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AAC Augmentative and Alternative Communication

Rate and Quality of Conversations Using a Text-Storage AAC System: Single-Case Training Study

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"TALK" is a text-storage and retrieval AAC system designed for literate people who are unable to speak. It aims to support free-flowing social conversation by means of features that model pragmatic aspects of unaided conversation. A single-case, six-phase training study was carried out to help a user to take advantage of the pragmatic potential of the system. She had 10 conversations in a baseline phase, 4 following each of 4 training interventions (about 6 hours in total), and 4 in a maintenance phase. Over phases, her average prespeech pause times decreased (from 9 to 5 seconds) and her conversational rate increased (from 36 to 64 words per minute). Participant and observer ratings indicated that the quality of the conversations increased and perceptions of the user's competence and personal qualities became more positive as her conversational rate increased. Speed and rating gains were sustained in the maintenance phase.

KEY WORDS: aided conversation, communicative competence, conversational rate, holistic phrases, pragmatic intervention, text prestorage, time delay

TEXT STORAGE

Good-quality synthesized speech output from text input is now widely available on laptop computers. This means that, in principle, assuming that some suitable input interface can be provided, people who are literate but unable to speak ought to be able to communicate by inputting text and outputting it as speech. This is fairly straightforward when the goal is to communicate frequently occurring needs and wants, such as "Will you turn the television on?" or "I'd like to go out soon." The user can prestore phrases such as these and subsequently select one to be spoken as appropriate.

Similarly, there is relatively little difficulty with highly routine exchanges where anticipation of required utterances is possible. An obvious example is "greeting and leaving" exchanges, as implemented in CHAT (Alm, Arnott, & Newell, 1992). In that system, to avoid boring repetitiveness, alternative utterances for each stage of a greeting or parting interaction are stored "behind" a label, and one of these is randomly selected for output when the user clicks the label. For example, the first move in a greeting exchange might be labeled "Hello," with entries such as "Hi," "Hello," "Hi there," and "Hiya" stored behind the "Hello" label. Subsequent moves might be represented by labels for inquiring after health (e.g., "How"), responding to such inquiries (e.g., "Fine"), commenting on how long since a previous meeting (e.g., "When"), and so on. Many transactional exchanges, such as ordering at a restaurant, are also sufficiently routine to be loosely scripted and are therefore amenable to the same approach, although usually without the random element. Examples of systems using this approach are ScriptTalker (Dye, Alm, Arnott, Harper, & Morrison, 1998) and SchemaTalk (Vanderheyden & Pennington, 1998).

The advantages of using prestored text in the foregoing examples are speed of output and reduction of input effort due to reuse of utterances. Speed of output is particularly important because augmentative and alternative communication (AAC) systems are often underused, with slowness of output being the most frequently given reason (Salminen et al., 1995). When output is slow, there is strong pressure to produce very short utterances (often limited to "yes" and "no") and for control of the conversation to reside firmly in the hands of a speaking partner (Buzolich & Wiemann, 1988). When there are long pauses before the responses of AAC users, this tends to reduce enjoyment of the social exchange for both partners and to lead to negative impressions of users' communicative and general competence (Eulenberg, 1984).

As we move beyond highly routine exchanges, the potential for increasing output speed by prestoring

phrases seems more limited. Certainly, in casual, social conversation, where there are no restrictions on conversational direction, it will be impossible to predict precisely what a partner might say and, therefore, what phrases will provide ideal responses. Furthermore, the more possible directions that are to be covered, the more phrases will need to be stored and the longer it will take to find one when it is needed. The task of providing a structure to help users anticipate large numbers of usable phrases and to find any one of them rapidly when it is required is formidable (Light, Lindsay, Siegel, & Parnes, 1990). This has led most developers of conversation aids to focus on the use of phrase prediction systems and coding schemes to speed the construction of novel phrases during a conversation. Unfortunately, there appear to be diminishing returns from enhancements in these areas, and online text generation usually restricts conversational output to between 2 to 15 words per minute (wpm) (Beukelman & Mirenda, 1998), which is far too slow to support socially effective conversation.

