Research

Listener Attitudes Toward Individuals With Cerebral Palsy Who Use Speech Supplementation Strategies

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This study examined listener attitudes toward 7 speakers with dysarthria who implemented 3 speech supplementation strategies (topic cues, alphabet cues, and combined topic and alphabet cues) and a habitual speech control condition. Findings were similar, but not identical, to intelligibility results published in 2 earlier papers (K. C. Hustad, J. Auker, N. Natale, & R. Carlson, 2003; K. C. Hustad, T. Jones, & S. Dailey, 2003). For each speaker, alphabet cues and combined cues resulted in higher attitude ratings than habitual speech, and combined cues resulted in higher ratings than topic cues. Listener ratings pertaining to cognitive, affective, and behavioral components of attitude showed that ratings for the behavioral component were the highest for all but 1 speaker. The relationship between intelligibility scores and attitude ratings for each speaker were strong and positive, indicating that attitude ratings seem to increase linearly with intelligibility scores.

Key Words: dysarthria, intervention, intelligibility, augmentative communication, attitudes

A growing body of research has consistently demonstrated that the use of augmentative and alternative communication (AAC) strategies designed to supplement dysarthric speech can markedly improve intelligibility in controlled clinical contexts (Beukelman & Yorkston, 1977; Beukelman, Fager, Ullman, Hanson, & Logemann, 2002; Crow & Enderby, 1989; Hustad, Auker, Natale, & Carlson, 2003; Hustad & Garcia, 2002; Hustad, Jones, & Dailey, 2003). These AAC strategies include alphabet supplementation, topic supplementation, and combined supplementation.

Several studies have demonstrated that speaker-implemented alphabet supplementation, in which the speaker points to the first letter of each word as he or she says the word (Beukelman & Yorkston, 1977; Beukelman et al., 2002; Crow & Enderby, 1989; Hustad, Jones, & Dailey, 2003), can lead to sentence intelligibility scores that average approximately 35% higher than the intelligibility scores associated with natural or habitual speech produced without using supplementation strategies (Beukelman et al., 2002; Hustad, Jones, & Dailey, 2003). Topic supplementation, in which the speaker points to the topic of his or her message before producing it (Beukelman et al., 2002; Hustad, Auker, et al., 2003; Hustad, Jones, & Dailey, 2003), can result in sentence intelligibility scores ranging from 3% to 16% higher than habitual speech intelligibility scores (Beukelman et al., 2002; Hustad, Auker, et al., 2003; Hustad, Jones, & Dailey, 2003). Finally, combined supplementation, in which the speaker first points to the topic and then to the first letter of each word as he or she says the word (Hustad, Auker, et al., 2003; Hustad, Jones, & Dailey, 2003), can result in intelligibility scores ranging from 35% to 40% higher than habitual speech intelligibility scores (Hustad, Auker, et al., 2003; Hustad, Jones, & Dailey, 2003). Within and across studies, results suggest that alphabet and combined supplementation are more effective than topic supplementation in increasing the intelligibility of sentences that are produced by speakers with dysarthria.

Variables that seem to play a role in the intelligibility gains observed with alphabet and combined supplementation include the linguistic information provided by the cues themselves and changes in speech production associated with implementation of the strategies (Hustad & Beukelman, 2001). With regard to linguistic information, research indicates that letter cues alone and in combination with topic cues independently enhance intelligibility by up to 33% when the cues are superimposed on habitual speech

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(Hustad & Beukelman, 2001). When speakers actually implement alphabet or combined cues, speech production characteristics seem to change in ways that are not yet well understood. However, from a global temporal perspective, studies clearly show that rate of speech is reduced markedly (Beukelman & Yorkston, 1977; Beukelman et al., 2002; Crow & Enderby, 1989; Hustad, Jones, & Dailey, 2003). This reduction in rate alone has been shown to enhance intelligibility by 20% (Beukelman & Yorkston, 1977; Crow & Enderby, 1989). In fact, one study found that speech rates decreased by an average of 70% relative to habitual speech when alphabet supplementation or combined supplementation was implemented (Hustad, Jones, & Dailey, 2003). In absolute terms, Hustad, Jones, and Dailey reported an average rate of 67 words per minute for habitual speech; when alphabet or combined cues were implemented, this decreased to approximately 20 word per minute for their speakers with severe dysarthria. It is important to note that average speech rates for sentence recitation by speakers without disability have been reported to be approximately 190 words per minute (Yorkston & Beukelman, 1981). The intelligibility gains associated with alphabet and combined supplementation strategies, then, clearly come at the expense of speed, relative to normative data for nondisabled speakers and relative to the habitual rate of the individual with dysarthria. This finding has extremely important implications for both the speaker and his or her communication partners. Indeed, the attitudes of potential communication partners may be influenced by variables such as rate and intelligibility. Partner attitudes, in turn, may impact a speaker's desire or motivation to adopt a strategy and therefore may provide valuable information that aids in clinical decision-making.

Attitudes have been a topic of interest within the disability literature for the past 5 decades, and a number of related definitions of "attitude" have been proposed (see Allport, 1935; Osgood, Suci, & Tannenbaum, 1957; Thurstone, 1931; Triandis, 1971). Widely accepted is the notion that attitude is a construct with three constituent components or dimensions: affective, cognitive, and behavioral (Antonak & Livneh, 1988; Eiser, 1986; Greenwald, Brock, & Ostrom, 1968; Lasker & Bedrosian, 2000; Triandis, Adamopoulos, & Brinberg, 1984). The cognitive dimension refers to beliefs and opinions, or what one thinks. The affective dimension refers to feelings, preferences, and emotions. The behavioral dimension refers to the course of action an individual would take with regard to the attitude object (Greenwald et al., 1968; Triandis et al., 1984). Although these components of attitude are widely recognized, most studies have focused on composite attitude ratings, with little attention given to similarities and differences among the individual components.

Clearly, attitude is a valuable construct that has important social implications for individuals who use speech supplementation strategies to enhance their intelligibility. However, characterizing the attitudes of potential communication partners toward these speakers is complex because attitude is an abstract, intangible, and private construct. As such, attitudes themselves cannot be directly observed; consequently, it is necessary to use other indicators that indirectly measure attitude and its constituent cognitive, affective, and behavioral dimensions. Research examining attitudes has primarily employed questionnaire-type instruments to characterize attitudes toward individuals with disabilities (Yuker, 1994), and more specifically, toward people who use AAC systems and strategies (see Beck & Dennis, 1996; Lilienfeld & Alant, 2002; Gorenflo & Gorenflo, 1991).

