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AAC Strategies for Enhancing the Usefulness of Natural Speech in Children with Severe Intelligibility Challenges

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Communication, by its very nature, is multimodal (Kraat, 1987). Human beings communicate by simultaneously using a variety of both verbal and nonverbal means. During early language development, children rely extensively on nonverbal or prelinguistic forms of communication. As children develop language and speech production skills, using multiple modes of communication seems to become less crucial for successful communication. For children who have speech production challenges that result in reduced speech intelligibility, the use of a variety of communication strategies as part of a multimodal communication package is critical for successful communication. Augmentative and alternative communication (AAC) strategies and systems that serve to enhance the effectiveness of natural speech can become important components of a multimodal communication system for these children. In fact, we suggest throughout this chapter that natural speech and multimodal communication strategies that include AAC should not be mutually exclusive options but, rather, complementary strategies.

The purpose of this chapter is to describe communication interventions that incorporate AAC and natural speech for children who have reduced speech intelligibility in any or all communicative contexts. We advocate for an approach to intervention that includes both functionally oriented AAC strategies and more traditional developmentally oriented speech-language interventions. We demonstrate simultaneous use of these approaches through vignettes, which illustrate clinical decision making and prioritization of intervention objectives for three children.

CHILDREN WITH SEVERELY REDUCED SPEECH INTELLIGIBILITY

The children to whom this chapter specifically refers are from diverse etiological groups. Nonetheless, these children share two important communication characteristics. First, all of them have relatively intact language and cognitive skills. That is, their language and cognition are not the primary areas of impairment underlying the communication disability. Second, intelligibility is compromised to such an extent that it is not sufficient for the child to meet his or her communication needs across all contexts. That is, reduced speech intelligibility is the primary communication disability that the child experiences, regardless of coexisting impairments. With varying degrees of success, these children attempt to use connected speech that consists of utterances that are two or more words in length. Implicit in the definition of this population is that these children have intentional, symbolic communication abilities but are unable to make themselves entirely understood via natural speech alone.

Reduced intelligibility is a heterogeneous construct that is defined subjectively in terms of the impact on functional communication. Two children with the same level of intelligibility may have very different functional capabilities. How reduced intelligibility affects a given child depends on a number of variables, such as chronological and/or developmental age, communication partners, context, language and cognitive skills, the use of gestures, the use of compensatory strategies, and previous experience with communication failure. There are no rules regarding what constitutes functionally compromised intelligibility; rather, each child must be considered individually.

Communication disability due to speech intelligibility challenges is always secondary to other underlying impairments, including phonological disorders, developmental apraxia of speech (DAS), cleft palate or other orofacial anomalies, cerebral palsy or other neuromotor disorders, Down syndrome, and mental retardation. Each of these impairments has unique characteristics, communication issues, and clusters of co-occurring impairments. As a result, intervention issues are unique to each etiological group. The intent of this chapter is to provide general principles for integrating natural speech with AAC strategies. Although issues that are specific to particular etiologies are beyond the scope of this chapter, clinicians should consider the characteristics of the underlying etiology and the individual child when designing interventions that target both AAC and natural speech.

Concomitant Communication Behaviors

The occurrence of challenging behavior in some children who have severe communication disorders secondary to mental retardation is well documented in the literature (Beukelman & Mirenda, 1998; Doss & Reichle, 1991; Parrish,

1997; see also Chapter 4). In fact, Reichle and Wacker (1993) devoted an entire book to assessment and intervention strategies for replacing challenging behavior with socially appropriate communicative behavior. Most of the literature on behavioral issues associated with severe communication disorders has focused on individuals whose primary disabilities are cognitive and/or emotionally based.

Little attention has been given to challenging behaviors that are associated with speech intelligibility challenges. Clinical observations and preliminary data suggest several patterns of behavior may be present in children with reduced speech intelligibility. Using parent and teacher surveys, Ball (1999) found that children with moderate to severe intelligibility challenges secondary to DAS consistently exhibited behavior differences relative to peers. Behaviors identified for these children included both social withdrawal and aggression. In addition, it has been observed that children with intelligibility challenges may also become excessively dependent on communication partners.

Our clinical observations suggest that children who exhibit social withdrawal or communication avoidance tend to do so with all but the most familiar communication partners (e.g., parents, siblings). When presented with new situations or even familiar situations that involve new speaking partners, children whose speech is severely unintelligible may choose not to participate in verbal exchanges or even nonverbal activities. Certainly, their experience with restating the same message to no avail reinforces the notion that verbal communication is a frustrating and unsatisfying process. Consequently, children with severely reduced speech intelligibility may appear withdrawn, shy, and unwilling to participate in activities that same-age peers seem to find interesting and intriguing.