Holistic Phrases in Conversation

There are characteristics of unaided social conversation that suggest that the potential role of text prestorage may have been underestimated. Even in natural conversation, there is a tension between the requirements of precision and speed. Carefully constructed responses make heavy demands on an individual's limited processing resources. Sometimes, a speaker will find the generation of a novel utterance to be worth the delay occasioned by the intensive processing involved. On the other hand, rapid recall of a complete phrase from memory is often the preferred option, even though it is only a rough approximation to an "ideal" novel response. The quick and approximate option is particularly prevalent when social aspects of the conversation predominate. Communicative competence requires that we use our ability to retrieve stored, holistic utterances when these support our conversational goals, freeing our generative power for use when it is important to be novel or precise (e.g., Wray, 1998).

A wide range of terms has been used to refer to holistic units of speech that are larger than a single word. Wray and Perkins (2000) listed about 50 such terms, some of which suggest important distinctions. We will not be concerned, however, with these theoretical distinctions and will simply use the term "holistic phrases" to refer to all units that can be stored (whether in memory or in an AAC system) for subsequent retrieval. On the issue of the importance of holistic phrases in communication, most theorists now concur that generative and retrieval strategies must be in some sort of mutually beneficial interaction (Wray, 1998). In terms of the balance between them, Bolinger (1976, p. 2) claims that "speakers do at least as much remembering as they do putting together," and Becker (1975) suggests that it is the holistic phrases that have the upper hand. More recently, Nattinger (1988) characterized speech as "basically a 'compositional' process, one of 'stitching together' preassembled phrases into discourse" (p. 76); this is a fairly typical view among theorists (e.g., Fillmore, Kay, & O'Conner, 1988; Pawley & Syder, 1983; Sinclair, 1991; Weinert, 1995).

There are several strands of evidence supporting the ubiquity of holistic phrases in natural conversation. Ball, Marvin, Beukelman, Lasker, and Rupp (1998), for example, found that almost half of the utterances of young children could be classified as "generic small talk." Moreover, as hinted above, the term "holistic phrase" can be used to cover a wider variety of functions than apply to generic small talk. Some holistic phrases may, for example, be quite specific and be used only once, as when an answer to an anticipated question is rehearsed ahead of time. In such a case, it may be very difficult for an observer to know whether the phrase was generated at the time or recalled from memory, so the incidence of holistic utterances is likely to be underestimated. Although there will be many occasions when classification of an utterance as generative or holistic will be a subjective judgment, when a phrase occurs repetitively in an unchanged form, it is likely that it is holistic. Using this objective criterion for identification of holistic phrases, Altenberg (1990) found that roughly 70% of the running words in a large corpus of spoken English formed recurrent word combinations. Another feature of holistic phrases is that they tend to be approximate, as opposed to precise, responses—although, as the above example of a carefully prepared answer makes clear, this is not a necessary characteristic of holistic utterances. Nonetheless, Langer (1978) provided experimental evidence that carefully considered precise responses are the exception rather than the rule. This is consistent with the view that keeping a conversation flowing satisfactorily will often seem more important than specifics of the content.

Design Considerations for AAC Systems

Taking natural conversation as the model, it seems that there should be a substantial role in AAC systems for prestored phrases, including many that can be recycled from one conversation to another. Buzolich and Wiemann (1988) made a powerful case that increasing the rate of communicative exchange should be the major impetus in communication system design. The challenge, given the acknowledged difficulties of predicting precisely what will be needed and of finding entries quickly when they are required, is to design a system that will make maximum effective use of large quantities of prestored material to increase conversational rate without compromising the quality of conversations. There is clearly a place for what Ball et al. (1998) referred to as *generic utter-*

ances that can be used in response to many different things that a communication partner may say. This would include feedback remarks and repairs.

The issue of how to incorporate specific topic content is more difficult. However, although it is impossible to predict everything that will be needed in a subsequent conversation, a great deal is predictable. In the first place, an AAC user, like anyone else, will enter a conversation with an agenda. They will have things that they want to talk about and queries they want to make. In introductory conversations, for example, exchange and comparison of personal narratives will usually make up a large part of the interaction (Wyer & Gruenfeld, 1995). There is scope here for branching predictions that may sustain a conversational topic through several exchanges of turn. If, for example, you tell someone where you came from originally, it is likely that they will ask you one of several things: where it is, how long you lived there, what it is like, how you liked it, why you moved, etc. A response to any one of these or similar queries will then lead to a new set of predictable options.