The present study focused on listener attitudes toward 7 adults with dysarthria who used speech supplementation strategies in conjunction with their natural speech. McCarthy and Light (in press) suggested that three categories of variables seem to influence attitudes: characteristics of the raters themselves, characteristics of the individuals using AAC, and characteristics of the AAC system. In the literature focused on attitude ratings of adults toward other adults who use AAC, there are several findings that are germane to the present study. First, AAC techniques that are more sophisticated seem to result in higher attitude ratings (Gorenflo & Gorenflo, 1991; Lasker & Beukelman, 1999). In addition, attitude ratings are generally higher for speech output that is "easier" to listen to (Gorenflo, Gorenflo, & Santer, 1994). In a preliminary study, Hustad (2001) examined listener attitudes toward topic cues, alphabet cues, combined cues, and a no cues control condition when all cues were experimentally imposed on the habitual speech of 4 individuals with severe dysarthria whose faces were not visible. In this study, listeners were able to see only the cues themselves, presented against a blue background. After completing transcription intelligibility tasks, listeners answered a series of Likert-type questions pertaining to their attitudes toward the speech supplementation strategies they had just seen. Questions targeting cognitive and behavioral dimensions were presented to listeners, and analyses were pooled across all 4 speakers with severe dysarthria. Results showed that for the cognitive dimension, combined cues resulted in higher ratings than any other cue condition, no cues resulted in lower ratings than any other cue condition, and alphabet cues resulted in higher ratings than topic cues. These results suggest that listeners thought that the strategies that provided the most frequent and specific supplemental information were most effective. For the behavioral domain, results showed that combined cues yielded higher ratings than any other cue condition, and alphabet cues resulted in higher ratings than no cues. Behavioral ratings suggested that listeners were most willing to interact with speakers, again, when more information was available to supplement the speech signal. Although not formally quantified, results seem to indicate that there was a positive relationship between intelligibility and attitudes.

The present study is a follow-up to the initial study by Hustad (2001). However, the methodology differed in several important ways. First, 7 speakers actually implemented the strategies. Second, listeners could see the speakers while they used each strategy. Third, questions targeting all three dimensions of attitude were presented to listeners. Data reported in the present article were collected in parallel with intelligibility measures from the same listeners and for the same speakers as those reported in Hustad, Auker, et al. (2003) (speakers with profound dysarthria) and Hustad, Jones, and Dailey (2003) (speakers with severe dysarthria). These two studies were designed to examine the effects on intelligibility of speaker implementation of alphabet cues, topic cues, and combined cues, relative to a habitual speech control condition. Intelligibility data showed different patterns of results for speakers with severe dysarthria than for speakers with profound dysarthria. For the speakers with severe dysarthria, Hustad, Jones, and Dailey reported that combined cues and alphabet cues resulted in higher intelligibility scores than topic cues and habitual speech (no cues). The difference between topic cues and habitual speech and the difference between combined cues and alphabet cues were each nonsignificant. For the speakers with profound dysarthria, combined cues resulted in higher intelligibility scores than any other cue condition, habitual speech (no cues) resulted in lower intelligibility scores than any other cue condition, and alphabet cues resulted in higher intelligibility scores than topic cues.

Four research questions pertaining to listener attitudes toward speakers who implemented speech supplementation strategies were of interest for the present study:

1. For each speaker, are there differences among overall attitude ratings associated with implementation of each speech supplementation strategy relative to a habitual speech control condition?
2. For each speaker, are there differences among cognitive, affective, and behavioral attitude ratings across speech supplementation strategies?
3. For each speaker, is there an interaction between individual attitude component ratings and speech supplementation strategies?
4. For each speaker and for all speakers as a group, what is the relationship between intelligibility scores and attitude ratings?

Method

All experimental procedures are identical to those described in Hustad, Auker, et al. (2003) and Hustad, Jones, and Dailey (2003). As such, descriptions provided in the present article are abbreviated.

Participants

Seven speakers with dysarthria and 168 listeners without disability participated in this experiment. Speakers produced a standard corpus of speech stimuli using three speech supplementation strategies (alphabet cues, topic cues, and combined cues) and habitual speech. Listeners viewed videotapes of speakers, transcribed what they heard, and made attitude ratings following completion of each experimental task (Hustad, Jones, & Dailey, 2003).

All 7 of the speakers with dysarthria had cerebral palsy. Four had dysarthria that was considered severe (between 20% and 40% intelligibility on the Sentence Intelligibility Test [SIT; Yorkston, Beukelman, & Tice, 1996]), and 3 had dysarthria that was considered profound (between 5% and 15% intelligibility on the SIT). Demographic information for speakers is presented in Table 1. Speakers were required to meet inclusion criteria as follows. Each speaker had to (a) have the ability to produce at least eight consecutive words in connected speech, (b) have the ability to produce speech with intelligibility between 5% and 40% on the SIT, (c) choose to use speech as a mode of communication in everyday situations per self-report, (d) speak American English as a first and primary language, (e) be able to read at or above the sixth-grade level, (f) have vision within normal limits (corrected or uncorrected) per self-report, (g) have hearing acuity within normal limits per self-report, and (h) have the ability to direct select letters and orthographically represented phrases from a communication board (Hustad, Auker, et al., 2003; Hustad, Jones, & Dailey, 2003)

TABLE 1. Demographic characteristics of speakers with cerebral palsy (SIT = Sentence Intelligibility Test; Yorkston, Beukelman, & Tice, 1996).

Speaker	Age	Gender	Medical Diagnosis	Speech Diagnosis	Selection Method	Education	SIT Score
1	42	Female	Spastic diplegia	Spastic dysarthria	Direct selection with right hand	Completed high school	27%
2	58	Female	Spastic quadriplegia	Spastic dysarthria	Direct selection with right hand	Completed high school equivalent	26%
3	33	Male	Mixed spastic-athetoid	Mixed spastic-hyperkinetic dysarthria	Direct selection with head pointer	Completed 1 year of college	20%
4	33	Female	Mixed spastic-ataxic quadriplegia	Mixed spastic-ataxic dysarthria	Direct selection with right hand	Completed 2 years of college	20%
5	37	Male	Spastic diplegia	Spastic dysarthria	Direct selection with right hand	Completed 2 years of college	5%
6	24	Male	Athetoid quadriplegia	Mixed spastic-hyperkinetic dysarthria	Direct selection with right hand	Completed high school	6%
7	32	Male	Athetoid quadriplegia	Mixed spastic-hyperkinetic dysarthria	Direct selection with head pointer	Completed 2 years of college	9%

Twenty-four different listeners were randomly assigned to view tapes of each of the 7 speakers, for a total of 168 listeners. Each listener viewed the same speaker producing a different narrative passage in each of the four experimental conditions (habitual speech, alphabet cues, topic cues, and combined cues). Participation took approximately 1 hour. All listeners were currently attending college or graduate school. Gender was not a variable of interest; consequently, no effort was made to balance the number of male and female listeners. Demographic information regarding listeners assigned to each speaker group is provided in Table 2.

> Inclusion criteria required that each listener: (a) pass a pure tone hearing screening at 25 dB SPL for 250 Hz, 500 Hz, 1 kHz, 4 kHz, and 6 kHz bilaterally, (b) be between 18 and 35 years of age, (c) have no more than incidental experience listening to or communicating with persons having communication disorders, (d) be a native speaker of American English, and (e) have no identified language, learning, or cognitive disabilities per self-report. (Hustad, Jones, & Dailey, 2003, p. 465)

Materials

Four narrative passages were employed as speech stimuli. Passages pertained to (a) a sporting event, (b) a natural disaster, (c) purchasing a vehicle, and (d) Independence Day. Specific details regarding the linguistic characteristics of these passages can be found in Hustad and Beukelman (2001, 2002) and Hustad (2001). In short, all passages followed standard American English conventions for content, form, and use, and each consisted of 10 syntactically and semantically predictable sentences. The length of sentences that made up each narrative passage varied between 5 and 8 words, and each passage contained a total of 65 words and 90–92 syllables. All passages had a sixth-grade reading level (Hustad, Auker, et al., 2003; Hustad, Jones, & Dailey, 2003)

Procedures

Data Collection From Speakers With Dysarthria. Following auditory presentation and a written script, speakers with dysarthria were recorded while producing the four narrative passages. Passages were produced a total of four times, once in each of the experimental conditions (i.e., habitual speech, while using alphabet cues, while using topic cues, and while using combined cues). Speakers completed the four experimental conditions in a different order to prevent a learning effect.