Conversely, other children with severely reduced speech intelligibility may exhibit aggressive behavior patterns that are considered excessive in same-age peers. When these children experience communication challenges, rather than withdraw, they are inclined to extend their communicative attempts by expressing themselves in a less acceptable and often more physical manner. They may manifest their frustration with the communication process by hitting, kicking, biting, pushing, and engaging in other combative behaviors. Consequently, these children are forced to cope with the social stigma that is the result of inappropriate behavior.

Finally, children with intelligibility problems may show inordinate dependence on parents or siblings. In situations with unfamiliar listeners or with familiar listeners who do not understand a message, unintelligible children may come to depend on someone else to interpret for them or act as their spokesperson. This dependence can also extend to other areas, such as gross motor skills (e.g., wanting to be carried), fine motor skills (e.g., wanting assistance with eating), hygiene (e.g., not learning to use a tissue or a napkin), or

adaptive skills (e.g., not being toilet trained until the later preschool years). Although some of these dependent behaviors may be unrelated to a communication disorder, we have observed functional dependence in these children even when the only overt disorder is severe unintelligibility.

It appears that these three patterns of behavior are not mutually exclusive but, rather, are context- and partner-specific for some children. Clearly, speech intelligibility challenges can have a serious effect on concomitant communication behaviors. Ideally, clinicians should provide means to support children with severe speech intelligibility challenges as functional communicators while they continue to work toward improving speech production. In essence, clinicians must strike a balance between encouraging ongoing work on speech goals while providing the scaffolding, by way of AAC strategies, for successful communicative interaction across communication environments.

Intervention Options

Historically, speech-language assessment and intervention for children with compromised speech intelligibility has taken a developmental approach with a focus on remediating underlying impairments, such as sound-specific errors and feature-specific processes, to improve speech production skills. Examples of resources for these types of interventions include Hodge and Wellman (1999) for childhood dysarthria; Yorkston, Beukelman, Strand, and Bell (1999) for DAS; Hodson and Paden (1991) for phonological processes; and Golding-Kushner (1995) for cleft palate and velopharyngeal incompetence. Yet, functional communication often remains markedly compromised when compensatory strategies, including AAC options that serve to enhance existing expressive skills, are not addressed as part of a comprehensive intervention package. For many children with speech intelligibility challenges, improvements in underlying impairments (i.e., articulatory, phonological, or motor skills development problems) are slow and may not result in short-term meaningful changes in functional communication. Conversely, using AAC to replace natural speech with intervention focused exclusively on AAC skill development may deprive the child of the chance to optimize speech production and speech intelligibility. Developmentally oriented speech-language interventions that focus on improving underlying speech-language impairments and compensatory communication approaches that focus on augmenting existing skills to improve functional communication need not be mutually exclusive. Both approaches can and should be integrated to best serve children with speech production deficits.

Natural speech is clearly the most efficient mode of communication for those who are able to use it effectively. As such, introducing AAC to children who have speech production capabilities, regardless of intelligibility issues, is often a "hard sell" for clinicians. Family members, educators, and others who are involved with these children often report concerns that introducing AAC

options will have a deleterious effect on any progress that might be made in improving speech production and speech intelligibility. Although there is no definitive research examining the effects of AAC on speech development, the results of a meta-analysis of the AAC literature seem to suggest that implementing AAC systems did not have a negative effect on the development of speech (Millar, Light, & Schlosser, 1999). However, none of the studies that Millar and colleagues examined focused on speech outcomes when speech production and AAC strategies were targeted simultaneously. This is an area where future research is necessary.

Supporting children's ongoing communication needs provides a strong rationale for introducing AAC options, even when one avenue of therapeutic emphasis continues to be speech production. The types of AAC systems that are typically introduced follow a hierarchy of options. This hierarchy encompasses strategies that range from gestures that naturally accompany communication (e.g., pointing) to low-technology communication systems (e.g., communication displays) and on to high-technology AAC systems (e.g., voice output communication aids [VOCAs]).

