Phonology and Reading: A Response to Wang, Trezek, Luckner, and Paul

FOUR CRITICAL RESPONSES to an article, "The Role of Phonology and Phonologically Related Skills in Reading Instruction for Students Who Are Deaf or Hard of Hearing" (Wang, Trezek, Luckner, & Paul, 2008), are presented. Issue is taken with the conclusions of the article by Wang and colleagues regarding the "necessary" condition of phonological awareness for the development of reading skills among deaf readers. Research findings (not cited by Wang and colleagues) are pointed out that reveal weak correlations between phonemic awareness and reading comprehension, and stronger correlations between other variables such as overall language skill and early exposure to a visual language.

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As part of a collaborative interdisciplinary research team that is exploring the interconnections among the neurocognitive, linguistic, social, and pedagogical determinants of language and literacy for those whose primary sensory input is through the visual modality, we are interested in current research reports on factors that facilitate literacy, especially those that conclude with definitive prescriptions for classroom practice. Given our focus, the recent article, "The Role of Phonology and Phonologically Related Skills in Reading Instruction for Students Who Are Deaf or Hard of Hearing," by Wang, Trezek, Luckner, and Paul (2008), had high salience for our team. These authors conclude (a) that phonological knowledge is a necessary precursor to reading comprehension, (b) that deaf students can gain access to phonological information, and (c) that instructional venues employing Visual Phonics and Cued Speech are effective in providing deaf student access to that knowledge. In general, our view is that these conclusions may be overstated. The conclusions beg the question of whether there may be alternative cognitive and linguistic pathways to reading success. The authors fail to consider evidence showing strong correlations between early sign language skill and reading comprehension, and they do not consider the sociocultural aspects of early language development that are important for subsequent language and literacy acquisition. We offer four critical responses that articulate these concerns in greater detail.

Response 1: Amy Lieberman, Alex del Giudice, and Rachel Mayberry

In their article, Wang and colleagues (2008) make a case for the importance of teaching phonology and phonologically related skills to deaf and hard of hearing readers. The findings of our forthcoming meta-analysis of phonological coding in deaf readers compel us to respond to Wang and colleagues' claims. Most significantly, Wang and colleagues present a narrative review of selected literature to support their claims that (a) deaf readers have access to phonological information and that (b) there is a strong relationship between phonological awareness and

reading skills in deaf readers. Our meta-analysis addresses both of these questions through a systematic review and a statistical analysis of over 25 studies. We find that the evidence in the literature is neither as definitive nor as robust as Wang and colleagues claim. In fact, we find that studies of deaf readers are equally likely to find no evidence for phonological coding as they are to find positive evidence. Furthermore, we find only a weak correlation between phonological coding and reading in deaf readers, with phonological coding accounting for, on average, roughly 10% of the variance in reading achievement at all reported grade levels.

Wang and colleagues begin with broad claims about the role of phonology in the process of learning to read, stating that "phonological processing plays an indispensable role that cannot be replaced by orthographic processing alone or by bypassing phonological processing entirely" (p. 399). This emphasis on knowledge of spoken phonemes as the only route to understanding the alphabetic principle is an oversimplification of the complex cognitive science literature on models of word recognition and the developmental literature of reading skills in hearing children. The authors point to the findings of the National Reading Panel (National Institute of Child Health and Human Development, 2000) as definitive support for the importance of phonemic awareness and phonics instruction for reading success. In fact the NRP addressed a broader range of factors which point to a more complex picture of the process of learning to read, including the finding that some phonemic awareness is helpful to beginning readers, but beyond a certain number of hours of such instruction it ceases to improve reading.

In their review, the authors sought to focus on "the most representative or recent research providing evidence regarding phonological coding of deaf readers, or discussing the relationship between phonological coding and reading proficiency of deaf readers" (p. 399). Unfortunately, this selective review does not cover the breadth of research in this area and overinflates the magnitude of effects found across the entire range of existing literature. Wang and colleagues highlight a few selected articles as the foundation for their much broader claims while ignoring a substantial body of research that finds little or no evidence of phonological coding in deaf readers (e.g., Campbell & Wright, 1988; Chamberlain, 2002; Harris & Beech, 1998; Izzo, 2002; Leybaert & Alegria, 1993; Miller, 2007a).