Before video and audio recording, speakers were instructed in the use of alphabet, topic, and combined supplementation. For each strategy, the experimenter provided speakers with a verbal description of the strategy, an explanation of the purpose of the strategy, and a model for using the strategy. For the alphabet cues condition, speakers were taught to point to the first letter of each word on an alphabet board at the same time that they produced the word. For the topic cues condition, speakers were taught to point to the topic of narrative on a communication board before producing each constituent sentence of the narrative. For the combined cues condition, speakers were taught to point to the topic of the narrative and then to the first letter of each word while simultaneously producing the word for each sentence in the narrative. Speakers practiced using the three strategies on a set of rehearsal sentences until each indicated that he or she was comfortable with the use of the strategy and until the experimenter determined that each speaker was able to use the strategy with 100% accuracy for selection of first letters and for selection of topics. All 7 speakers had rapid success with learning each of the strategies, and all were able to implement strategies without difficulty while producing the experimental passages. Learning time was less than 15 min per strategy for each speaker (Hustad, Auker, et al., 2003; Hustad, Jones, & Dailey, 2003).

Speakers were video- and audio-recorded in a quiet room within their homes. Speakers wore a Sony ECM-77B lapel microphone that was attached to a Tascam DA-P1 digital audiotape (DAT) recorder. A Canon XL-1 digital camcorder was used for video recording. The background against which speakers were seated and the lighting were both controlled and were the same for all speakers. A laptop computer was positioned directly in front of the speakers during recording (but was not visible on the videotape) and was used for presenting speech stimuli. The video camera was focused on the upper body of each speaker so that a communication board that was situated on his or her lap or lap tray (if the speaker was seated in a wheelchair) and his or her facial features were clearly visible (Hustad, Auker, et al., 2003; Hustad, Jones, & Dailey, 2003).

TABLE 2. Summary demographic characteristics of listeners by speaker group to which they were randomly assigned.

Speaker Group	Mean Age of Listeners	*SD*	Number of Male Listeners	Number of Female Listeners	Total Number of Listeners
1	20.79	2.24	10	14	24
2	21.22	3.01	10	14	24
3	20.39	1.62	1	23	24
4	21.42	1.17	6	18	24
5	20.08	1.38	2	22	24
6	21.67	3.18	4	20	24
7	22.91	2.15	8	16	24

Speakers were required to direct select the correct alphabet cues, topic cues, and combined cues for all speech stimuli used in the study as determined by experimenter judgment. In addition, they were required to produce all words within each sentence per an auditory model and written script shown on the laptop computer. Speakers were asked to repeat any sentence in which these criteria were not met. Fewer than 10% of the sentences comprising the narrative passages required repetition across speakers. The full protocol took approximately 5 hours, including periodic breaks (Hustad, Auker, et al., 2003; Hustad, Jones, & Dailey, 2003).

Constructing Stimulus Tapes. Procedures for constructing stimulus tapes followed those detailed elsewhere (Hustad, Auker, et al., 2003; Hustad & Cahill, 2003; Hustad, Jones, & Dailey, 2003). In brief, digital video and audio recordings were transferred to computer via digital-to-digital interface (IEEE 1394 for digital video and S/PDIF for audio) so that there was no generational loss of quality. Video recordings of stimulus sentences produced in each of the four experimental conditions (i.e., habitual speech, alphabet supplementation, topic supplementation, and combined supplementation) were edited using Adobe Premiere 6.0 (computer software) for the Macintosh. High-quality audio recordings from DAT of each stimulus sentence were similarly edited and peak amplitude normalized using SoundForge 4.5 (computer software) to ensure that maximum loudness levels of the recorded speech stimuli were consistent across speakers and sentences. The normalized audio files were then matched with the native audio associated with the video samples using auditory–perceptual judgments and visual matching of the native waveform and the higher quality amplitude normalized waveform. Following alignment of the two audio samples, the native audio sample was deleted, leaving only the high-quality amplitude normalized sample from DAT associated with the video of each stimulus sentence.

Because the video camera was positioned directly in front of each speaker, it was nearly impossible to decipher the target letters to which he or she was pointing when implementing each of the three speech supplementation strategies. Therefore, videotapes were digitally enhanced so that cues for each condition were clearly visible. For alphabet cues, the first letter of each word was represented in a box to the right of the speaker's face on the videotape. The onset of each grapheme corresponded to the physical pointing gesture of the speaker and was displayed for the duration of the target word. For topic cues, the topic of each sentence was represented orthographically in a box to the right of the speaker's face on the videotape and was shown for a duration of 3 s immediately before the onset of speech and corresponding approximately with the pointing gesture of the speaker. For combined cues, the topic was displayed first and then individual graphemes that corresponded with the production of each word were displayed following the same conventions as the alphabet and topic cues conditions (Hustad, Auker, et al., 2003; Hustad, Jones, & Dailey, 2003).

Data Collection From Listeners. Listeners independently viewed the broadcast-quality digital videotapes in a quiet, sound-attenuating booth. Each individual listener was seated at a desk and positioned approximately 3 ft away from a 25-in. television monitor. One external speaker and a digital video cassette player were attached to the television. The peak output level of stimulus material was calibrated to approximately 65 dB SPL from where listeners were seated. Calibration of sound output was checked periodically to ensure consistency among listeners (Hustad, Auker, et al., 2003; Hustad, Jones, & Dailey, 2003).

Before beginning the experiment, the experimenter explained to listeners that they would complete four different listening tasks and provided a brief description of each cue condition (task). Listeners were told that their job was to watch and listen, following all instructions presented on the videotape. The experimenter emphasized to listeners that all productions were grammatically correct and meaningful and that the sentences within each task constituted a short story. Listeners were encouraged to write down anything and everything they thought they understood during the short break between the presentation of each sentence, taking their best guess if they were unsure. After transcribing the 10 sentences comprising the narrative passage for each task, listeners were instructed to answer a series of Likert-type questions on the reverse side of their transcription sheet. Finally, the experimenter explained that she would be controlling the videotape from an adjacent control room and that listeners could take as much time as necessary to complete the task (Hustad, Auker, et al., 2003; Hustad, Jones, & Dailey, 2003).

Randomization and Counterbalancing. The order of presentation of the four experimental conditions (habitual speech, alphabet cues, topic cues, and combined cues) was counterbalanced so that each of the 24 listeners in each speaker group viewed the speech supplementation conditions in a different sequence. Across all four tasks, each narrative passage was presented in only one task so that listeners heard different speech stimuli for each task. Finally, assignment of individual narratives to each of the four experimental conditions was evenly distributed across speaker groups and cue conditions so that data for each cue condition represent all narratives (Hustad, Auker, et al., 2003; Hustad, Jones, & Dailey, 2003).

Dependent Measures

The primary dependent variable for this study was listener responses to statements probing attitudes in cognitive, affective, and behavioral domains. Because attitudes were a secondary question in the scope of the larger research project, which focused on speech intelligibility, it was important that the questions could be answered efficiently. Therefore, only one question probing each attitude component was presented to listeners. Specific questions are presented in the Appendix. These particular questions were selected because they directly addressed the three components of attitude, and very similar questions have been used in related research (Gorenflo & Gorenflo, 1991; Hustad, 2001; Lasker & Beukelman, 1999; Light & Binger, 1998). Likert-type ratings from these questions for each listener in each speaker group were subjected to statistical analyses.