Advance planning of messages is known to lead to more rapid message production in normal speech (Greene, 1995). However, as Berger (1997) noted, detailed planning of communication strategies is unrealistic. There has to be a flexible, opportunistic aspect to the planning. This, we suggest, is why an organizational method that stores phrases exclusively on the basis of adjacency within topic categories is unlikely to be conducive to effective to-and-fro conversation with the AAC partner playing a full part in the control of topic direction.

What is required to support opportunistic planning is an organizational method that helps an AAC user to both (a) lead his or her partner in a direction in which the user has plenty of relevant things to say and (b) anticipate where the partner is headed so that the user can be ready with a response. One approach to this problem is to model the way in which natural conversation tends to move in small steps between different perspectives. Typically, the focus of a topic tends to shift a little at a time, with occasional large topic changes. For example, talk about one's self may shift to talk about one's conversational partner; talk about the past may shift to talk about the present; or talk about where something happened may shift to talk about why it happened that way. More often than not, a topic tends to shift on only one perspective at a time and rarely on all three at once (Todman, Alm, & Elder, 1994a). With topic content organized along these lines, it is possible for content representing an intersection of the three perspectives to be stored on the same screen. For example, content about where a user came from originally would be on a screen labeled *me/where/past.* If the user wanted to move the conversation on to why he or she moved, one key press (shifting from *where* to *why*) would reveal the relevant content on a screen labeled *me/why/past.* Similarly, having asked a partner where he or she comes from (while on a screen labeled *you/where/past*), a user might anticipate that the partner will answer the question and then turn it around (e.g., *How about you?*). In such a case, the user might shift from *you* to *me* in order to be ready to select a response from the *me/where/past* screen.

It would be a mistake to suggest that prestored phrases on the perspective screens are likely to provide precise responses to many of the things that a conversational partner might say. Although a partner's replies to what a user says may be somewhat predictable, usually the precise nature of these responses will not have been anticipated. Frequently, the user's prepared rejoinders are likely to be approximations to what they might, ideally, wish to say once they have heard their partner's response. Furthermore, they will sometimes be less satisfactory approximations than those that occur typically in natural conversation. Whether using a flawed approximation is more damaging to the quality of a conversation than the delay incurred in taking the time to enter a more precise response will probably vary from one instance to another. In any case, a facility to allow online entry of a response can coexist comfortably with a perspective method of organization. Finally, there will inevitably be occasions when even an approximation to a suitable response has not been entered, and it will then clearly be worth the additional time required to enter a response online.

Again, adoption of a perspective method of organization does not exclude the possibility of incorporating a topic/partner/context-type of organization at a level above the perspective structure. For example, a user would probably make different predictions about what phrases would be useful if he or she expected to be meeting with students, discussing stamp collecting with a friend who shared this interest, or attending an interview. It is feasible to have multiple set-ups, each with the same perspective structure, to meet a wide range of different circumstances and with unrestricted movement between the alternative set-ups. Similarly, there does not need to be a conflict between a perspective structure and an extended narrative facility. The latter may be desirable for multiple-phrase entries such as stories or jokes, where it is highly likely that phrases will be output in a more or less fixed sequence, and it will make sense to have them located in adjacent positions on a single screen.

TALK SYSTEM

All of the features described in the preceding section have been implemented in the current version of an AAC system known as "TALK" and in a commercially available version of the software, "TALK Boards" (Todman & Alm, 1997b; Todman & Alm, 1998) that runs under Speaking Dynamically Pro™ (Mayer-Johnson, 1999). All features apart from those specified in

the last two paragraphs of the preceding section were implemented in earlier prototypes of TALK (Todman & Alm, 1997a; Todman et al., 1994a; Todman & Mackay, 1996; Todman & Morrison, 1995).

As the TALK system has been extensively reported in the above references, it will not be described in detail here. However, the layout of the perspective screens in a current version of TALK is illustrated in Figure 1; apart from the "stories," "storage," and "switch" buttons along the top and the online entry message strip at the bottom, the screen layout is virtually identical to that used in the present study. The perspective change buttons are down the left side. In Figure 1, the *me/where/past* perspectives have been selected and content relevant to those perspectives is displayed in the central portion of the screen. Clicking on text in this area results in it being spoken. To bring up content relating to a different combination of perspectives would require one to three button clicks, depending on how many perspectives were required to change.

