/, /ɪ/, /m/, /p/.

*E:* How many little parts can you hear in *stick*?

$P_1$ (onset-rime): 2.

$P_2$ (onset-vowel-coda): 3.

$P_3$ (phonemic): 4.

(Note that a response of "5" would indicate that the participant is probably basing the answer on the spelling, rather than the oral form, of the word *stick*.)

**2.23 Categorization, comparison.** Grouping or matching words according to whether they have speech elements in common (e.g., recognizing that two stimuli begin similarly or rhyme with each other). Oddity and matching tests are most often used, typically with pictorial aids to reduce the memory demand. The former require the participant to decide which of several spoken stimuli is the "odd one out" (i.e., does not have a phonological element that the others all share). The latter require the participant to indicate which of several choices is the same as a target with regard to some component of phonological structure. For example:

*E* (pointing to pictures): *door...pan...duck...*Which one doesn't belong?

*P:* Pan.

*E* (pointing): This is *boat*. These are *pear*, *coat*, and *dish*. Point to the one that ends the same way as *boat*.

*P:* (points to *coat*).

As noted earlier (1.16), in simple words such as those in the foregoing examples, the initial consonant can be understood as the *onset* and/or as the first *phoneme*. Therefore, a child who analyzes words at the level of onsets and rimes and a child who analyzes them at the level of individual phonemes will both arrive at the same correct answers. In such a circumstance categorization skill should probably be considered evidence for phonological, but not necessarily phonemic, awareness.

**2.24 Identity.** Specifying the identity of a speech element within a word (e.g., by labeling it), or recognizing that different words have a particular speech element in common. Awareness of *phoneme* identity may be especially crucial for learning to read (Byrne, 1992). (Note that this metalinguistic term should not be confused with the speech perception task known as *phoneme identification*, which was discussed in 1.24 above.)

*E:* Tell me the last little sound in *fish*.

*P:* sh.

*E:* Which word contains the /m/ sound: *star*, *lamp*, or *boat*?

*P:* Lamp.

**2.25 Synthesis, blending.** Putting together speech elements that are presented separately. In tasks to assess this aspect of phonological/phonemic awareness, the participant is required to say the word that is formed by adjoining a series of syllables, subsyllabic elements, or phonemes that are presented in succession.

*E* (syllabic item): *car…tune…*What word do you get when you say them together?

*P:* Cartoon.

*E* (subsyllabic): What word does it make when you say these together: /st/…/ɪk/?

*P:* Stick.

*E* (phonemic): What word does it make when you say these together: /s/…/p/…./u/…/n/?

*P:* Spoon.

**2.26 Manipulation.** Altering the pronunciation of a stimulus by adding, subtracting, or rearranging its elements. For example, in *deletion* (or *elision*) tasks, the participant must repeat back a portion of the spoken stimulus. The element to be deleted can be explicitly specified (as in the first two examples), which reduces the segmentation burden on the participant, or can be identified only with respect to position.

*E:* (syllabic item) Say *winter* without the *ter* part.

*P:* Win.

*E:* (phonemic) What's left if you leave out the /n/ in *band*?

*P:* Bad.

E: What word is left if you leave off the very first part of *scare*?

$P_1$ (responding at the subsyllabic level): Air.

$P_2$ (responding at the phonemic level): Care.

In other manipulation tasks, blocks or other tokens may be used to represent speech elements and the participant is asked to rearrange them in ways that correspond to changes in the phonological composition of the item. For example,

*E:* (Indicating a row of 3 blocks): If this is *isp*, show me *ips*.

*P* (phonemic response): Reverses the order of the second and third blocks.

*E:* Good. Now if that is *ips*, show me *ip*.

*P:* Removes the third block.

Over the years, researchers have used a variety of measures of the sorts described above and a few others (e.g., translating words and phrases into Pig Latin). Standardized tests of phonological and phonemic awareness are also commercially available for use with children in kindergarten and the early grades. Potential users of these measures should be alert to the fact that they can differ considerably with regard to the level of phonological analysis (syllable, phoneme, etc.), the difficulty of the items (length, similarity of choices, etc.), and the requirements of the task itself (matching, deletion, etc.).