For the research questions pertaining to the relationship between intelligibility scores and attitude ratings, intelligibility data published in Hustad, Auker, et al. (2003) and Hustad, Jones, and Dailey (2003), which were collected at the same time as attitude measures reported in this article, were used. In the companion studies (Hustad, Auker, et al., 2003; Hustad, Jones, & Dailey, 2003), intelligibility was measured by calculating the percentage of words transcribed correctly for each experimental task and listener. Transcriptions from each listener were scored by tallying the number of words that were identified correctly based on whether each was an exact phonemic match to the corresponding word in the sentence. This number was then divided by the total number of words possible and multiplied by 100 to yield a percentage intelligibility score for each listener and cue condition (task).

Experimental Design and Analysis

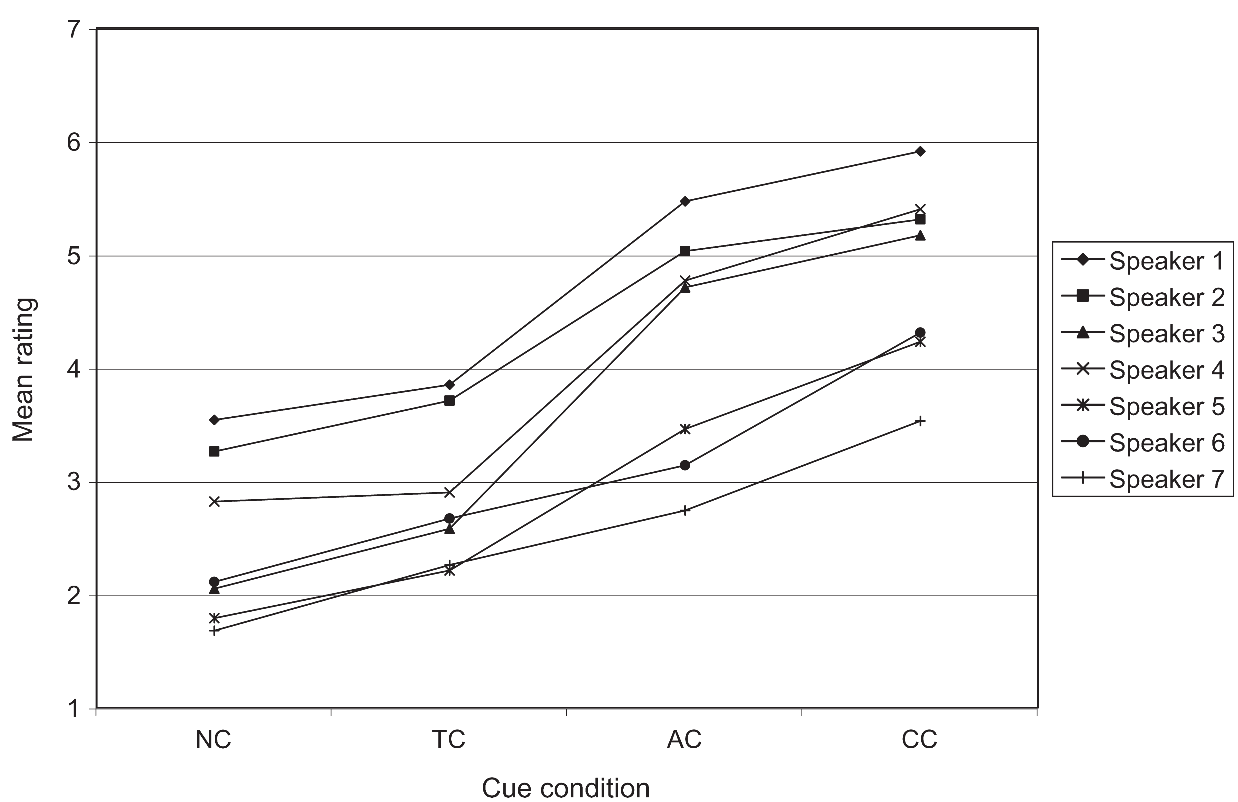
This study employed a 4 × 3 × 7 split plot design (Kirk, 1995). The first within-subjects repeated measure was cue condition, and its four categories were habitual speech, alphabet cues, topic cues, and combined cues. The second within-subjects repeated measure was attitude component, and its three categories were cognitive, affective, and behavioral. The between-subjects measure was speaker group, with each of the 7 different speakers randomly assigned a different group of 24 listeners. Because of the heterogeneity of the population of speakers studied, and because of a desire to characterize individual differences in results, separate analyses of variance were performed for each speaker. Thus, a series of seven fully factorial multivariate analyses of variance (MANOVA), which were each treated as a totally within-subjects design (3 × 4), was performed. To control the Type I error rate, the Bonferroni procedure was used. For each speaker, three omnibus tests and nine planned follow-up contrasts were performed. Each speaker was allotted a total alpha level of .05, which was evenly divided among the 12 statistical tests. Consequently, a probability value of $\leq .004$ was necessary for a test to be considered significant. For the correlational analyses, individual data and pooled data across speakers were both examined. However, statistical tests of significance were not performed because the strength of the relationship between variables from a descriptive perspective was of primary interest.

Results

Cue Conditions

Mean attitude ratings by speaker and cue condition are shown in Figure 1. Across all speakers and attitude

FIGURE 1. Mean attitude ratings (averaged across all three components) by cue condition and speaker (NC = no cues [habitual speech], TC = topic cues, AC = alphabet cues, and CC = combined cues).



components, mean ratings were as follows: for habitual speech, the mean was 2.386 (*SD* = 1.599); for topic cues, the mean was 2.806 (*SD* = 1.651); for alphabet cues, the mean was 4.103 (*SD* = 1.811); and for combined cues, the mean was 4.739 (*SD* = 1.737).

MANOVA results revealed a significant main effect of cue condition for each of the 7 speakers (see Table 3 for statistics). For each speaker, six pairwise contrasts were examined to characterize this main effect (see Table 4 for statistics). Results showed three consistent findings across all speakers: (a) Attitudes were significantly higher for alphabet cues than for habitual speech, (b) attitudes were significantly higher for combined cues than for habitual speech, and (c) attitudes were significantly higher for combined cues than for topic cues. The difference in attitude ratings between habitual speech and topic cues was not significant for Speakers 1 through 4; however, topic cues yielded significantly higher attitude ratings for Speakers 5, 6, and 7. In addition, alphabet cues yielded significantly higher attitude ratings than topic cues for Speakers 1 through 5; however, this same difference was not significant for Speakers 6 and 7. Finally, the difference between attitude ratings for combined cues and alphabet cues was not significant for Speakers 1 though 5; however, combined cues yielded significantly higher ratings than alphabet cues for Speakers 6 and 7.

Attitude Components

Mean ratings by speaker and attitude component are shown in Figure 2. Across all speakers and cue conditions, mean ratings were as follows: for the cognitive component, the mean was 3.224 (*SD* = 1.169); for the affective component, the mean was 3.229 (*SD* = 1.221); and for the behavioral component, the mean was 4.073 (*SD* = 1.559).