Gestural Communication Strategies   Gestural communication systems and strategies require manual dexterity and are executed in relation to the body's axis. No external materials or aids are required to use gestures. There are, however, numerous gestural systems from which to choose (e.g., American Sign Language, Manually Coded English, Cued Speech, Amerind). In addition to formalized gestural systems, some gestures seem to be universally present across languages. Gestures such as waving for "good-bye" and head shakes/nods for "no"/"yes" fall into this category. These gestures are readily used and understood by speakers and listeners alike. When an adult speaker with severe dysarthria used gestures concurrently with speech, Garcia and Cannito (1996a, 1996b) found that the participant's speech intelligibility increased by approximately 23%, from 16% when no gestures were employed to 39% when iconic gestures were employed along with speech. In addition, Garcia and Cannito (1996b) found that when gestures alone were presented to listeners, sentence intelligibility was approximately 26%. That is, listeners were able to understand 26% of what the speaker said simply from hand gestures. Taken together, these results clearly indicate that gestures can contribute markedly to the utility of impaired speech. However, generalization of these results to children as yet remains unclear. The selection of gestures to include in a child's repertoire may be guided by the following principles:

- Follow the path of least resistance: Teach common gestures, and encourage the continued use of any socially acceptable gestures within the child's repertoire. Begin with gestures that will have a high payoff in terms of communicative gain across a number of communication environments.
- Capitalize on the child's manual dexterity: Choose gestures that the child can easily produce. Even if a child's manual dexterity is not perfect, ges-

tures should be "readable" enough that the meaning is clear. It is important for the child to produce gestures with enough motor accuracy so that they do not provide the listener with misleading information, which can then result in communication breakdown. In addition, for children with motor impairments, it is important to be certain that the communication benefit from gestures is worth the potential motor expenditure. These issues must be considered on a case-by-case basis with careful consideration of the child's motor skills profile.

- Use pointing as a means of deictic communication and as a clarification strategy: Teach the child to point to referents that are available within the environment to identify or clarify messages. Simply stated, take advantage of situational context with particular emphasis on the referent objects and people around which communication occurs.
- Select gestures to support the child in his or her most problematic communication situations: Teach gestures that alleviate or reduce the communication breakdowns that most frequently occur. Often, family members and others can identify the communication situations in which breakdowns occur regularly.
- Teach familiar and novel communication partners to understand gestural cues: By their very nature, many of the gestural cues used to supplement speech are relatively transparent and can be readily understood by familiar communication partners. When new gestures are incorporated into a child's repertoire, it is nonetheless important that they be introduced in a systematic manner to familiar communication partners. In this way, communication partners are apprised of new additions to the child's repertoire and the flow of communication is not hampered. Beukelman and Mirenda (1998) suggested using gesture dictionaries in which a particular child's gestures are described and the meaning of each is defined.

Gestures often constitute the first tier in communication intervention for children with severe speech intelligibility challenges. Because gestures require only manual involvement for their execution, they are entirely portable and are always "on the child's person." Communication boards are another portable means of supplementing speech, although they are not always on the child's person.

Communication Boards   There are many different types of communication boards; this discussion focuses on two—topic boards and alphabet boards. These types of communication boards, or displays, are intended specifically for use as supplemental aids to communication that is principally conducted via speech.

Topic Boards   Topic boards are low-technology communication displays that consist of photographs, symbols, words/utterances, or all three, depending on the child's literacy skills. Items that are included on a topic board are

usually environment or activity specific and are selected to represent common items, people, and events that occur within the target context. As such, children who use topic boards typically have a different board for each context in which speech is not sufficient to meet their communication needs. Individual topic boards can be either limited in size and scope of items or more detailed and specific, depending on the child's communication needs and the adequacy of natural speech in each context.

Topic boards can be used to indicate a referent or topic that pertains to a message. Hustad and Beukelman (2000) suggested that indicating a topic via written words or pictures serves as a preparatory set for the listener, thereby helping him or her anticipate and/or narrow expectations for the content of messages. In turn, providing this top-down knowledge to the listener serves to enhance the speaker's intelligibility. Research in this area has shown that topic cues increase the intelligibility of adult speakers' sentences by 4%–20% (Bruce, 1958; Carter, Yorkston, Strand, & Hammen, 1996; Dongilli, 1994; Garcia & Cannito, 1996a, 1996b; Monsen, 1983). Hustad and Morehouse (1998) examined how topic cues affected the intelligibility of speech in children with severe intelligibility challenges secondary to phonological disorders and/or DAS. This research showed that topic cues increased intelligibility by approximately 12% across four children.

In practice, implementing topic supplementation involves having the child point to a picture while speaking his or her message. The verbal message produced by the child would ultimately be more complex and elaborate than the topic picture. For instance, if a child were participating in a craft-making activity, to request scissors he or she would point to the picture of scissors on his or her topic board while saying, "Can I please have the scissors?" Should the child only point to the picture without using natural speech, he or she would be cued to "tell me with your speech, too." During initial implementation of this type of strategy, we have used highly structured activities, such as craft making, in which all of the referents are clearly known to all communication partners. This may seem counterproductive because the child could easily obtain the desired item by using gestural strategies rather than the more restrictive topic board. However, we have found this type of situation to be excellent for teaching the concurrent use of topic boards and speech. As children become increasingly successful in highly structured activities, the use of topic boards is introduced into activities that are more spontaneous. Speech production objectives can be easily implemented within topic supplementation activities through careful planning on behalf of the interventionist. That is, activities can be designed that incorporate target sounds and words so that as the child produces speech, he or she is working on speech production in a highly communicative and functional context.