Wang and colleagues first mention a study by Colin, Magnan, Ecalle, and Leybaert (2007) that found evidence that phonological skills predicted word-recognition scores after 1 year of reading instruction. However, the word-recognition task used by Colin and colleagues was a lexical decision task that often does not correlate with reading comprehension. Next, Wang and colleagues discuss a study by Kyle and Harris (2006) that found no significant relationship between performance on a rhyme decision task and either single-word reading or sentence comprehension. Although Wang and colleagues attribute the null findings to the limits of the rhyme decision task, it is essentially the same task used by Colin and colleagues. Studies of the phenomenon of phonological coding in deaf readers employ a wide range of tasks and test diverse samples of deaf readers. Thus, the results of any particular study must be considered within the context of this larger body of research.

Wang and colleagues claim that phonological skills are one of the strongest predictors of early reading success in deaf readers, and thus that phonemic awareness and phonics instruction should be a central part of reading instruction for deaf students from an early age. In our meta-analysis, we found that among all factors examined as contributing to reading ability, a stronger predictor was overall language ability. Phonological coding predicted reading no better than several other factors, including speech intelligibility, age, IQ, and memory span.

We agree with Wang and colleagues' assertion that literacy levels are unacceptably low among deaf readers and that this is a crucial area in need of investigation. We also agree that deaf children, like all children, must be taught to read and that a structured focus on the alphabetic structure of words should be a part of their reading instruction. It is possible that deaf students require even more instruction about orthographic patterns and need even more reading practice than do hearing students. However, it is important to realize that an extensive body of research in this area shows that deaf readers' phonological coding abilities (or inabilities) are only weakly predictive of their reading achievement. Therefore, we disagree with the conclusion that phonemic awareness is the major route to reading achievement in deaf readers and caution that educational efforts overly focused on developing phonemic awareness at the expense of other reading instruction and reading practice are unlikely to lead to large gains in reading ability.

Response 2: Paul Miller

The article by Wang and colleagues (2008) is tendentious in many regards and does not present an adequate discussion of existing literature. First, the article fails to note that, even with regard to hearing readers, there

is growing evidence that the role of phonology in reading has been overstated (e.g., Camilli, Wolfe, & Smith, 2006; Hammill & Swanson, 2006; see also Share, 2008). For example, intensive training of phonological awareness—although leading to increased accuracy in voiced reading—was found neither to permanently enhance the reading fluency of dyslectic readers (Niemi, Poskiparta, & Vauras, 2001) nor to notably improve their reading comprehension (Krashen, 1999, 2001, 2002).

Second, the article disregards research that suggests that many deaf readers process written words with hearing-comparable efficiency (Miller, 2001, 2002, 2004a, 2004b, 2005a, 2005c, 2006b, 2006c, 2007a, 2009); Wauters, Van Bon, & Telling, 2006). In other words, the word reading strategies of prelingually deaf individuals, similar to those of hearing readers, allow for the effective processing of written words at the lexical level. Evidence suggests that this ability is present even for those deaf individuals whose reading levels are poorest (e.g., Miller, 2006c). Given that phonological awareness and phonological decoding are claimed to impact reading comprehension by enhancing the lexical processing of written words (e.g., Vellutino, Fletcher, Snowling, & Scanlon, 2004), ignoring such evidence does not provide an accurate portrayal of existing research.

