

# Influence of Alphabet Cues on Listeners' Ability to Identify Sound Segments in Sentences Produced by Speakers with Moderate and Severe Dysarthria

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This study examined the effects of experimentally imposed alphabet cues on the perception of individual sound segments relative to a no cues control condition. Eight speakers with dysarthria and 128 listeners participated in this study. Results suggest that experimentally imposed alphabet cues enhanced the overall identification of initial phonemes, final phonemes, consonants, and vowels for speakers with both mild-moderate and severe dysarthria, relative to the no cues control condition. Listeners identified significantly more initial than final phonemes correctly for all speakers. However, the difference between initial and final phoneme identification accuracy was descriptively larger for the alphabet cues condition than the for no cues condition. Finally, results showed that although the difference between consonants and vowels identified correctly was statistically significant, in some conditions, the magnitude of the effect was small and probably not clinically important.

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Alphabet supplementation (Beukelman & Yorkston, 1977; Crow & Enderby 1989) is a compensatory strategy in which a speaker points to the first letter of each word while simultaneously saying the word. Studies have shown that this strategy increases intelligibility by up to 30% (Hanson, Yorkston, & Beukelman, 2004; Hustad, Jones, & Dailey, 2003). Studies also suggest that the effectiveness of alphabet supplementation is related to the independent and joint influences of reduced rate of speech associated with implementing the strategy (Beukelman & Yorkston, 1977; Beukelman, Fager, Ullman, Hanson, Logemann, 2002; Hustad et al., 2003) and the linguistic information

provided by the alphabet cues themselves (Hustad & Beukelman, 2001; Hustad et al., 2003). To date, all alphabet supplementation studies have examined the impact of cues on intelligibility of *words* produced by speakers with dysarthria. The effect of alphabet cues on listener perception of individual sound segments has not been examined, but has important implications for understanding the ways in which alphabet cues benefit listeners. Thus, the goal of the present study was to describe the effects of experimentally imposed alphabet cues on the perception of individual sound segments relative to the same speech signal presented without alphabet cues.



## METHOD

### Participants

#### *Speakers with Dysarthria*

Eight speakers with dysarthria secondary to cerebral palsy (4 male; 4 female) participated in this study. Speakers met the following criteria: (a) native speaker of American English, (b) age between 30 and 55 years and (c) ability to produce connected speech consisting of at least eight consecutive words. Speakers varied in their intelligibility (as measured by the Sentence Intelligibility Test (SIT; Yorkston, Beukelman, & Tice, 1996). Four speakers had severe dysarthria (20% to 50% intelligibility), and five speakers had mild-moderate dysarthria (60–85% intelligibility).

#### *Listeners*

One hundred twenty-eight nondisabled individuals (64 male; 64 female) served as listeners. Listeners met the following criteria: (a) passed pure tone hearing screening at 20 dB; (b) age between 18 and 45 years; (c) no more than incidental experience listening to or communicating with persons having communication disorders; (d) native speaker of American English; and (e) no identified language, learning, or cognitive disabilities per self-report.

### Materials and Procedures

Each speaker was recorded in a quiet environment on digital audio and video recording equipment. Speakers produced 20 predictable sentences taken from Hustad and Beukelman (2001). Speakers were required to repeat each stimulus sentence following the experimenter's model.

Stimulus tapes containing digital video and audio were prepared on a Macintosh computer using Adobe Premiere 6.0. For the experimental condition involving alphabet cues, cues were experimentally superimposed on habitual speech samples following the procedures of Hustad and Beukelman (2001). To prevent a learning effect, two sets of stimulus tapes were generated for each speaker, with each set of tapes containing the stimulus sentences in a different randomly ordered sequence. Each stimulus sentence occurred only one time across the entire experiment.

Listeners completed two experimental tasks, one in which they orthographically transcribed 10 sen-

tences without alphabet cues, and one in which they transcribed 10 different sentences with experimentally imposed alphabet cues. The order of presentation of the two experimental conditions was counterbalanced. Listeners viewed experimental tapes individually in a quiet, sound-treated environment.

### Dependent Measures

Listeners' orthographic transcriptions of what they thought the speakers said were analyzed using an in-house computer program that converted graphic input to phonemic output. From the phonemic output the software tallied the number of consonants, vowels, initial phonemes, and final phonemes identified correctly relative to the target productions. Percent scores for each variable were then subjected to statistical analysis.