At the top right of the screen, there are six category labels for commonly used comments, which consist mainly of idiomatic phrases. When one of these is clicked, a pop-up menu displays the phrases that the user has stored under the category label. Below the comment labels are a number of generic categories, mainly dealing with "quick-fire" feedback and repair, for each of which the user will have entered a number of exemplars. When a generic label is clicked, one of the exemplars is randomly selected to be spoken. For example, if *good* is clicked, the available choices could be *That's great, Oh good, Terrific, That's fine,* and so on. Sample phrases are provided initially for all phrase categories, but the expectation is that the user will progressively replace these with idiosyncratic alternatives. In current versions of TALK, there is also a nonrandom mode. On the screen displayed in Figure 1, the random mode has been activated. The buttons at the bottom right of the screen have administrative functions, mainly concerned with entering and editing text.

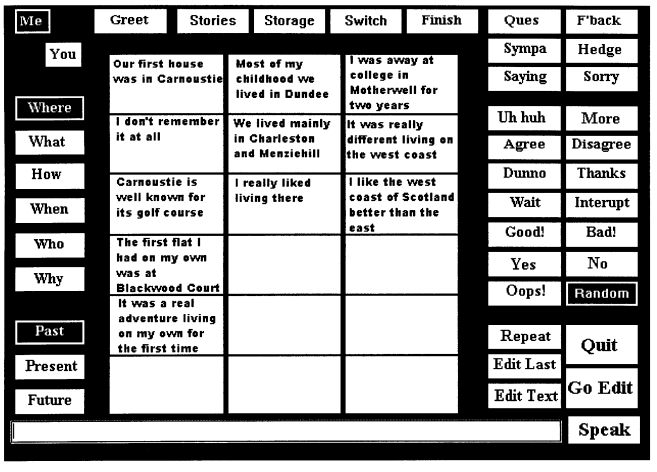

Figure 1. Layout of the TALK screen.

The design features incorporated in the TALK prototypes (i.e., perspective organization, together with feedback, repair, and other categories of generic comment) were intended to enable a user to produce, as rapidly as possible, an acceptable response to anything that a partner might say in an introductory, "getting-to-know-you" conversation. At an early stage in the development of TALK, the online facility was deliberately omitted in order to test the capabilities of an exclusively prestorage system whose features modeled pragmatic aspects of natural conversation.

An early study found that a nondisabled researcher using TALK could converse at an average rate of 67 wpm (Todman et al., 1994a). A person who had lost the ability to speak due to motor neurone disease (MND, also known as amyotrophic lateral sclerosis), but who retained full motor control of her hands, needed only a small amount of practice to achieve an average conversational rate of 42 wpm (Todman & Lewins, 1996). After the first few conversations, there was no further systematic increase in this user's speed, suggesting that practice alone would not bring her closer to the rate of the nondisabled researcher. Partner ratings of the social effectiveness of the MND user's conversation were positively related to her conversational rate, which seems to rule out the possibility that faster output was being achieved at the cost of reduced quality of content. This conclusion received additional support from the result of an experimental study (Todman, Elder, & Alm, 1995) in which the content of TALK-aided conversations was rated significantly higher than that of unaided conversations on the same topic. Further indications of the quality of TALK-aided conversations came from a study reporting at least as many topic shifts initiated by a TALK user as her speaking partners (Todman et al., 1994a). Another study, in which sequences of speech acts were analyzed, revealed considerable reciprocity of structure between a TALK user and her partners (Todman, Elder, Alm, & File, 1994b).

Like the individual with MND in Todman and Lewins (1996), some AAC users lose the ability to speak due to a degenerative illness, neural injury, or other acquired impairment. Many others with congenital conditions such as cerebral palsy have never been able to speak. Individuals in this group may be faced not only with learning to operate an AAC device but also with learning how to have effective conversations. Although they may have learned much about the pragmatics of conversation through observation, they may have had few opportunities to practice real conversational skills. One such individual was Sylvia, an adult with cerebral palsy and limited fine motor control of one hand who had been using a Lightwriter to communicate for several years. She was introduced to the TALK system and, by the end of her first con-

versation, achieved an output rate of 16 wpm. This compared favorably with her usual rate of communicating with the Lightwriter®, with which she produced 7 wpm. In eight subsequent TALK conversations, her mean output rate increased to 29 wpm (range = 26–37 wpm). Although clearly better than her rate with the Lightwriter, this rate did not approach either the nondisabled researcher's rate of 67 wpm that was reported by Todman et al. (1994a) or the MND user's rate of 42 wpm reported by Todman and Lewins (1996). However, the reason for this was not clear. For example, although Sylvia was able to use a trackball interface to operate the TALK system, her slower output rate may have been due to her fine motor impairment, her limited conversational skills, or some combination of both. Alternatively, she may not have been able to take full advantage of the potentially rate-enhancing features of the TALK system because of a lack of training and practice. The present study was designed to explore the latter hypothesis by investigating with Sylvia the effects of training on her use of TALK for rate enhancement.