Alphabet Boards   Alphabet boards are similar to topic boards in that they, too, are low-technology communication displays. As the name implies, how-

ever, alphabet boards contain orthographic representations of the letters of the alphabet, numbers, and, often, some conversational control phrases or picture symbols. The size and arrangement of alphabet boards is typically customized according to the child's motor skills. An example of an alphabet board is shown in Figure 13.1. The use of alphabet boards presupposes facility/familiarity with traditional orthography. Clearly, to use alphabet boards, the child minimally must have letter identification skills.

Alphabet boards can be used in several different ways. Perhaps their most obvious use is to spell out individual words and messages. Yet, this can be a very time- and motor-intensive strategy, requiring extensive literacy skills. We recommend this only as a last resort when other strategies have failed.

Alphabet boards can also be used to provide word initial orthophonetic context to listeners in conjunction with natural speech. This type of strategy is known as *alphabet supplementation*. To use alphabet supplementation, the speaker must point to the first letter of each word as he or she speaks it (Hustad & Beukelman, 2000). Consequently, the speaker is providing the listener with complementary information through two modalities simultaneously—the acoustic speech signal and orthographic information that supports decoding of the acoustic speech signal (Hustad, 1999). Alphabet supplementation can also involve the use of a partner-based technique called *shadowing* (Yorkston, Beukelman, & Hustad, 1999). Shadowing involves having the communication partner repeat the letter that the speaker indicates on the board as well as the spoken word. In this way, communication is followed on a word-by-word basis. Should an error in transmission occur, communication breakdown can be repaired at the level of the individual letter and/or word.

Alphabet supplementation also affects temporal properties of the speech signal, resulting in reduced rate of speech and increased word segmentation (Beukelman & Yorkston, 1977). Research suggests that the combined effects

I'll point to the first letter of each word I'm saying.

Please repeat each word after I say it.

A	B	C	D	E	F
G	H	I	J	K	L
M	N	O	P	Q	R
S	T	U	V	W	X
Y	Z	New word	Start over		

Figure 13.1. Sample alphabet board.

of reduced rate and orthophonetic cues can enhance speech intelligibility in adults by as much as 52% (Beukelman & Yorkston, 1977). Because the Beukelman and Yorkston study is the only one of its kind in the literature, additional research is necessary to replicate this effect with both adults and children.

Alphabet supplementation requires a number of prerequisite skills, such as the ability to identify word-initial letters, sound–letter correspondence, and the metalinguistic ability to segment words at their boundaries. There is no published research that examines the skills that are necessary to use alphabet supplementation successfully. Nevertheless, we have found that children as young as 6 years of age, who have intact cognitive and language skills, have been able to begin learning this strategy in structured contexts. Similar to implementing topic boards, we have found the use of structured activities for assessment and teaching to be highly productive. In addition, it is critical that clinician modeling of alphabet supplementation be provided during all initial teaching activities.

Empirical evidence suggests that alphabet supplementation results in greater intelligibility gains than topic supplementation (Hustad, 1999). Therefore, alphabet supplementation is a preferred strategy for children who have the necessary linguistic and literacy skills. Hustad and Beukelman (2001) examined adult speakers with cerebral palsy and demonstrated that using a combined cuing strategy that incorporates both alphabetic and topic cues is superior to either strategy in isolation. These results showed that intelligibility was approximately 15% higher for combined cues than for alphabet cues alone and approximately 23% higher for combined cues than for topic cues alone. From a developmental perspective, the use of topic cues seems to be the simplest speech supplementation strategy, followed by the use of alphabet cues, and, finally, combined cues. Therefore, we recommend that a combined cuing strategy be implemented only after a child has demonstrated successful use of both strategies in isolation.

Voice Output Communication Aids   In some situations, high-technology options such as VOCAs may be introduced to help compensate for speech intelligibility challenges. The range of available VOCAs is broad, such that some support text to speech and others support a limited number of prerecorded messages. For the purposes of this chapter, we discuss the use of VOCAs as speech supplementation strategies and as a means for clarifying messages when they are not understood by listeners. We emphasize situation-specific use of VOCAs as part of a hierarchical communication system.