### Experimental Design & Analysis

A  $2 \times 4 \times 2$  split plot design (Kirk, 1995) was employed for this study. The two-factor within-subjects measure was cues, and its categories were no cues and experimentally imposed alphabet cues. The four factor within-subject measure was stimuli, and its categories were initial phonemes, final phonemes, consonants, and vowels. The two-factor between subjects measure was speaker severity group, and its two categories were mild-moderate and severe.

Analysis procedures employed a series of eight planned contrasts targeting differences between the percent of initial phonemes identified correctly versus final phonemes identified correctly, and the percent of consonants identified correctly versus vowels identified correctly. These two contrasts were examined within each severity group and cue condition for a total of eight comparisons. An alpha of .05 was partitioned evenly among the 8 comparisons. A probability level of .006 was necessary for any contrast to be considered significant.

## RESULTS

### *Speakers with Mild-Moderate Dysarthria*

Descriptive data for speakers with mild-moderate dysarthria suggest that the percent of consonants and vowels identified correctly was higher for the



alphabet cues condition than the no cues condition. In addition, descriptive results suggest that listeners seemed to identify more initial phonemes than final phonemes correctly for both the no cues and alphabet cues condition. However, the magnitude of the benefit for initial phonemes was greater in the alphabet cues condition. Summary data are shown in Figure 1.

For speakers with mild-moderate dysarthria, inferential statistics showed that listeners identified significantly more initial phonemes than final phonemes correctly within both the no cues condition and the alphabet cues condition. The difference was 5% ( $p < .0001$ ), and 10% ( $p < .0001$ ), respectively.

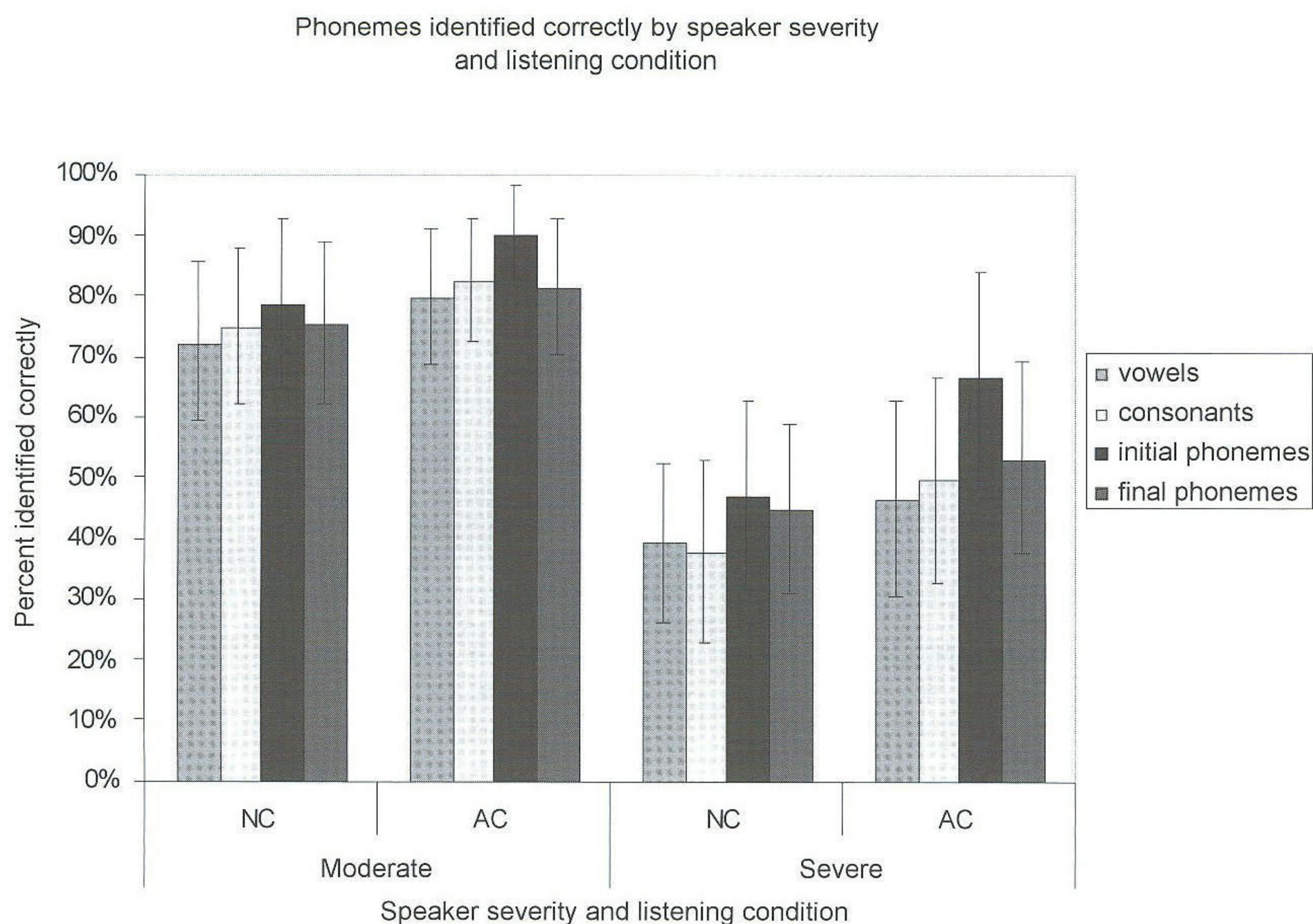
Listeners correctly identified significantly more consonants than vowels within the alphabet cues condition and the no cues condition. However, the magnitude of this difference was very small, approximately 3% ( $p < .0001$ ) and 2% ( $p < .0001$ ), respectively.