METHOD

Participants

Sylvia, the 40-year-old AAC user with cerebral palsy and dysarthria who was introduced in the preceding section, was the main focus of the study. Her cognitive and visual-perceptual skills are normal. Her motor capabilities are severely limited, although she has learned, despite a degree of spasticity, to achieve fine motor control with one hand and has a fair degree of head and facial muscle control. Sylvia attended school from ages 7 to 17 and was both literate and numerate at the completion of her school education. She used a nonelectronic communication board during her school years, followed by a Canon Communicator, which she used until she acquired her Lightwriter in 1992; she was still using this device at the time of the present study. She estimated that approximately 15% to 20% of her Lightwriter messages consisted of prestored words and phrases. Her Lightwriter produced synthesized speech output that was accompanied by a rich repertoire of nonverbal nods, smiles, gestures, and vocalizations. The training study was conducted immediately after her initial nine conversations with the TALK system (described previously) were completed. Sylvia was aware that the purpose of the study was to teach her to use techniques intended to improve the speed and quality of her conversations.

In addition to Sylvia, participants included 30 (1st to 4th year) undergraduate psychology students who were approached individually and invited to chat with Sylvia. Although the students' ages were not recorded, most were between 19 and 24 years old. None of the students had previously met Sylvia or any other AAC user. A family observer, Sylvia's mother, was also unobtrusively present at all sessions.

Equipment and Materials

A TALK prototype without an online entry facility was implemented on a Macintosh™ PowerBook 165 laptop computer linked to a DECTalk Multivoice™ speech synthesizer. Sylvia used the standard (built-in) trackball interface to access the system. All conversations were audiorecorded on a Marantz® CP 430 cassette recorder.

Rating sheets for Sylvia, her conversational partners, and the family observer were prepared. The questions included on the user, partner, and observer sheets are shown in Table 1. These required responses on a 7-point scale on which the end points were labeled (e.g., for the question "How enjoyable was the conversation?" the first and seventh response boxes were labeled "very unenjoyable" and "very enjoyable," respectively). The intervening points were unlabeled. Ratings were scored from 1 (most negative) to 7 (most positive).

Procedure

The 30 volunteer conversational partners each had a single conversation with Sylvia lasting approximately 20 minutes, after which time Sylvia began winding down the conversation. The volunteers were randomly assigned to ordinal positions within a sequence of 30 conversational slots. There were 10 baseline conversations, followed by 4 intervention phases, each with 4 conversations that occurred immediately after a training intervention. Finally, there were four conversations in a maintenance phase. Baseline and intervention sessions were scheduled twice a week (with at least 2 days between sessions) over a period of 10 weeks. Sessions lasted approximately 1 to 1.5 hours; two conversations took place in most sessions, with a rest period between. The remaining sessions were scheduled for training. The four maintenance conversations took place in 1 week following an interval of 4 weeks.

Before each conversation, Sylvia's partner for that conversation was informed that Sylvia would be using a communication aid with synthesized speech (i.e., the TALK system). The student partner was asked to relax and have a "getting-to-know-you" chat, just as might normally occur when meeting someone for the first time. All conversations were audiorecorded and transcribed. At the end of each conversation, Sylvia, her partner, and the family observer each completed a rating sheet pertaining to the conversation (see Table 1). Some questions on the partner and observer sheets (e.g., questions 5–8 and 10) were specifically about qualities attributed to the AAC user and were not included on Sylvia's rating sheet.