Third, a substantial number of studies examining the relationship between phonological awareness and reading comprehension in prelingually deaf readers have failed to reveal significant correlations between the functioning of such individuals in these two domains (e.g., Izzo, 2002; Kyle & Harris, 2006; Leybaert & Alegria, 1993; Miller, 1997, 2006b). Wang and colleagues downplay such findings, choosing to focus on evidence from studies reporting a positive relationship between phonological skills and reading levels. It should be noted that in many cases such evidence was obtained from reader populations who may not be representative of deaf readers as a whole, for example, university students (see the studies cited in Hanson & Fowler, 1987; Hanson & McGarr, 1989).

The reader is not told that deaf individuals with increased phonological awareness are often those raised from an early age according to a strict oral philosophy in conjunction with Cued Speech (Charlier & Leybaert, 2000; LaSasso, Crain, & Leybaert, 2003b; Leybaert & Lechat, 2001), that is, environments that consistently stress the phonological structure of words. Moreover, in instances in which such evidence was reported, it demonstrated increased sensitivity to word rhymes rather than to phonemes. Rhymes are relatively robust syllabic units and—at least in alphabetic orthographies—are not represented at the graphemic level. Therefore, one would expect Wang and colleagues to explain how exactly they assume that awareness of rhymes accelerates the decoding of written words. Indeed, there is little in the research literature to support the conclusion that rhyme ability predicts reading comprehension.

In citing Conrad's seminal study (1979), the authors stress the finding that better readers were confused by phonological between-item similarity when asked for immediate recall of serially presented written words, suggesting the increased sensitivity of these participants to the phonological properties of written words. They fail to point out, however, that—such phonological sensitivity notwithstanding—the reading comprehension levels of such individuals remained markedly below those of hearing controls. Moreover, nothing is said about the fact that from among the few (5) deaf readers who were found to read at a hearing-comparable level, the majority (3) were deaf children of deaf parents. Given that the prevalence of hereditary deafness is about 5–10% in the deaf population, these findings actually suggest that having deaf parents may result in a significant advantage for deaf children as they are learning to read. Possibly, the core underlying this advantage is the presence of an effective communication system at home, that is, sign language. Regrettably, Wang and colleagues do not discuss the role of sign language in the acquisition of reading.

In sum, as already stated, this article is tendentious in many regards, and it disregards important evidence that may not support the authors' instructional prescriptions. What moderate evidence that is reported associating phonemic awareness with reading comprehension is largely correlational in nature; it does not necessarily reflect a causal relationship, and even if it does, it fails to explicitly demonstrate its direction, that is, whether phonological awareness promotes reading comprehension or vice versa (see Musselman, 2000).

Response 3: Daniel Koo

Wang and colleagues (2008) argue that knowledge of phonology serves as a crucial foundation that facilitates reading development. In addition, the authors recognize that phonemes are not necessarily modality specific; that is, they can be acquired visually through speechreading. While we do not dispute the notion of a modality-free phonology, we need to address some points of a manual system of phonology, most notably some inaccuracies in the description of Cued Speech. Wang and colleagues state, "Cued Speech represents speech at

the syllable level. . . . However, for instructional purposes, Cued Speech can also be used at the phoneme level" (p. 403). This description is entirely incorrect.

First, Cued Speech does not represent *speech* at the syllabic level, or any other level (Fleetwood & Metzger, 1998; Koo & Supalla, in press). According to the National Cued Speech Association (n.d.), Cued Speech is a manual "mode of communication based on the phonemes and properties of traditionally spoken languages." Inasmuch as we cannot use gustatory sensations to represent sounds, the visual senses do not represent auditory information such as speech or sound, as they are mutually exclusive modalities (Fleetwood & Metzger, 1998). Instead, Cued Speech represents abstract, modality-independent phonemic units and articulates them using manual hand configurations and locations rather than the vocal apparatuses (Cornett, 1967; Cornett & Daisey, 1992; Fleetwood & Metzger, 1998; Koo & Supalla, in press). The introduction of Cued Speech as an alternative set of articulatory features of hand configurations and hand locations in conjunction with mouth movements has radically altered previously held assumptions about phonemes of spoken languages being inextricably tied to the articulatory features of the vocal apparatus.