# Part 3. "Phon" Terms for Talking About Phonological Memory and Naming

## 3.1 Functions of Phonological Information

Speaking, listening, and metalinguistic awareness are not the only human behaviors that rely upon phonological representations and speech. As will be discussed in detail in Part 4, phonological abilities and codes are also fundamental to reading and writing. In addition, phonological memory and naming are two other important cognitive tasks that have been studied extensively in research on how children learn to read and write and on why some children have particular difficulty in doing so. These, too, have been hypothesized to depend heavily on phonological abilities and knowledge. The term *phonological processing* has been employed to refer to some or all of these functions of phonological information, but there is much inconsistency in how the term is currently used.

**3.11 Phonological processing.** The formation, retention, and/or use of phonological codes (1.19) or speech while performing some cognitive or linguistic task or operation such as speaking, listening, remembering, learning, naming, thinking, reading, or writing. Phonological processes do not require conscious awareness; they can be, and often are, carried out without our attending to them.

Note that this term applies only to the phonology-related components of cognitive-linguistic tasks, which also require many other sorts of processing (attentional, visual, semantic, mnemonic, etc.), as will be discussed below and in subsequent sections of this glossary. Most verbal (and even nonverbal) cognition involves phonological processing to some extent (e.g., if spoken answers are given, if the stimuli can be verbally named or described, and so forth). At present, however, there is no way to measure phonological processing directly or in isolation at the behavioral level (although neuro-imaging techniques may provide a way to do so in the future). Nevertheless, many researchers use the term phonological processing to refer to many actual tasks and measures (section 3.2), rather than just to the underlying component(s) of those tasks that involve the formation, retention, and/or use of phonological codes or speech. As we next discuss, confusion is heightened by disagreement as to which particular tasks (if any) involve phonological processing and should be labeled accordingly.

**3.12 Phonological processing tasks/measures**. Even though phonological processing (as defined above) is a mental operation that cannot be directly measured, and even though it plays a role in virtually every kind of task that is used in contemporary research on language and reading, researchers often refer to some tasks and measures, but not others, as indices of phonological processing. Although it is not always stated explicitly, the term tends to be used for tasks that are hypothesized to require relatively more phonological processing than other tasks in a battery, and/or for those in which phonological processing is thought to be so crucial that individual differences in performance largely reflect variability in this component of the overall task. There is not yet full agreement, however, as to which measures meet these criteria.

Both conceptually and methodologically, the kinds of measures that are given the label *phonological processing* in the recent literature fall into four groups. First, this category of research measures has sometimes included the kind of *speech perception* and *speech production* tasks that we described in Part 1, although quite often such tasks are instead treated separately as basic phonological abilities. Second, measures of *phonological awareness* (Part 2) are sometimes called *phonological processing* tasks/constructs, but sometimes treated as a separate category distinct from other phonological abilities because they also require conscious reflection on the phonological structure of words.

Third, the term *phonological processing* has been applied to some reading and writing tasks, especially *decoding* of pseudowords (4.16) and *invented spelling* (4.26), that are thought to depend heavily on the use of phonological information during the processing of printed material. Again, such tasks are often instead grouped separately along with other literacy measures because they also require visual processing, control of eye movements, and so forth. Fourth, there are several cognitive tasks that have sometimes been termed measures of phonological processing, namely the *memory* and *naming* skills that are defined in section 3.2 below.

In our view, variability in the use of the term *phonological processing* blurs important distinctions (a) between the construct (underlying processes that cannot be directly measured) and actual tasks, and (b) between the various tasks themselves with regard to their requirements for other sorts of processing. Greater clarity would be achieved by restricting the use of the term (if consensus could be reached as to some criteria for doing so) or by avoiding it altogether except to refer to the theoretical construct defined in 3.11 above.

## 3.2 Memory, Lexical Retrieval, and Naming

Retaining, retrieving, and producing phonological information about words are cognitive operations and tasks to which the label *phonological processing* has sometimes been applied. These operations are used heavily in reading and writing, and impairments in these abilities are often observed in poor readers (see section 4.3).

**3.21 Phonological memory.** The temporary storage of information in terms of phonological representations. Tasks used to assess phonological memory typically require the immediate or delayed recall of spoken stimuli. In *memory span* tasks, the stimuli are most often short lists of digits, letter names, or words. In *pseudoword repetition* (or *nonword imitation*) tasks, the stimuli are isolated, phonologically complex pseudowords (1.19); hence, such tasks are used to assess the encoding and perception, as well as the retention, of novel phonological stimuli.

Even when visual information must be remembered, phonological memory contributes to performance to the extent that verbal encoding of the stimuli is carried out (e.g., remembering what pictures have been shown by retaining the names of the things pictured; remembering what geometric squiggles have been seen by creating and using verbal descriptions of the squiggles).