For children who use speech as their primary means of communication, VOCAs confer some unique advantages over gestures and low-technology aids. With both gestures and communication boards, the communicative interaction must be face to face with the listener physically present and actively interpreting information as it is presented through the visual modality. A

VOCA, however, allows for the introduction of space between child and listener. For example, telecommunication and communication from a distance are possible with VOCAs, but they are difficult if the child uses gestures or communication boards. As speech supplementation strategies, VOCAs can be employed in a similar fashion as that described for topic or alphabetic supplementation. When VOCAs are employed, however, supplemental information is presented via the auditory modality or simultaneously through the auditory and visual modalities, depending on the type of device and the communication partner's position. Typically, supplemental cues are presented prior to the production of words and messages that are produced via natural speech.

In addition, VOCAs can be used to clarify messages for listeners when they are unable to understand what the child is saying via speech plus a supplementation strategy. In this way, the VOCA is used as a measure of last resort for the child to make him- or herself understood. There also may be some special situations in which it is necessary for the child to use his or her VOCA in lieu of natural speech. Examples of this type of situation include communication in extremely noisy situations, with individuals who are hearing impaired, or with novel communication partners. Situations in which the child uses his or her VOCA as a primary means of communication should be decided on a case-by-case basis, with careful consideration given to the severity of the child's speech intelligibility problems and to his or her success with speech supplementation strategies.

There are pros and cons to introducing a VOCA to a child who speaks but has intelligibility challenges. On the positive side, the child has an aid that is powerful and commands attention. On the negative side, the child has additional responsibility for part of his or her communication when using a VOCA. Successful implementation of a VOCA depends on appropriate programming and continued maintenance. Should the VOCA not work for some reason, it is important that the user have a low-technology back-up system handy (e.g., communication boards). Relying on technology can inadvertently leave a child with limited communication options if he or she does not have facility with a nontechnical system as well.

The information presented thus far describes several viable strategies that can be used to enhance the functionality of natural speech for children who have severe speech intelligibility issues. We advocate a hierarchical approach of moving from less to more in terms of strategy use. It is of the utmost importance to consider the individual child when implementing multimodal communication strategies to enhance the utility of natural speech. For children who have patient and capable communication partners and are capable of engaging in revisions that involve conversational repair, we recommend the following hierarchy for strategy use:

1. Say the message by using speech. If the listener does not understand, go to the next step.

2. Say the message by using speech while simultaneously producing gestures or pointing to environmental referents, if available. If the listener does not understand, go to the next step.
3. Say the message by using speech while simultaneously employing a supplementation strategy, either via communication board or a VOCA (use alphabet cues with topic cues if possible, or use alphabet cues alone or topic cues alone). If the listener does not understand, go to the next step.
4. Repeat the message by using a supplementation strategy. If the listener does not understand, go to the next step
5. Use a VOCA to produce the entire message or the components of message that the listener did not understand.

For beginning communicators who are not capable of conversational revision and repair or who have communication partners who are less patient and/or capable (e.g., other children), these guidelines should be modified. Although we advocate a less-to-more approach to communication augmentation, the needs of the individual child always take precedence. For instance, children with more pervasive intelligibility challenges may benefit from a more aggressive approach to communication augmentation in which VOCAs are introduced early in intervention and faded as speech production and intelligibility skills improve. For this type of communicator, the previous hierarchy may be most appropriately implemented in a backward fashion.

VIGNETTES

The three vignettes that follow illustrate the decision-making and intervention prioritization process for children with speech intelligibility challenges. These examples show the diverse skill profiles and issues that might be observed in children who would likely benefit from using speech supplementation strategies in conjunction with traditional speech production oriented interventions.

Assessment Measures

Four different assessment measures were selected to illustrate the ensuing decision-making processes. A number of other formal and informal instruments may be employed in comprehensive assessments of children. Yet, the following measures seem to be most illustrative with respect to the content of this chapter:

1. Khan-Lewis Phonological Analysis (KLPA; Khan & Lewis, 1986): This measure was used to determine the presence of typical and atypical phonological processes at the sound segment level according to age expectations.

2. Index of Augmented Speech Comprehensibility in Children (I-ASCC; Dowden, 1997): This measure was used to assess word intelligibility with and without topic cues. To accomplish this, tape recordings were made of each child as he or she produced 30 different words. Listeners were then asked to listen to the words and write down what they thought the child had said. To measure the effects of topic cues on word intelligibility, listeners were given a single topic word on their transcription forms that was associated with each target word that the child produced. They were asked to transcribe a series of 30 words that were produced by the child under this condition as well. For both measures, intelligibility was calculated as the number of words that were identified correctly from the total number of words.