MANOVA results revealed a significant main effect of attitude component for 6 of the 7 speakers (the main effect of attitude was nonsignificant for Speaker 7). For the 6 speakers evidencing a significant main effect, three pairwise contrasts were examined. Results revealed the same findings for each of the 6 speakers. That is, ratings for the behavioral component were significantly higher than ratings for the cognitive component, ratings for the behavioral component were significantly higher than those for the affective component, and ratings for the cognitive and affective components did not differ from one another.

Interaction Between Cue Conditions and Attitude Components

The interaction between cue conditions and attitude components was not significant for any of the 7 speakers. This finding indicates that cue conditions had a constant effect on attitude components. Figure 3 shows pooled data

TABLE 3. MANOVA omnibus results (Hotelling's *T*) for main effects and interactions.

Source	Value	*df*	*F*	η^2	$1 - \beta$
Speaker 1					
Main effect of cues	4.503	3, 21	31.518*	.818	1.000
Main effect of attitude	2.596	2, 22	28.552*	.722	1.000
Cues × Attitude	0.984	6, 18	2.951	.496	.767
Speaker 2					
Main effect of cues	2.124	3, 21	14.871*	.680	1.000
Main effect of attitude	1.465	2, 22	16.119*	.594	.999
Cues × Attitude	0.458	6, 18	1.374	.314	.401
Speaker 3					
Main effect of cues	9.892	3, 21	69.241*	.908	1.000
Main effect of attitude	2.038	2, 22	25.387*	.698	1.000
Cues × Attitude	1.056	6, 18	3.169	.514	.800
Speaker 4					
Main effect of cues	5.126	3, 21	35.881*	.837	1.000
Main effect of attitude	2.003	2, 22	22.028*	.667	1.000
Cues × Attitude	1.197	6, 18	3.592	.545	.854
Speaker 5					
Main effect of cues	2.945	3, 21	20.615*	.747	1.000
Main effect of attitude	1.142	2, 22	12.561*	.533	.991
Cues × Attitude	0.223	6, 18	0.670	.182	.202
Speaker 6					
Main effect of cues	3.302	3, 21	22.411*	.762	1.000
Main effect of attitude	1.206	2, 22	13.261*	.547	.994
Cues × Attitude	0.366	6, 18	1.099	.268	.322
Speaker 7					
Main effect of cues	3.138	3, 21	21.969*	.758	1.000
Main effect of attitude	0.441	2, 22	4.854	.306	.742
Cues × Attitude	0.181	6, 18	0.544	.153	.168

*$p < .001$.

TABLE 4. Follow-up contrasts for significant omnibus tests.

Contrast	Speaker 1	2	3	4	5	6	7
Main effect of cues							
TC vs. NC (mean diff)	0.306	0.444	0.528	0.083	0.417	0.556	0.5833
t(23)	0.842	1.434	2.120	0.353	3.158*	3.183*	3.519*
Cohen's *d*	0.214	0.304	0.544	0.067	0.418	0.517	0.555
AC vs. NC (mean diff)	1.924	1.764	2.653	1.951	1.667	1.028	1.056
t(23)	8.017*	5.961*	9.708*	4.894*	5.254*	4.864*	5.142*
Cohen's *d*	1.615	1.142	2.336	1.343	1.352	0.868	0.998
CC vs. NC (mean diff)	2.368	2.042	3.111	2.583	2.458	2.194	1.847
t(23)	8.935*	5.694*	12.428*	8.755*	8.190*	8.491*	8.302*
Cohen's *d*	2.125	1.391	2.867	2.031	1.807	1.568	1.725
AC vs. TC (mean diff)	1.681	1.319	2.125	1.868	1.25	0.4722	0.4722
t(23)	4.770*	3.832*	10.200*	5.632*	3.884*	1.844	2.442
Cohen's *d*	1.267	0.841	1.657	1.341	0.955	0.402	0.394
CC vs. TC (mean diff)	2.063	1.597	2.583	2.500	2.042	1.634	1.264
t(23)	6.060*	4.089*	10.950*	9.820*	7.033*	6.694*	5.144*
Cohen's *d*	1.710	1.070	2.087	2.078	1.428	1.179	1.045
CC vs. AC (mean diff)	0.444	0.2778	0.458	0.632	0.792	1.167	0.792
t(23)	2.186	0.801	2.021	2.828	3.111	4.655*	4.140*
Cohen's *d*	0.489	0.177	0.334	0.445	0.494	0.791	0.651
Main effect of attitude							
Cog vs. Behav (mean diff)	1.094	0.813	1.052	0.792	1.021	1.625	
t(23)	6.754*	3.321*	6.637*	3.434*	4.249*	5.257*	NA
Cohen's *d*	1.277	0.679	0.996	0.702	0.834	1.227	
Cog vs. Aff (mean diff)	0.177	0.052	–0.083	–0.021	–0.292	–0.479	
t(23)	1.346	0.263	–0.763	–0.131	–2.145	–2.731	NA
Cohen's *d*	0.191	0.044	0.092	0.022	0.322	0.446	
Behav vs. Aff (mean diff)	1.271	0.865	0.968	0.7708	0.729	1.146	
t(23)	7.381*	5.804*	6.929*	6.407*	5.110*	4.503*	NA
Cohen's *d*	1.333	0.632	0.899	0.616	0.558	0.784	

Note. TC = topic cues; NC = no cues (habitual speech); AC = alphabet cues; CC = combined cues; Cog = cognitive; Behav = behavioral; Aff = affective.

*$p < .004$.

across speakers by attitude component and speaking condition.