Furthermore, the nature of the stimuli can influence the degree to which limitations in phonological processing ability are the primary constraint on performance, even when two tasks are similar in method and modality (Brady, 1997). For instance, in a pseudoword imitation task, the more word-like the stimuli, the more a participant might rely on background knowledge of what English words are like, rather than solely on the phonological representations of the stimuli themselves, to make a correct response (e.g., Dollaghan, Biber, & Campbell, 1995). Similarly, the more difficult the pseudowords are to pronounce (due to their length and phonological complexity), the more a person's articulatory (output) abilities, rather than the quality of phonological representations in memory, could lead to imitation errors.

Phonological memory is also presumed to be relied upon in any task or cognitive operation in which phonological codes (whether the product of perception or retrieved from the lexicon) must be compared or evaluated (Torgesen, 1996). For instance, the speech discrimination task of saying whether two successive stimuli are the same or different (see 1.22) requires retention of a representation of the first one so that its similarity to the second can be judged. Similarly, during listening and reading, individual words in a text are first quickly recognized, activating their phonological representations. These codes, and other information retrieved from the mental lexicon, are held in working memory while the listener or reader figures out the syntactic structure and meaning of sentences and longer passages. Hence, as seen in some poor readers, if coding and retention of the words is faulty or inefficient, comprehension may suffer.

**3.22 Naming**. Retrieving the phonological representation and producing the spoken word that is the label for a particular referent that we encounter or think about. Note that reading aloud printed words or pseudowords is also sometimes termed *naming*, but those reading tasks should not be confused with the oral language skills described in this section. The following two kinds of naming abilities have most often been associated with reading achievement differences (e.g., Scarborough, 1998; Wolf, 1999).

*Confrontation naming* refers to tasks in which the names must be produced for stimuli (usually drawings of objects) that are presented by an examiner. Because the stimulus names typically get less familiar over the sequence of eliciting items, this is traditionally considered to be: (a) an expressive vocabulary measure, with low scores often reflecting a lack of knowledge of what some of the stimuli are called; and/or (b) a measure of lexical retrieval, with low scores resulting from difficulty in calling up known names for words from the lexicon. However, performance can also be hindered if phonological representations of lexical items are stored and retrievable but so degraded or poorly specified that the object's name is not correctly pronounced. Given the several possible bases for poor confrontation naming scores, the reason for their strong relationship to reading ability remains a subject of debate.

*Rapid serial naming* is a task in which all stimuli in a large visual array must be named as quickly as possible. Typically, the items in such arrays are letters, digits, color patches, or pictures of common objects. Because one early version of this task is the *Rapid Automatized Naming (RAN)* test (Denckla & Rudel, 1976), the term *rapid automatized naming* is often used more generically to describe any such task; however, this label carries theoretical connotations (regarding *automaticity*, 4.18) that may not be appropriate or intended, so we prefer the more neutral descriptive term *rapid serial naming* unless one is referring specifically to the RAN. There is considerable debate at present as to how heavily performance on rapid serial naming tasks depends on phonological processing or on other types of processing that could account for its relationship with reading ability. (See also section 4.32 regarding a hypothesized relationship of naming speed to reading disabilities.)

# Part 4. *Phon* Terms for Talking About Reading and Writing

## 4.1 Phonological Aspects of Word Recognition and Spelling

Reading and writing are complex cognitive operations that require the coordination of many processes. Phonological constructs and terms are most directly related to the recognition of printed words and to spelling, rather than to comprehension and written expression.

**4.11 Graphemes.** The basic elements of a writing system that are combined to represent the oral language (in English, the phonemes) in the visual modality. In English, the graphemes are not just individual letters but also *digraphs* and longer letter combinations. Vowel graphemes include the letter O in *go*, the digraph OO in *cook*, and the trigraph IGH in *night*; consonant graphemes include the M in *my* and the digraphs TH and CK in *thick*.

Digraphs and trigraphs are often confused with *blends*, in which two or more phonemes are represented by a letter sequence. For example, the word *stop* begins with a blend (S-T, representing the initial consonant cluster), but the word *shop* begins with a digraph (SH, for the single initial consonant phoneme /ʃ/, the *sh* sound). It can be confusing to novice readers that some common spelling patterns correspond to just one speech element, while others represent more than one phoneme; teachers who are aware of this can help to clarify it in instruction.