### Speakers with Severe Dysarthria

Descriptive statistics for speakers with severe dysarthria showed a similar pattern to those for speakers with mild-moderate dysarthria. First, the percent of consonants and vowels identified correctly was higher for the alphabet cues condition than the no cues condition. Second, listeners seemed to identify more initial phonemes than final phonemes correctly for both the no cues and alphabet cues condition, with a greater benefit observed in the alphabet cues condition.

For speakers with severe dysarthria, inferential statistics showed that listeners identified significantly more initial phonemes than final phonemes correctly within both the no cues condition and the alphabet cues condition. The difference was 6% ( $p < .0001$ ) and 15% ( $p < .0001$ ), respectively.

Listeners identified significantly more consonants than vowels correctly within the alphabet cues condition. However, the magnitude of this dif-



**Figure 1.** Mean percent of phonemes identified correctly by cue condition and speaker severity group.



ference was very small (approximately 3%;  $p < .0001$ ). This same difference was not significant in the no cues condition.

## DISCUSSION

Overall, results of this study suggest that experimentally imposed alphabet cues enhanced the identification of initial phonemes, final phonemes, consonants, and vowels for speakers with both moderate and severe dysarthria, relative to a no cues control condition. In addition, alphabet cues seemed to have a differential benefit for initial phoneme identification accuracy, a finding that is not surprising given the nature of the cues. The impact of these cues is especially noteworthy given that they were superimposed on the habitual speech of individuals with dysarthria.

Findings of this study are consistent with previous work by Platt, Andrews, and Howie (1980), showing that word final errors are more common than word initial errors in the habitual speech of individuals with cerebral palsy. This study also demonstrated that listeners of speakers with mild-moderate and severe dysarthria have similar difficulty with perception of consonants and vowels.

Regarding the influence of alphabet cues, findings of this study are consistent with other research examining word intelligibility in which there was a marked advantage when alphabet cues were available. This study extends the literature by demonstrating that listeners are more successful in identifying initial phonemes when alphabet cues are provided than when no cues are provided (12% benefit for speakers with mild-moderate dysarthria; 20% for speakers with severe dysarthria). The magnitude of these gains is consistent with those reported for word intelligibility in studies in which speakers implemented the cues themselves (Hustad et al., 2003) and studies in which cues were experimentally superimposed on habitual speech (Hustad & Beukelman, 2001). Thus, listeners seem to be able to remember and make use of word-initial linguistic information provided by alphabet cues even when such information is experimentally superimposed and not associated with changes in speech production that are characteristic of speaker-implemented alphabet cues. Additional studies should examine whether the same types of gains occur when speakers implement alphabet cues.

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