3. Informal sentence intelligibility measure (Hustad & Morehouse, 1998): This measure was used to determine sentence intelligibility with and without topic cues and alphabetic cues. Similar to word intelligibility measures, recordings were made of each child repeating a collection of 20 short sentences, which were developed to be linguistically appropriate for children older than 3 years. Listeners were asked to transcribe each sentence with topic cues, alphabet cues, and no cues. For each cue condition, information regarding the first letter of each word (for the alphabet cue condition) and the topic of each sentence (for the topic cue condition) was provided on the transcription sheet that was given to the listeners. Intelligibility for each condition was calculated as the number of words that were identified correctly.

4. Informal Discourse Comprehensibility Measure (Hustad & Morehouse, 1998): This measure was used to assess discourse comprehension with and without topic cues. Again, recordings were made as each child repeated a 10-sentence narrative. Listeners were required to answer simple, factual comprehension questions regarding the narrative with and without topic cues, which were delivered as previously described.

Connor

Connor was a 5-year-old boy who had dysarthria secondary to cerebral palsy. He had mild cognitive and language impairments and moderate gross and fine motor impairments. Connor was a highly verbal and interactive child who frequently told stories and readily sought interaction with other children and adults. Although other children often had difficulty understanding Connor's speech, he was not easily deterred from communication attempts. When communication partners indicated that they did not understand him, Connor repeated his message or narrative, embellishing his verbal productions with gestures. Connor was a persistent communicator who continued his attempts until his partners understood his message. Yet, Connor often expended ex-

tensive amounts of time and energy in an attempt to convey his messages. Connor's speech intelligibility was moderately reduced overall, but when he became frustrated, intelligibility was further reduced because of increased spasticity and muscle tone in his speech musculature.

Formal and informal assessment measures at the sound segment level indicated that developmental articulation errors and phonological processes were not particularly prevalent for Connor. Because of the neuromotor etiology of Connor's disability, however, a number of dysarthric characteristics were present in his speech, such as mild consonant distortions, reduced respiratory support, and mild hypernasality. Overall, targeting developmental processes with Connor would not likely affect his speech intelligibility markedly in the short-term, as his underlying neurological impairments could not be alleviated. Yet, because Connor was a child, his gross and fine motor skills, including speech production, would continue to develop and change. Therefore, intervention should not entirely disregard sound segment and connected speech production skills.

Table 13.1 presents the results of the assessment measures for Connor. Measurement of speech intelligibility showed that Connor's word-level productions were 61% intelligible, sentence-level productions were 52% intelligible, and connected narratives were 43% understandable to unfamiliar listeners. When listeners were provided with topic cues, however, word intelligibility increased to 92% (a 31% gain), sentence intelligibility increased to 65% (a 13% gain), and narrative comprehensibility increased to 50% (a 7% gain). When alphabetic cues were provided to listeners, sentence intelligibility increased to 76% (an 11% gain from topic cues and a 24% gain from no cues).

These data suggested several important things. Connor's speech intelligibility decreased as length and complexity increased—words were most intelligible, followed by sentences, and, finally, connected discourse. We suspected that this finding may have been due to Connor's rapid rate of speech, his difficulty with word segmentation, and his motor-coordination problems. Connor benefited when topic cues were provided to his listeners; however, this benefit decreased as the length and complexity of his messages increased. Although the effectiveness of alphabetic cues was only measured at the sentence level, results suggested that Connor's speech intelligibility was optimal when alphabetic cues were provided to his listeners.

Table 13.1. Assessment measures for Connor

	Word intelligibility	Sentence intelligibility	Narrative comprehensibility
No cues	61%	52%	43%
Topic cues	92%	65%	50%
Alphabetic cues	—	76%	—

Overall, Connor's communication profile clearly indicated a need for AAC strategies to supplement speech, particularly for sentence and narrative length productions. In addition, speech intervention was necessary to focus on coordination and rate reduction. Because Connor did not yet have literacy skills that were sufficient for him to use alphabet supplementation accurately—cues were experimentally imposed for the previously presented measures—this strategy would not be addressed in intervention at this time. Yet, as Connor became increasingly literate, we would continue to assess the feasibility of having him use alphabet supplementation. Connor's intervention plan was prioritized as follows:

1. Introduce low-technology AAC topic boards. Teach the integration of natural speech and pointing to the referent or topic for addressing communication breakdowns.
2. Work on the segmentation of words in connected speech to improve listeners' ability to identify word boundaries.
3. Work on reducing the rate of speech to provide listeners with more processing time.
4. Introduce a VOCA as a backup and replacement for natural speech when listeners are unable to understand speech that is supplemented with pictures.
5. Teach the hierarchical use of communication strategies. Focus on enhancing an awareness of listeners' understanding.