**4.12 Orthography.** The writing (spelling) system of a language (i.e., the way an oral language is represented by visual symbols). Around the world, different kinds of orthographies (*logographies, syllabaries, alphabets*) have been created to represent various levels of language. English has primarily an *alphabetic* orthography, which means that the graphemes correspond mainly to the phonemic level of spoken words. In other words, for the most part, the letters of our alphabet represent phonemes. For a fuller discussion of orthographic differences among languages, see DeFrancis (1989).

An alphabetic orthography is called *transparent*, or *shallow*, when there is a one-to-one mapping of phonemes onto graphemes, as in Finnish, German, and Spanish. English orthography is said to be much more *opaque* or *deep*, however, because there are multiple ways to represent many phonemes in print, and because spelling patterns often preserve morphemes at the expense of phonological consistency (e.g., *heal*, *health*). That is, English spelling patterns are governed by morphological as well as phonological structures and thus reflect the historical origins (especially Anglo-Saxon, Latin/Romance, and Greek) of our words and morphemes. Of the 500 words most commonly written in English, nearly all are of Anglo-Saxon origin, and these often retain somewhat odd spellings that reflect their roots (e.g., *said, does, were, once, their, gone, night*). The vast majority of the many thousands of other English words have Latin (including Romance languages like French and Italian) and Greek origins with spelling patterns that are usually phonemically predictable, but sometimes reflect morphemic differences also. For example, the English prefixes *dys*- and *dis*- are phonologically identical (/dIs/) but represent different morphemes; dys- derives from Greek and connotes disease or malfunction (as in *dystrophy*), whereas *dis*- comes from Latin and implies separation (as in *disconnect*) or negation (as in *disagree* and *dishonest*). For a fuller discussion of these issues in relation to reading, see Adams and Henry (1997) and Moats (1995).

Orthographic knowledge, therefore, is what a reader knows about the writing system, including the appropriateness of various graphemes for representing a particular phoneme at different positions within a word (e.g., when to spell /k/ as K, C, CK, or CH); familiarity with the spelling patterns and meanings of common morphemes (e.g., that *micro*- is a prefix meaning *small*); and word-specific information about how particular words are spelled (e.g., that although *b-r-a-n-e* is phonemically plausible, *b-r-a-i-n* is the correct spelling). If such knowledge is available to conscious consideration, the term *orthographic awareness* (analogous to phonological awareness, Section 2.11) is sometimes used (Siegel, Share, & Geva, 1995).

**4.13 Alphabetic principle**. The concept that for English and other languages that use an alphabetic orthography, the written graphemes (4.11) correspond to the phonemes of spoken words. Discovery of this governing principle is a crucial early step in learning to read and spell. The extent to which a beginning student understands this idea is often reflected in reading and spelling errors that a teacher can observe. For instance, a child who spells *cans* as *k-a-n-z* clearly grasps the alphabetic principle, but has not mastered other aspects of English orthography.

The alphabetic principle is not the same as *phonemic awareness* (2.12), although the two are often confused. The former involves knowledge of printed letters and spelling-speech relationships, while the latter (being an oral metalinguistic skill that can be attained by children with no knowledge of letters) does not. However, the two are closely related both theoretically and developmentally. Without the insight that spoken words can be decomposed into phonemic segments, it would be exceedingly difficult for a child to understand what letters stand for. For instance, a teacher's saying that the letter B stands for the first part of *ball*, *bed*, and *big* would make little sense to a child who has never thought of words as having parts at all. Hence, it is not surprising that training in phonemic awareness can facilitate the discovery of the alphabetic principle and thus promote early reading acquisition (Ehri, Nunes, Willows, Schuster, Yaghoub-Zadel, & Shanahan, 2001; National Reading Panel, 2000).

**4.14 Phoneme-grapheme and grapheme-phoneme correspondences.** The systematic regularities in the way the phonemes of spoken words are represented by sequences of written graphemes (4.11), and vice versa (also called *GPC rules*). Some phonemes have more than one graphemic representation (e.g., F or PH for /f/; OO, OU, or U__E for /u/), and some graphemes correspond to several possible phonemes (e.g., /s/ or /k/ for C). However, in many instances, choices are constrained by the element's position in a word and the surrounding context (e.g., /k/ after a short vowel is spelled with the *-ck* digraph). Hence, most correspondences are neither arbitrary nor haphazard, but instead are quite predictable. For a fuller introduction, see Moats (1995); for a thorough discussion, see Venezky (2000).