Second, Cued Speech does not represent the linguistic properties of traditionally spoken language at the syllabic level. Cornett (1967) specifically designed the Cued Speech system to represent the *phonemes* of traditionally spoken languages. In fact, many instructors of Cued Speech use a phonemic-based curriculum (Cornett & Daisey, 1992) to teach the manual system to interested parties who have already mastered a spoken language (i.e., hearing parents and professionals). Understandably, Cued Speech seems to indicate syllabic structure because consonants and vowels are simultaneously articulated via handshapes placed at a location near the mouth. In reality, it does not represent the syllables of spoken languages, as evident in the use of consonant clusters (i.e., /str-/), in which three consonant handshapes change at a single location before moving to a vowel location (Koo & Supalla, in press).

Moreover, Wang and colleagues propose that "alternative means of acquiring phonology include speechreading, articulatory feedback, Visual Phonics, and Cued Speech. . . . that Visual Phonics or Cued Speech can be used to develop phonologically related skills" (p. 403). We agree with the point that Cued Speech as a mode of communicating a traditionally spoken language can facilitate the language acquisition process in deaf and hard of hearing children. Children who acquired language via Cued Speech show strong phonological skills commensurate with those of their hearing peers (Koo, Crain, LaSasso, & Eden, 2008; LaSasso, Crain, & Leybaert, 2003a; LaSasso & Metzger, 1998; Leybaert, 1993, 2000). However, Visual Phonics, as an instructional tool designed to support the development of phonological and/or speech articulatory skills, cannot be part of the natural language-acquisition process in which a child effortlessly acquires language through naturally occurring discourse. Instead, Visual Phonics utilizes a multisensory approach to *teach* children about phonology and the articulatory properties of the vocal apparatus. In contrast, Cued Speech as a manual communication system does not explicitly teach children the phonology of spoken languages but allows children to access and implicitly acquire phonology through the natural language-acquisition process (Fleetwood & Metzger, 1998; LaSasso & Metzger, 1998).

Response 4: M. Diane Clark

Controversies such as oral versus manual education, created communication systems versus natural sign language, and now phonological versus alternative pathways to reading have been part of the landscape of deaf education at least since the Milan Congress of 1880. Many, if not all, of these philosophies have not been based on solid scientific evidence—but rather on theoretical assumptions that have not been investigated with adequate scientific rigor. Interestingly, the push for oral languages at the Milan Congress emphasized speaking to God as the only route to salvation (Ladd, 2003). This tradition is echoed in a view of language that claims that animals can communicate reflexively without purpose, but only humans can communicate with a "true language" (Paivio & Begg, 1981). Hockett (1963), cited by Paivio and Begg, articulated 16 features that must be met for all true languages. The first feature is that they **must** be vocal-auditory—from the ear to the mouth.

The centrality of this auditory-oral component to all true languages has influenced thinking about the relationship between written language (*la langue*), seen as the abstract language system, and communicative utterances (*la parole)* (Saussure, 1974; cited in Paivio & Begg, 1981, p. 12). Saussure focused on the acoustic image—derived from speech—and its relationship to semantics. Therefore, the historical view for hearing people is that the oral/aural tradition, including its "acoustic image" (i.e., phonological awareness), is required to transform oral language into written language.

It was around this same period, the 1960s, that Stokoe (1960) identified

sign languages as having all but one of Hockett's (1963) design features, that is, the vocal-auditory feature. After more than 45 years, linguists now accept that sign languages **do** include all of the necessary features of true languages. On the other hand, we have not yet resolved how *la langue* that is based on a spoken language can be acquired through *la parole* of a signed language.

These historical-philosophical threads can be seen in the article by Wang and colleagues (2008). These authors assert that phonological knowledge is necessary to improve the average fourth-grade reading level found for deaf individuals. Wang and colleagues are correct to be concerned about this lag that has not been reduced in the past 30–40 years (e.g., Marschark & Harris, 1996; Musselman, 2000). Their theoretical framework is based on both mainstream research with hearing students and Paul's qualitative similarity hypothesis (Paul, 2001, 2003, 2008). This hypothesis proposes that deaf and hearing readers use qualitatively similar strategies in learning to read but are quantitatively delayed. The question becomes, How can one explain skilled deaf readers with this model?