Relationship Between Attitude Ratings and Intelligibility Scores

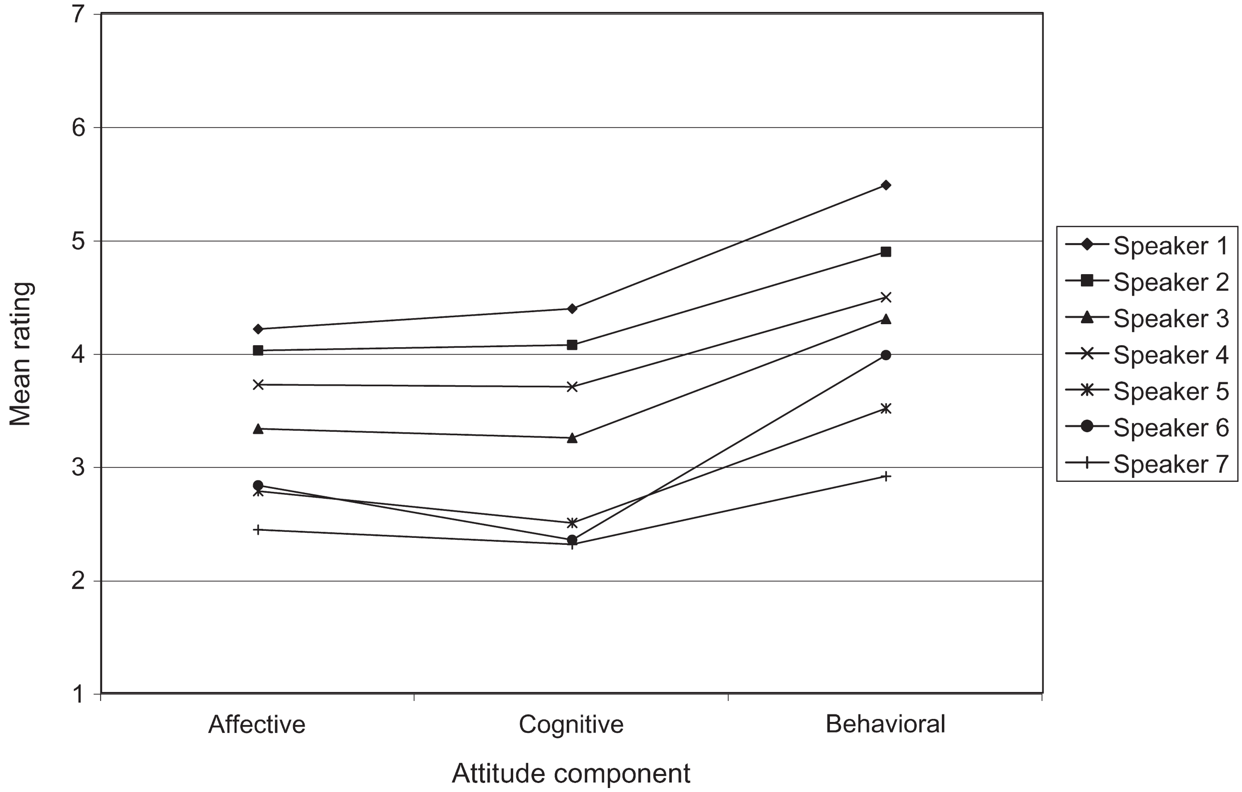
A series of Pearson product moment correlation coefficients was computed to examine the relationship between intelligibility scores and attitude ratings (intelligibility scores are shown graphically in Figure 4). Values for each speaker group were determined by correlating bivariate pairs consisting of individual listener intelligibility scores and individual listener attitude ratings (across attitude components) associated with habitual speech, alphabet cues, topic cues, and combined cues for each speaker group. The following correlation coefficients resulted: for Speaker 1, $r = .664$; for Speaker 2, $r = .599$; for Speaker 3, $r = .848$; for Speaker 4, $r = .724$; for Speaker 5, $r = .744$; for Speaker 6, $r = .552$; and for Speaker 7, $r = .615$.

When mean intelligibility scores by cue condition within each of the 7 speaker groups were correlated with mean attitude ratings (across components) by cue condition within each of the 7 speaker groups, a correlation coefficient of $r = .94$ resulted (see Figure 5). When data from individual attitude components were substituted into this equation, the relationship between intelligibility and the cognitive component was .96, the relationship between intelligibility and the affective component was .93, and the relationship between intelligibility and the behavioral component was .94.

Discussion

The present study examined listener attitudes toward 7 speakers with dysarthria associated with cerebral palsy who implemented each of three speech supplementation strategies and a habitual speech control condition. Overall results for attitude ratings were similar, but not identical, to results published in two earlier articles examining intelligibility scores associated with implementation of these strategies. Although there were some individual differences in the attitude ratings associated with the cue

FIGURE 2. Mean attitude ratings (averaged across all speaking conditions) by attitude component and speaker.



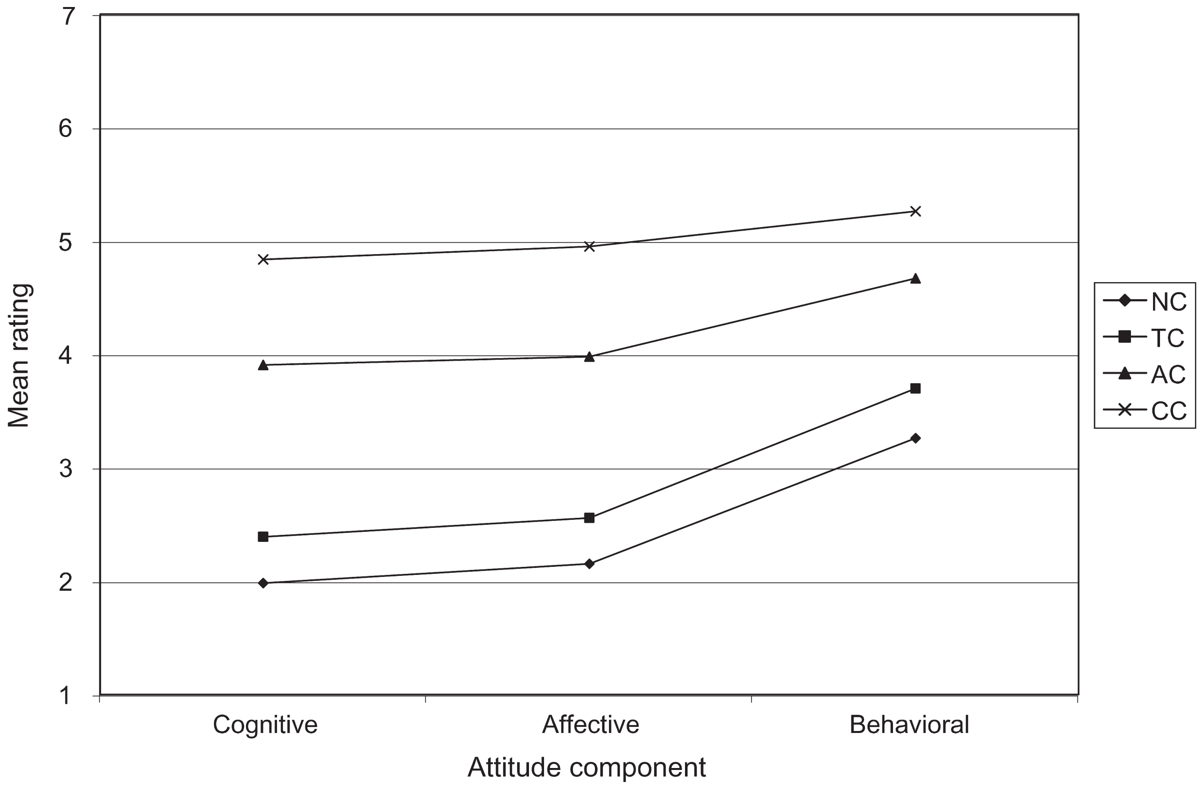
conditions, several findings were consistent across all speakers. Further, when each of the three components of attitude—cognitive, affective, and behavioral—was examined individually for each speaker, results showed that for all but 1 speaker, ratings for the behavioral component were higher than ratings for the other two components. Interestingly, there was no interaction between attitude components and cue conditions for any of the speakers, suggesting that ratings for each attitude component were affected similarly by the different cue conditions. Results examining the relationship between intelligibility scores and attitude ratings for each speaker were generally strong and positive. When summary attitude and intelligibility data for each speaker and cue condition were entered into one correlation equation, the relationship was .94, providing clear indication that attitude ratings increase linearly with intelligibility scores. Findings are discussed in detail below.

Effects of Speech Supplementation Strategy Use on Overall Attitudes

All speakers in the present study had habitual intelligibility scores that were less than 30% as measured by the SIT (Yorkston et al., 1996). However, there were two subgroups within the larger group—speakers who were severely impaired and speakers who were profoundly impaired. There were three findings related to the effects of speech supplementation strategies on mean listener attitudes that were consistent across all 7 speakers. First, alphabet cues resulted in higher attitude ratings than habitual speech. Second, combined cues resulted in higher attitude ratings than habitual speech. Third, combined cues resulted in higher attitude ratings than topic cues. These results are consistent with intelligibility findings reported in Hustad, Auker, et al. (2003) and Hustad, Jones, and Dailey (2003) (see Figure 4 for a graphic illustration of intelligibility data).