**4.15 Regularity.** The degree to which the spelling of a word conforms to conventional phoneme-grapheme correspondences. A word is *regular* if its spoken form is entirely deducible from its spelling (e.g., *it, bug, froze, complicated, serendipity*). In *b-u-g*, for example: the only option for initial B is /b/; the U, because it occurs in a consonant-vowel-consonant syllable structure, must be a short vowel; and the G, because it is in final position, must be /g/ rather than the "soft G" (as in *cage*).

*Irregular* words, also known as *exception* words, are those with spellings that do not conform fully to the usual grapheme-phoneme correspondences (e.g., *of, were, once, lose, choir, indict, yacht*). In nearly all such words, however, the deviation from regularity involves only one grapheme-phoneme correspondence, with the remainder of the word being regular. Further, as noted in 4.12, lack of regularity at the phonemic level may in fact preserve morphemic regularity (e.g., *photo, photography, photographic*). To read and write irregular words correctly, word-specific knowledge of their spellings or of morphemic elements must be learned, because knowledge about phoneme-grapheme and grapheme-phoneme correspondences alone will not suffice. Although a distinction between regular and irregular/exception words is traditionally made, regularity is not really such a strict dichotomy, in that many words fall between the extremes with regard to the predictability of their pronunciations from their printed forms (e.g., Bruck, 1993; Harm & Seidenberg, 1999).

**4.16 Decoding, phonological recoding.** The process of applying one's knowledge of the correspondences between graphemes and phonemes to determine the pronunciation, and hence the identity, of the word represented by a particular letter sequence. More broadly, it may refer also to the use of other kinds of orthographic knowledge (e.g., syllabication rules) for word identification. Decoding may be carried out without conscious awareness, as is typical for skilled readers. When decoding is a deliberate approach to reading a letter string, it is often referred to as *sounding out* the printed word.

In contrast to decoding, *word recognition* (or *word identification*) is a somewhat broader term that refers to the process of determining a written word's identity by any means, not just by using one's knowledge of orthographic regularities. For example, decoding is one of the two hypothesized routes within "dual route" models of word recognition (4.17 below).

The term *encoding* is sometimes used to refer to the same processes in the opposite direction (i.e., spelling). That is, the speller applies knowledge of phoneme-grapheme correspondences in order to select the appropriate letters to combine to spell a word. Encoding can also mean the process of forming phonological representations for stimuli, such as the items to be remembered in a memory task (3.21).

To assess decoding abilities, tests of *pseudoword reading* (also termed *nonword reading* or *pseudoword naming*) are often used. Such tasks require the student to read aloud regularly-spelled pseudowords (1.19), and responses are scored as correct if they adhere to grapheme-phoneme correspondences (4.14). Because memorized information about the spellings of real words is not sufficient for success on a well-designed test of this sort, such measures are considered to be a more direct means of assessing decoding skills than are reading tests with real words. Assessments of pseudoword reading skill are sometimes called *word attack* or *word analysis* tests, although those terms also apply more broadly to a variety of strategies or procedures for determining the pronunciation or identity of unfamiliar letter strings. Although sometimes criticized as artificial, pseudoword reading actually resembles the very natural and frequent situation for children of encountering a word in print for the first time (Nagy & Anderson, 1984), and thus is a more authentic assessment than it may seem.

The process of decoding is acquired gradually over a period of several years. Several theorists have put forth phase or stage models for describing the development of word recognition skills (e.g., Chall, 1983; Ehri, 1991; Ehri & McCormick, 1998; Juel, 1991). The acquisition of encoding/spelling abilities also has been described in terms of phase or stage models; these correspond closely with the development of word reading skills (Schlagel, 2001; Venezky, 2000). We will not discuss here the many terms that have been coined or adopted to describe qualitative and quantitative differences between skill levels in developmental models of these kinds.

**4.17 Dual-route theories of word recognition.** The hypothesis that word recognition is accomplished by the application of two different mental operations that are carried out simultaneously: (1) *decoding* (4.16 above) of a spelling into a corresponding phonological code, by which the identity and meaning of the word are then accessed in the mental lexicon; and (2) *direct access* to the lexicon from spellings (a process that, more informally, is often termed *sight recognition*, *sight reading*, or *orthographic coding*). It has usually been presumed that the phonological route is slower, is relied on most heavily by beginning readers who have not yet built up a large sight vocabulary, and can often be bypassed by skilled readers, except when they encounter unfamiliar words. However, this account of the reading process is currently in debate, because strong empirical challenges to these ideas have been presented, and alternative models, some based on connectionist networks, have been put forth. For a discussion, see Lukatela and Turvey (2000) and Harm and Seidenberg (1999).