Jenny

Jenny was a 6-year-old girl who had a primary diagnosis of DAS. Although Jenny's expressive language was moderately delayed, her cognitive and gross motor skills were within age-expected levels. Jenny had a history of chronic otitis media, allergies, hyperactivity, and challenging behavior that was associated with communication problems. Jenny's speech intelligibility was moderately compromised, and she experienced difficulty communicating effectively across all contexts. During communicative interactions when listeners did not understand her, Jenny often did not persist in her communicative attempts. In addition, she was somewhat socially isolated from peers because of their inability to understand her and because of her unconventional communication behavior. Jenny used behaviors to attain positive reinforcement as well as negative reinforcement. For example, she used physical aggression to gain attention and access to tangible items that were associated with specific activities. In addition, she became reluctant to attempt verbal communication to avoid communication failure with her peers. Jenny's behaviors tended to alienate her communication partners and further increased her social isolation.

Assessment at the sound segment level revealed that Jenny used a number of phonological processes. In fact, she incorrectly produced approximately 40% of target consonants. In addition to, and possibly because of, Jenny's sound production challenges, she also had difficulty with the syntactic and morphological aspects of spoken language. Her utterances contained multiple morphophonological errors that affected structures such as regular plurals (stridency deletion) and regular past tense (final consonant deletion). These errors seemed to further reduce her speech intelligibility.

Table 13.2 presents the results of the assessment measures for Jenny. Measurement of speech intelligibility showed that Jenny's word level productions were 38% intelligible, sentence-level productions were 60% intelligible, and connected narratives were 73% understandable to unfamiliar listeners. When listeners were provided with topic cues, word intelligibility increased to 82% (a 44% gain), sentence intelligibility increased to 75% (a 15% gain), and narrative comprehension remained at 73%. When alphabetic cues were provided to listeners, sentence intelligibility increased to 88% (a 13% gain from topic cues and a 28% gain from no cues).

These data showed that as the length and complexity of Jenny's production increased, her intelligibility and understandability increased. This pattern of results was quite different from the pattern observed with Connor, and it is what we would expect based on the intelligibility literature (Dongilli, 1994; Miller, Heise, & Lichten, 1951). For intelligibility tasks, Jenny showed a marked benefit when topic cues were provided to her listeners. For the narrative comprehension task, provision of cues did not differ from provision of no cues. Again, the effects of alphabet cues were measured only at the sentence level, but the results suggested that optimal intelligibility was obtained under this condition.

Jenny's communication profile clearly demonstrated that she benefited from the use of speech supplementation strategies, particularly at the word and sentence levels. In addition, her behavioral manifestations of communication frustration suggested an immediate need for intervention that focused on functional communication. Jenny's maximum intelligibility and comprehensibility levels were 88% (with alphabetic cues) and 73% (with topic cues), respectively; therefore, intervention with a VOCA did not seem to be warranted.

Table 13.2. Assessment measures for Jenny

	Word intelligibility	Sentence intelligibility	Narrative comprehensibility
No cues	38%	60%	73%
Topic cues	82%	75%	73%
Alphabetic cues	—	88%	—

Because Jenny showed age-appropriate literacy skills, the use of alphabet supplementation would be introduced in highly structured therapeutic contexts and, over time, generalized to broader conversational contexts. The use of alphabet supplementation could easily be combined with speech production objectives to target the remediation of sound segment errors. Jenny's intervention plan was prioritized as follows:

1. Introduce low-technology AAC topic boards. Teach the integration of natural speech and pointing to the referent or topic while speaking in words or isolated sentences.
2. Emphasize the provision of context through the verbal production of narratives or contiguous messages that maintain topical cohesion. This might be accomplished through partner dependent prompting (e.g., "Tell me more," "What else?").
3. Introduce alphabet supplementation strategies, and work on first letter identification of words in structured contexts.
4. Address phoneme- and process-specific speech production errors in word and connected speech.
5. Teach the hierarchical use of communication strategies as discussed previously. Focus on enhancing an awareness of listeners' understanding.

Eli

Eli was a 4-year-old boy who had typical cognitive skills, a mild language impairment, and severely impaired speech production skills. Eli's gross motor skills were within normal limits; however, he had difficulty with fine motor skills. He sought interaction with other children and adults, but his attempts to communicate were often unsuccessful because of his reduced speech intelligibility. In addition, Eli was easily frustrated by his unsuccessful communication attempts and often exhibited physically aggressive behavior toward peers and himself when others failed to understand him. Eli did not use gestures or environmental cues (e.g., pointing to referents in the environment, using universal gestures) to enhance his spoken communication.