Results for the comparisons examining differences between topic cues and no cues, topic cues and alphabet cues, and combined cues and alphabet cues seemed to depend on the severity of the individual speaker, with two patterns of results emerging. For each of the 4 individuals with severe dysarthria (Speakers 1 through 4), there was no difference between attitude ratings associated with topic cues and habitual speech. Further, alphabet cues resulted in higher attitude ratings than topic cues, and there was no difference in attitude ratings between combined cues and alphabet cues. These results for attitude ratings followed the same pattern as those reported in Hustad, Jones, and Dailey (2003) for intelligibility, suggesting that listener attitudes toward speakers with severe dysarthria closely mirror their performance on intelligibility tasks. This observation is interesting considering that listeners did not receive any feedback on intelligibility tasks, and suggests that listeners have reasonably good insight into their own performance. These findings further indicate that topic

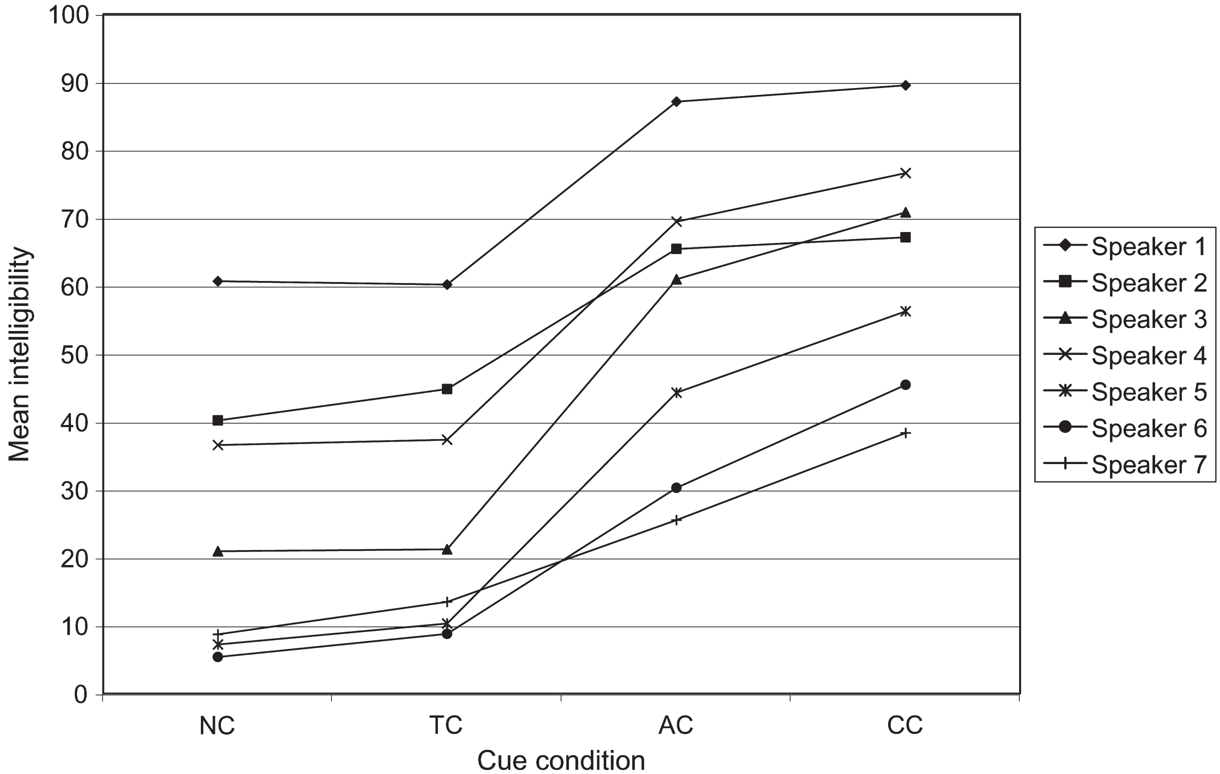
FIGURE 3. Mean attitude ratings (averaged across all speakers) by attitude component and speaking condition.



cues (alone and in combination with alphabet cues) did nothing to enhance listener attitudes toward speakers with severe dysarthria, likely because topic cues did not improve intelligibility. Thus, alphabet cues alone would seem to be the most efficient strategy that enhances both intelligibility and listener attitudes toward speakers with severe dysarthria. It is also important to note that for alphabet cues and combined cues, mean ratings across the 4 speakers with severe dysarthria were generally quite positive (between 4.75 and 6.0 on a 7-point scale). This is in contrast to mean ratings for habitual speech and topic cues for these same speakers (between 2.8 and 3.8 on a 7-point scale). This observation clearly demonstrates that use of AAC strategies that incorporate alphabet cues results in markedly improved attitudes of listeners, which may in turn result in more communication opportunities for these speakers. When these results are considered in light of speech rate data for the same speakers, presented in Hustad, Jones, and Dailey (2003), it is interesting to note that listeners appeared to be very tolerant of marked rate reductions associated with the implementation of alphabet and combined cues. That is, average rate decreases of 70% did not seem to have a detrimental impact on attitude ratings associated with combined and alphabet cues, suggesting that the cost (time) of these strategies was worth the benefit (intelligibility).

For each of the 3 individuals with profound dysarthria (Speakers 5 through 7), topic cues resulted in higher attitude ratings than habitual speech. For Speakers 6 and 7, there was no difference in attitude ratings between alphabet cues and topic cues, and combined cues resulted in higher attitude ratings than alphabet cues. These results were different from analogous intelligibility results reported in Hustad, Auker, et al. (2003), suggesting that for speakers with profound dysarthria, intelligibility may interact to a greater extent with other variables to influence the attitudes of listeners. Hustad (2001) suggested that attitude ratings may reflect, in part, what listeners believe to be effort on behalf of the speaker. That is, listener attitudes may be more positive toward strategies in which they perceive the speaker to be trying, regardless of whether the strategy was actually useful for enhancing intelligibility. This is likely the reason that topic cues resulted in higher ratings than habitual speech and combined cues resulted in higher ratings than alphabet cues. However, the different findings among speakers with profound dysarthria, particularly Speaker 5, suggest that individual differences seem to play an important role in listener attitudes. Examination of the mean ratings for each cue condition suggests that although ratings improved when strategies were implemented, attitudes never became particularly positive (the mean rating for combined cues across the three speakers with profound dysarthria ranged from 3.53 to 4.31 on a 7-point scale). These neutral ratings are likely due, in part, to the difficulty that listeners continued to experience in

FIGURE 4. Mean speech intelligibility scores by speaking condition and speaker.



understanding the speakers, even when they implemented combined or alphabet cues.