**4.18 Automaticity.** The fast, effortless, and unsuppressable operation of a cognitive process that has been well learned. With respect to reading, the process of decoding gradually becomes automatized for more and more spelling patterns over time. Fluency in reading depends on attaining a high level of automaticity of word recognition, so that cognitive resources can be directed primarily toward parsing, analyzing, and interpreting the structure and meaning of connected text. Skilled readers immediately recognize most of the words they see (even those that have not been encountered frequently), without any awareness of the process of linking phonemes to graphemes. Less-skilled readers may recognize some highly familiar *sight words* automatically, but the process of identifying others is often observably slow, effortful, and prone to error. For a fuller discussion of automaticity and fluency, see the report of the National Reading Panel (2000).

## 4.2 Phonological Terms Pertaining to Reading Instruction

Teaching word recognition and spelling skills requires introducing young children to the alphabetic principle, pointing out the correspondences between graphemes and phonemes, and helping students master their decoding skills so that word recognition becomes automatized and text reading becomes fluent. As described in the preceding section, these facets of reading bear a close relationship to phonological skills and knowledge. Hence, there are several additional *phon* terms that are widely used to refer to aspects of reading instruction.

**4.21 Phonological/phonemic awareness training.** Instruction and activities aimed at promoting children's awareness of the phonological structure of spoken language, especially of phonemes. Activities for fostering phonological awareness cover the same range of concepts as were described in section 2.2: rhyming, segmentation, categorization, and so forth. Generally, these are taught using songs, games, and other activities that draw children's attention to the structure of words and the articulation of speech. With very young children, such training may be introduced on its own, without any reference to letters or print. With slightly older children, the focus is often on individual phonemes, and phonemic awareness training is often provided in conjunction with informal instruction in identifying and writing letters. There is now considerable evidence from intervention studies that literacy development can be enhanced by phonological awareness training, particularly when provided along with activities that introduce children to letters (e.g., Byrne, 1992; Committee on the Prevention of Reading Difficulties of Young Children, 1998; Ehri et al., 2001; National Reading Panel, 2000).

Research also indicates a reciprocal causal relationship between advances in phonemic awareness and growth in reading skill (Ehri & Wilce, 1980; Perfetti, Beck, Bell, & Hughes, 1987). That is, appreciating the existence of phonemes contributes to the learning of the system by which spoken words are spelled in print, and learning more about spelling-sound relationships in written words deepens the child's awareness of the phonological structure of spoken words. Hence, phonemic awareness training often continues to be a component of formal reading instruction throughout the primary school grades (e.g., as a means of helping children who still have difficulty perceiving, reading, and spelling words that contain consonant clusters).

**4.22 Phonics.** An approach to, or type of, reading instruction that is intended to promote the discovery and understanding of the alphabetic principle, the correspondences between phonemes and graphemes, and phonological decoding. For

> decades, many methods have been used for phonics instruction. Advocates of phonics maintain that the spelling patterns of English are largely predictable and that teaching children about phonological, orthographic, and morphemic regularities makes reading and writing easier to learn. For an extensive discussion of past and present aspects of phonics instruction, see Stahl, Duffy-Hester, and Stahl (1998) and for a meta-analysis and review of intervention research, see the report of the National Reading Panel (2000).

Historically, the opposing approach to Phonics was *Whole-Word* instruction. As its name implies, this approach did not emphasize the elemental, alphabetic aspect of English orthography, but instead advocated that reading instruction should (at least initially) promote the recognition of whole words as visual patterns that become associated with their spoken counterparts through learning and practice. Intense disagreements between Phonics and Whole-Word proponents came to be called the "great debate" (Adams, 1990; Chall, 1967). Few now advocate the Whole-Word method as it was conceived in decades past, but some educators still favor minimizing instruction about phonics concepts. For others, phonics instruction remains an important component of *code-based* approaches to reading instruction.