Paul (2003) himself mentions issues related to early language deficits that impact reading. Often the deaf child is attempting to learn both BICS (basic interpersonal communicative skills) and CALP (cognitive academic language proficiency) (Cummins, 1989) at the same time—when he or she arrives at school. But in the piece by Wang and colleagues, there is no separation of those individuals who have obtained BICS at home in sign language from their signing families from those individuals who arrived at school without an L1. It is imperative to determine the impact of early home language on later reading development. As a side note, both American Sign Language (ASL) and English-language assessments become vital to helping untangle this issue.

The effect of having an L1 in the normal course of development is seen in Hauser, Lukomski, and Hillman's (2008) finding that executive functioning for deaf individuals from deaf families is higher than for deaf individuals from hearing families. Hauser and colleagues attribute this difference to early language experiences in which parents can scaffold their children's metacognitive skills if they share a common language. These cognitive skills appear to lead to higher academic functioning and reading skills for many of these individuals. Metacognition and home languages are not discussed by Wang and colleagues despite being an important sociocultural component of skilled reading that should be included in discussions of reading skill development.

Next, use of the Alphabetic Principle for learning to read is suggested as "one of the most well-established conclusions in all of behavioral sciences" (Stanovich, 1993/1994, p. 286, as cited in Wang et al., 2008, p. 398). On its reading website, the University of Oregon states that "**letter-sound** knowledge is prerequisite to effective word identification" [emphasis added], helps improve reading, is difficult to teach but is achievable, is found in good readers, requires lots of practice, and is essential for decoding words (Center on Teaching and Learning, n.d.). However, Gaustad (2000) points out that for deaf students who are unable to recode to speech, sight word identification is the primary strategy for identifying base words. Additionally, she suggests that students first begin to use morphographic analysis when they are exposed to multimorpheme words.

A morphographic model for word identification (Frith, 1985) identifies three stages in the reading development of the normally functioning child. The first stage, logographic, is signified as principally visual. At this stage, visual skills, meaningful exposure to print, and word knowledge supply the reader with contextual keys necessary for identifying words. Visual discrimination is noted as a key element of the second stage, also known as the alphabetic or "sounding out" stage. The third and final stage is the analysis of words into larger orthographic units, which Ehri (1992) labeled "cipher sight word reading." These three types of visual analysis are different for readers who lack easy access to phonology for word identification. Here one does not rely on "sounding out" but uses context for word identification. Given this model, one can move directly from the early logographic stage into word identification without the middle step of recoding to the phonology. This model eliminates a redundancy that is assumed to aid in new-word decoding—rather, it relies on a morphological analysis. Additional research is needed to test these ideas.

Wang and colleagues state that phonological processing plays an irreplaceable role as an effective mechanism for storing information in working memory. They assert that visual information "needs to be coded into phonological information in order for it to proceed through the subvocal rehearsal in the articulatory loop (Baddeley, 1986)" (p. 399). Potter (2006) demonstrates that meaningful information can be identified and recalled much faster than nonmeaningful information. This memory persists briefly and is consistent with her conceptual short-term memory system. Given Potter and her colleagues' work (e.g., Potter & Fox, 2009; Wyble, Bowman, & Potter, 2009), alter-

native memory systems are available to aid in reading without reliance on a phonological loop in short-term memory. This assumption that only a phonological process can aid in the retention of information is an assumption that has not been definitively demonstrated as correct, but is one that has been shown to be false.