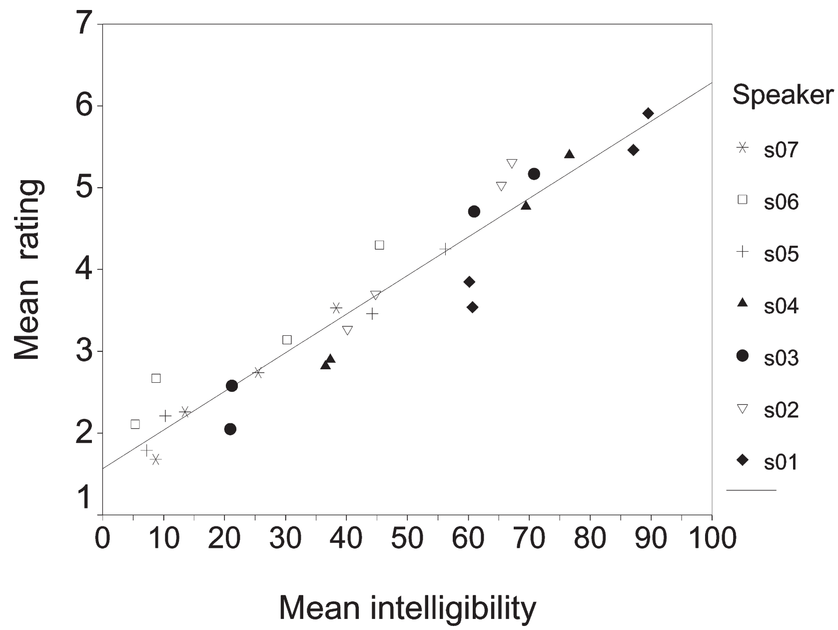
Differences Between Attitude Components

For 6 of the 7 speakers in the present study, there were differences among listener ratings for the three attitude components. In fact, results showed that listener ratings were consistently higher for the behavioral component than for the affective and cognitive components. Further, descriptive data shown in Figure 4 imply that cognitive, affective, and behavioral ratings seemed to be markedly higher for combined cues and alphabet cues than for the other cue conditions. Together, these results suggest that listeners are willing to interact with speakers who have dysarthria, regardless of whether they use speech supplementation strategies. Descriptive data (Figure 3) also imply that all attitude ratings are enhanced by the use of speech supplementation strategies, particularly alphabet and combined cues. Another interesting finding was that there was no difference between listener ratings for affective and cognitive components of attitude. There are two possible explanations for this. First, perhaps listener beliefs and feelings really did not differ from one another; second, perhaps the questions asked of listeners did not allow for differentiation between the dimensions. Nonetheless, cognitive and affective ratings did not seem to have a detrimental effect on listeners' self-reported tendencies to behave, which may be the ultimate goal of improving attitudes.

Relationship Between Attitudes and Speech Intelligibility

Evidence for the hypothesis that attitude ratings are influenced by intelligibility is provided by the consistent strong positive relationship between these two variables for listeners of each speaker. The strength of this relationship varied from .552 to .848 across speakers. Interestingly, the two lowest correlation coefficients were obtained for 2 of the 3 speakers with profound dysarthria, supporting the notion that other variables, in addition to intelligibility, play an important role in attitude ratings. Also noteworthy was that the highest correlation occurred for the third speaker with profound dysarthria, further demonstrating that individual differences have an impact on attitude ratings. The strong relationship between intelligibility and attitude ratings is consistent with the results of Gorenflo et al. (1994), who found that listeners tended to have more favorable attitudes toward speech synthesizers that were rated (using a Likert-type scale) as "easier to listen to." Taken together, these results suggest that AAC strategies that serve to enhance intelligibility are very likely to result in concomitant increases in listener attitudes, which in turn may result in more communication opportunities for individual who use AAC.

FIGURE 5. Relationship between mean speech intelligibility score and mean attitude rating by cue condition. Note that four points are plotted for each speaker: mean attitude rating and mean intelligibility score for the habitual speech condition, mean attitude rating and mean intelligibility score for the topic cues condition, mean attitude rating and mean intelligibility score for the alphabet cues condition, and mean attitude rating and mean intelligibility score for the combined cues condition.



Limitations and Future Directions

There are several important limitations to the present study that restrict the generalizability of results. First, the study employed a traditional experimental paradigm, the nature of which differs tremendously from real communication situations. For example, speakers and listeners did not interact dynamically with one another, and the content, form, and use of messages produced by speakers was scripted. Moreover, speakers were novice users of each of the three speech supplementation strategies. Perhaps after speakers had had more practice and experience with strategy use in interactive contexts, the influence of the strategies on intelligibility, speech rate, and listener attitudes would be different. Another important consideration is that the tapes of speakers that listeners viewed were digitally enhanced so that alphabet, topic, and combined cues were readily visible. In real-life implementation of these strategies, the communication partner would not have the advantage of this type of digital enhancement and would have to look more closely and from a different angle to see the cues. This difference would likely result in an interaction between speaker and listener that was qualitatively different than the experimental situation presented in this experiment. Consequently, attitudes may be different.

Of critical importance is the method by which attitudes were measured, through a series of only three Likert-type questions. Although the construct of attitude and its constituent dimensions—cognitive, affective, and behavioral—are well grounded in the literature, measurement of these dimensions is less straightforward. In the present study, listeners were asked to answer one question designed to target each dimension. Responses to individual questions as well as the mean response on the three questions were used as the dependent variables. Interesting and significant results emerged; however, the construct of attitude and each of the three constituent dimensions are clearly more complex than just three questions would suggest. Future research should seek to either adapt one of the existing instruments with identified psychometric properties (see Gorenflo & Gorenflo, 1991; Beck & Dennis, 1996) or develop a new instrument with well-described psychometric properties to further explore the attitudes of listeners toward individuals who use speech supplementation strategies. Perhaps more importantly, research should examine attitudes as they are evidenced by listener behavior in the milieu. That is, are listeners more likely to interact with someone using combined or alphabet cues than with someone who is not using speech supplementation strategies? Attitudes of familiar communication partners toward speakers who use speech supplementation strategies should also be explored, as should the attitudes of the speakers themselves toward the use of these strategies. Research should also focus on other behaviors and strategies that speakers could implement, such as providing listeners with preparatory information or using other verbal or nonverbal cues, that may serve to improve listener attitudes and thus increase the number of potential communication partners and opportunities available to individuals who use AAC to supplement their speech.

Conclusion

Results of the present study have several important clinical implications for individuals who supplement their speech with AAC strategies. First, implementation of combined cues or alphabet cues results in the highest attitude ratings relative to topic cues and habitual speech. These strategies also result in the greatest intelligibility gains (Hustad, Auker, et al., 2003; Hustad, Jones, & Dailey, 2003). Further, listeners seem to be most willing to communicate with speakers who implement alphabet or combined cues. Finally, although other variables are likely to have an influence on listener attitudes, the present study provides strong evidence that attitudes are closely linked to intelligibility. Consequently, the use of strategies that serve to enhance intelligibility will likely serve to enhance the attitudes of listeners, and particularly the self-reported behavioral tendencies of listeners. The findings of the present study provide important evidence from the perspective of unfamiliar listeners that supports the use of speech supplementation strategies, especially alphabet cues and combined cues, by speakers with dysarthria. These findings could be used clinically as part of an informational package that provides partner-related evidence of the usefulness of alphabet and combined supplementation for enhancing speech intelligibility.

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Appendix

Likert-Type Questions Probing Attitude Components

Cognitive

I think this person is an **effective communicator** using this strategy.

	1	2	3	4	5	6	7	
Disagree strongly								Agree strongly

Affective

I would feel **comfortable** communicating with this person in a class or at work if he/she used this strategy.

	1	2	3	4	5	6	7	
Disagree strongly								Agree strongly

Behavioral

I would be **willing** to communicate with this person in a class or at work if he/she used this strategy.

	1	2	3	4	5	6	7	
Disagree strongly								Agree strongly