> **4.23 Code-emphasis instruction, code-based instruction.** Early reading instruction that includes phonics (4.22) but also promotes awareness of the phonological structure of spoken words (phonological/phonemic awareness training, 4.21) and of other structural elements of the language (morphemes and syntax). Advocates of this approach point to research evidence that the alphabetic principle is more readily grasped by children who have greater phonological awareness and that early reading acquisition can be facilitated by training in phonological awareness and phonics instruction (National Reading Panel, 2000).

*Whole Language, literature-based*, and *meaning-emphasis* approaches to instruction in reading (or, more broadly, the language arts) are generally seen as in opposition to the code-emphasis approach, and the current "reading wars" between these two camps have often been construed (inaccurately) as a perpetuation of the "great debate" about the relative merits of Phonics versus Whole-Word instruction. This controversy is not a terminological one, and we will not discuss it further except to mention that several new terms – *balanced, coherent,* and *comprehensive* instruction – have been introduced to refer to programs that are intended to incorporate the advantages of both meaning-emphasis and code-emphasis approaches into a coherent package. For a variety of views on this complex topic, see Adams and Bruck (1995), Brady and Moats (1997), and Weaver (1997). Likewise, we will not address the controversial issue as to what particular approaches to teaching about the code – *explicit/direct* versus *implicit/embedded*, *analytic* (whole-to-part) versus *synthetic* (part-to-whole) – are more effective in helping beginning readers to crack the alphabetic cipher, because those questions are well beyond the scope of this discussion of terminology. For a discussion, see Beck & Juel (1995) and Stahl et al. (1998).

**4.24 Phonogram.** A letter or group of letters used to represent a unit of speech that is the focus of a phonics lesson. When a single speech segment is targeted, the phonogram is simply the grapheme that represents it. When the target is a group of words that each end with the same letter sequence (e.g., a *word family* such as *car*, *bar*, *star*, *far*, and so forth), the phonogram *ar* is the written analog to the *rime* (1.16). Phonograms are also used to help children recognize other common spelling patterns (i-n-g, t-i-o-n, and so forth). For a fuller discussion, see Blevins (1998).

**4.25 Decodable text.** Reading material that includes numerous occurrences of words that can be phonologically decoded, and a minimum number of words that cannot, at the reader's current level of mastery of spelling-sound regularities. The purpose of such texts is to provide beginning readers with practice in decoding while reading for meaning.

**4.26 Invented spelling.** Writing that is produced when a novice reader/speller represents language using graphic symbols without knowledge of the conventional spellings of the words being written. Such spellings are thought to reflect the child's understanding of the writing system and of the phonological structure of spoken words, and hence provide the teacher or researcher with a valuable means of ascertaining what degree of phonological awareness and decoding/encoding skill a child has attained. For instance, if a child writes down just a B to spell *bed*, this suggests that she knows something about letter-sound relationships in the initial position but may not yet be able to analyze the remainder of the word. In addition, it is interesting that some young children's invented spellings – such as p-h-o-t for *pot*, c-h-r-u-k for *truck*, and h-a-o-o-s for *house* – suggest that they are using letters to represent phones (1.13) rather than phonemes (1.12). For more discussion, see Moats (1995).

## 4.3 Phonological Aspects of Reading Disability (Dyslexia)

Some individual children learn to read much less readily than others of the same age who receive equivalent instruction. It is estimated that reading problems are the primary academic difficulty of more than 80% of all children considered to have *learning disabilities* (Kavale & Reese, 1992). Over the years, various terms have been used to label and classify reading difficulties, including (*developmental*) *dyslexia*, (*specific*) *reading disability*, *reading retardation*, *reading backwardness*, (*garden variety*) *poor reader*, and so forth. Disagreements persist regarding the criteria used in research and practice to identify such individuals and to categorize them as to subtype. It is beyond the scope of this paper to resolve these questions, which are reviewed in detail in many recent sources (e.g., Catts & Kamhi, 1999; Committee on the Prevention of Reading Difficulties in Young Children, 1998; Kavale & Forness, 2000; Lyon, 1995). Instead, we will restrict our discussion primarily to issues directly related to phonological constructs and terms for describing and explaining low achievement in reading.

One dimension along which explanations and classifications of reading disabilities vary concerns the question of heterogeneity (subtyping). That is, can all (or nearly all) cases be attributed to the same processing limitations and etiology, or do different individuals have reading problems for fundamentally different reasons? The idea that at least some reading disabilities stem from phonological deficits has been included in nearly all explanations of reading disability, although the terminology for describing such deficits and the estimates of their prevalence have differed. Familiarity with the following terms is helpful for reading the current literature on reading disabilities.