When discussing alternative means for developing phonology, Wang and colleagues propose speechreading as one possible source and cite the McGurk effect to support their claim. McGurk and MacDonald (1976) did find that visual input through lipreading impacted the accuracy of understanding repeated utterances. Their paradigm used a clip of a woman mouthing the phoneme [ga], but the phoneme [ba] was dubbed on the audio track. When watching the clip and listening to the audio, participants reported hearing a completely different phoneme [da]. When the video clip was eliminated and participants only listened to the soundtrack, they correctly reported the phoneme [ba]. Here, the **auditory input** led to correct identification (hearing [ba]), while the **visual input** led down the garden path (leading to hearing the phoneme [da], which was in neither the audio nor video information). It is therefore unlikely that this visual dimension "might enable deaf and hard of hearing readers to access the same phonological information visually" (Wang et al., p. 402). Wang and colleagues do note that not all phonemes are visible through speechreading. To resolve this issue, they suggest cueing and visual phonics as support strategies for the development of phonological awareness. If Gaustad (2000) is correct, then adding an additional mechanism to develop a "sounding out" process is not necessary.

Many deaf individuals do demonstrate phonological awareness as reported by Wang and colleagues. The question then becomes, which develops first—phonological awareness or reading? Many of the studies demonstrating phonological awareness (Alegria, 1998; Colin et al., 2007; Hanson, 1989; Luetke-Stahlman & Nielson, 2003; Narr, 2008) do so with tasks that are not reading—for example, rhyme judgments, phoneme substitution, or visual phonemics decoding—and these effects are either weakly related to reading or not related at all to reading. For example, Narr finds that after Visual Phonics training, there was an increase in skills for decoding visual phonics items but this skill showed no relationship to reading skills. It is possible that with additional metalinguistic knowledge one can develop a sense of how phonetic information is used in oral languages. Careful studies need to track these two developments side by side to evaluate which comes first, phonological awareness or reading proficiency. Until an understanding of the order of these skills is available, we must be careful not to overgeneralize our research findings. As noted by del Giudice, Lieberman, and Mayberry (2008), the literature supporting phonological knowledge as the pathway for successful reading is not as robust as Wang and colleagues suggest. Their meta-analysis points to an overreliance on traditional theories when looking at deaf readers that may lead to reading curricula that are not as effective as possible for deaf children.

Additionally, Koo and colleagues (2008) found that deaf individuals who had been raised with either oral or cueing methods showed phonological awareness in contrast to deaf individuals whose L1 was ASL. This finding does support Wang and colleagues' argument. But interestingly, even though these two groups of deaf individuals showed phonological awareness, their reaction times were much slower than hearing individuals' on the same task. These kinds of findings suggest that phonological knowledge does not function the same for deaf individuals as it does for hearing individuals.

It is important to note that there are highly skilled deaf readers. Therefore, an alternative approach would be to study those who are skilled readers in order to uncover strategies that led to **successful** reading outcomes. This perspective would investigate the sociocultural contexts in which individuals are embedded. An interactionist viewpoint underlies this notion (Clark, 1993; Gottlieb, 1983). Here, the focus is on dynamic interactions between individuals and their ongoing contexts. Now, one focuses on the idea of constant change that is embedded within various levels of individuals' lives—biological, psychological, linguistic, and social. Development is viewed as driven by reciprocal interactions between these contexts or levels, leading to behaviors that are interconnected (Clark, 1993). Studies using this theoretical framework may find that phonological awareness is necessary for these successful readers, or that it may point to phonological awareness as an epiphenomenon that is a result of highly developed reading skills. A mounting body of evidence (Clark, Begue, Gilbert, & Weber, 2008; Izzo, 2002; Miller, 2005a, 2005b, 2006a, 2006b, 2006c, 2007a, 2007b) suggests that alternative strategies may be more productive for deaf individuals' reading development. Given the low overall average reading levels among deaf individuals, it is vital that we take into account all possible strategies that can aid in deaf children's reading development. In conclusion, one can challenge Wang and colleagues' assertion that "the development and use of

phonological knowledge may be the key to ultimately improving the higher-level reading skills of this [deaf] population of students" (p. 405), based on recent and ongoing work that points to alternative pathways for deaf children's reading development.

Note

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