Assessment measures at the sound segment level indicated that Eli frequently made developmental articulation errors and used phonological processes that followed an atypical pattern, with many nondevelopmental processes present. Oral-motor examination revealed motor planning difficulties that were characterized by oral groping behavior as well as coordination difficulty on repeated productions of single words and multisyllabic word productions. Eli had received speech-language intervention that specifically targeted phonological processes, articulation, and motor planning, but there was minimal progress and virtually no change in his functional communication skills.

Table 13.3. Assessment measures for Eli

	Word intelligibility	Sentence intelligibility	Narrative comprehensibility
No cues	3%	3%	3%
Topic cues	33%	11%	17%
Alphabetic cues	—	28%	—

Table 13.3 presents the results of the assessment measures for Eli. His speech intelligibility was measured to be 3% at the word-level and 3% at the sentence-level. His connected narratives were also only 3% understandable to unfamiliar listeners. When listeners were provided with topic cues, word-level intelligibility increased to 33% (an improvement of 30%), sentence-level intelligibility increased to 11% (an improvement of 8%), and narrative comprehension increased to 17% (an improvement of 14%). When alphabetic cues were provided to listeners, sentence intelligibility increased to 28% (a 25% gain from no cues and a 17% gain from topic cues).

Although the data indicated that speech supplementation strategies markedly enhanced Eli's intelligibility and understandability, his speech intelligibility and understandability continued to be severely impaired. Consequently, implementing these strategies might not provide meaningful functional improvement. Eli's communication profile suggested that a VOCA was necessary to enhance functional communication skills. Eli's intervention plan was prioritized as follows:

1. Introduce VOCAs immediately. Focus intervention on operational, social, linguistic, and strategic competencies (Light, 1989). Encourage the use of natural speech with VOCA for future integration of speech and AAC.
2. Encourage and increase the use of gestures and other paralinguistic cues, such as pointing to environmental referents to facilitate the exchange of meaning.
3. Work on speech production skills, including sound segments, coordination, and sequencing.
4. As speech production skills and, subsequently, speech intelligibility improve, reassess the usefulness of speech supplementation strategies.

CONCLUSION

In this chapter, we have described communication strategies and intervention options for children who have reduced speech intelligibility such that they are unable to meet their communication needs across all contexts. We have

advocated for a communication approach in which natural speech, supplemented by AAC strategies, is regarded as the primary mode of communication for all but the most severe cases. In addition, we have recommended using a hierarchy of communication strategies that move from less to more dependency on AAC. Finally, we have emphasized that functionally oriented AAC interventions and developmentally oriented speech interventions should not be mutually exclusive options for children who have speech intelligibility challenges.

Only preliminary research exists on the efficacy of speech supplementation strategies for children with speech intelligibility challenges. Experimental as well as clinically based research is necessary to further the field's understanding of how these strategies influence speech intelligibility and the prerequisite skills that are necessary for the use of speech supplementation strategies. Other avenues of related investigation might include intervention paradigms to facilitate learning and the successful use of strategies, the partner's role in successful communication strategies, and the listener's perceptions of communicative competence and effectiveness when strategies are employed. Finally, the effects of supplementation strategies on the development of natural speech and speech intelligibility are important areas for future study.

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14

The Role of Language Comprehension in Establishing Early Augmented Conversations

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Language comprehension is the ability to understand what is said so that one can function as a listener in communicative exchanges. Conversely, language production is the ability to express information so that one can function as a speaker in conversational exchanges. For an individual to develop functional communication skills, he or she must be able to comprehend *and* produce language so that he or she can take on the reciprocal roles of both listener and speaker in conversational exchanges (Sevcik & Romski, 1997).

Augmentative and alternative communication (AAC) systems have typically provided an output mode so that an individual can produce communications and engage as a speaker in conversations with others to express his or her wants, needs, feelings, and ideas. Although this role is essential and permits the individual to have a visible communicative effect on his or her environment, it does not exist in isolation (Romski & Sevcik, 1993). There is the presumption that the individual can also take on the role of listener or receiver of messages in a conversation. To assume the role of message receiver, the individual must be able to understand the information that is being conveyed to him or her by a range of communicative partners. For beginning communicators, a primary focus on production may actually make learning to communicate via AAC systems extremely difficult. In these cases, the individual is asked to produce communications with the assumption that he or she has an adequate foundation of understanding on which to build these AAC productions.

In this chapter, we explore the role that language comprehension can play for beginning AAC communicators. The first section of this chapter provides