**4.31 Phonological Deficit Hypothesis.** The widely held view that the vast majority of reading difficulties stem from limitations in phonological skill. A proximal cause of low achievement is hypothesized to be a weakness in phonemic awareness (2.12), such that discovering the alphabetic principle (4.13) and learning about phoneme-grapheme correspondences (4.14) are impeded. Accordingly, pseudoword reading (4.16) and spelling are correctly predicted to be particularly troublesome for these individuals. In addition, various theorists have posited that difficulty in attaining phonemic awareness is itself the result of more fundamental phonological deficits, for instance in perceiving speech accurately, in laying down adequate phonological codes in the lexicon (1.19) and working memory (3.21), and so forth. Hence, they argue, poor performance will tend to be exhibited on any task that depends heavily on phonological skills and knowledge. For more about this hypothesis and the evidence in support of it, see Shankweiler and Liberman (1989) and Stanovich and Siegel (1994).

**4.32 Double Deficit Hypothesis.** The view, put forth as an alternative to the phonological deficit hypothesis (4.31), that reading difficulties can stem from one or both of two core deficits: (1) in phonological skill (especially phonemic awareness and decoding) and (2) in naming speed, which is typically measured using a rapid serial naming task (see Section 3.22). It is further hypothesized that individuals exhibiting both sorts of deficits will have the most severe reading problems. As was noted in Part 3, there is debate about whether rapid naming should be viewed as a distinct skill or as one aspect of phonological ability. For a fuller discussion of the Double Deficit hypothesis, see Wolf (1999).

**4.33 Auditory Temporal Processing Hypothesis.** The notion that phonological deficits are secondary to a more fundamental sensory deficit in hearing brief or rapid acoustic events, and that these deficits can be overcome through training that requires processing of fast-changing tone sequences and listening to acoustically altered speech (Tallal et al., 1996). This hypothesis has been challenged by data and arguments indicating that children with reading disabilities have difficulty in dealing only with speech input, not with other kinds of auditory perception, and that temporal processing speed is not responsible for their phonological and reading deficits (e.g., Adlard & Hazan, 1998; McAnally, Hansen, Cornelissen, & Stein, 1997; Mody, Studdert-Kennedy, & Brady, 1997).

**4.34 Dysphonetic.** One of five subtypes of reading disabilities within an influential early clinical classification system proposed by Boder (1973). Dysphonetic readers were said to have poor phonological decoding skills in reading and spelling, instead relying on global strategies. In contrast, the *dyseidetic* subtype was characterized by poor sight recognition and weak visual memory, but adequate decoding. A third (*alexic*) subtype involved a combination of both dysphonetic and diseidetic weaknesses. Subsequent work has generally failed to validate this subtyping scheme, but these terms still surface with some regularity in discussions of reading disabilities.

Finally, subtyping is an issue not just with regard to *developmental* dyslexia (which begins in childhood) but also to *acquired* dyslexia, a loss of reading ability following a brain injury. Not surprisingly, phonological deficits are implicated in some such cases.

**4.35 Phonological Alexia.** A form of acquired dyslexia in which the patient has great difficulty in the phonological decoding of print, particularly for pseudowords (for which no orthographic information is available in the mental lexicon). In *deep dyslexia*, which may be a more severe form of phonological alexia or a separate syndrome, the patient also frequently makes oral reading errors (called semantic paralexias) in which semantically-related words are substituted for the printed word (e.g., reading *n-i-g-h-t* as *sleep*). In contrast, patients with *surface dyslexia* remain competent at decoding pseudowords and regularly spelled words, but not at recognizing exception words (4.15-4.16).

## Conclusion

*The Literacy Dictionary* (Harris & Hodges, 1995) contains more entries (32) beginning with the morpheme *phon* than with any other except *read* (54). This attests to the close association in theory, research, and practice between reading and phonological concepts. In this paper, we have provided and discussed definitions of many of these important *phon* words plus several dozen related terms. We have emphasized the historical and conceptual links between similar terms, because we think those links are important for understanding the connotations and current usage of many terms. We have pointed out a few disagreements or ambiguities about the current usage of particular terms, and we have tried to provide useful and accurate definitions. We hope this glossary will serve its intended purpose of reducing miscommunications and misinterpretations that arise from a lack of clarity about the phonological terms that are used in discussions of speech, language, and reading

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# Appendix

Alphabetical Index of Terms and the Locations in Text Where They are Discussed