TABLE 1: **Questions Appearing on Rating Scales for the TALK User, Partners, and Observer**

Questions for the TALK user
Q1. How enjoyable was the conversation?
Q2. How well were you able to say what you wanted to say?
Q3. How well were you able to say things in good time?
Q4. How well were you able to share in control of the conversation?
Q5. How well did the conversation flow?
Q6. Overall, how satisfactory was the conversation?
Questions for partners
Q1. How enjoyable was the conversation?
Q2. How well did Sylvia seem able to say what she wanted to say?
Q3. How well did she seem able to say things in good time?
Q4. How well did she seem able to share in control of the conversation?
Q5. How confident did she seem?
Q6. How relaxed did she seem?
Q7. How lively did she seem?
Q8. How interesting was the content of the conversation?
Q9. How well did the conversation flow?
Q10. How "natural" did the conversation seem?
Q11. Overall, how satisfactory was the conversation?
Questions for observer
Q1. How enjoyable did the conversation appear to be for Sylvia?
Q2. How enjoyable did the conversation appear to be for her partner?
Q3. How well did Sylvia seem able to say what she wanted to say?
Q4. How well did she seem able to say things in good time?
Q5. How well did she seem able to share in control of the conversation?
Q6. How confident did she seem?
Q7. How relaxed did she seem?
Q8. How lively did she seem?
Q9. How well did the conversation flow?
Q10. How "natural" did the conversation seem?
Q11. Overall, how satisfactory was the conversation?

An order for the four training interventions had to be established. In any time-constrained single-case study such as this, conclusions will necessarily be specific to the order adopted until replications with different orders are carried out. It was decided that a random order would be preferable to imposing an order that reflected the experimenter's expectations. The randomly determined order was (1) turnarounds, (2) comments, (3) quick-fires, and (4) perspective shifts. Before each of the four conversations following a training intervention, Sylvia was reminded to use the trained technique as often as seemed appropriate. No reminders were given before the four conversations in the maintenance phase.

Baseline, intervention, and maintenance phase data were recorded for Sylvia's (a) conversational rate, (b) prespeech pause times, and (c) frequency of use of the four trained techniques. Rating scores (Sylvia, partners, and family observer) were also recorded over all phases.

Training Interventions

Prior to each training intervention, the goals and procedures were explained and demonstrated to Sylvia. No attempt was made to develop a formal "training script," and different numbers of examples were used in each intervention as appropriate, based on feedback from Sylvia. One or two training sessions were used for each intervention, depending on the balance between supervised and home practice that seemed appropriate for that intervention.

Intervention 1: Turnarounds

A "turnaround" involves making a response to a question asked by the initiating partner and then following this immediately with a question that returns the topic to the partner. For example, if asked "What movies do you like?," a turnaround response might be "I like comedies. How about you?" Or, if asked "How do you feel about the space budget?," a turnaround response might be "Dunno. What do you think?" This technique, which is commonly employed in natural conversation, seems particularly useful as a means for AAC users to maintain conversational flow when they are short of appropriate stored content and would otherwise have to resort to time-consuming entry of new content to respond to the question. O'Keefe and Dattilo (1992) demonstrated that the technique, which they refer to as the "response-recode form," could be effectively taught to adult AAC users with mental retardation. It is possible that cognitively average AAC users who have never been able to speak may also fail to use the technique spontaneously, in which case training may be desirable.

Training was conducted in two sessions, each lasting about 1 hour. In the first session, the technique was explained and demonstrated. This was done using examples from the messages that were prestored in Sylvia's TALK system. Thirty sample questions were taken from transcripts of previous conversations and Sylvia practiced responding with turnarounds. For example, the research assistant might ask "Did you make a lot of friends at school?," to which Sylvia might respond, "Oh yes" by clicking the *Yes* random quick-fire button and then selecting "How about you?" from the pop-up menu produced by

clicking on the *Question* category in the idiomatic phrase section (top right in Fig. 1). If a suitable turn-around response was not available, she was asked to enter one that was both suitable and as general as possible, in order that it might prove useful on a range of occasions. Following the first training session, Sylvia took another 30 questions home with her to practice using the technique. In the second session, new questions were mixed in with the ones she had practiced previously and speed was emphasized. Sylvia was given feedback on how long each turn-around took and was encouraged to try to reduce the time taken.

Intervention 2: Comments

This refers to use of the "context-sensitive comment" menu provided at the top right of the TALK screen (Todman et al., 1994a; Todman & Morrison, 1995). This menu provides labels for groupings of general comments that serve as responses to many different things that may be said within a broad category. For example, under the label "Sympathy," phrases such as "That's too bad" and "What a drag" might be stored. This type of comment, again much used to maintain conversational momentum in natural conversation, may potentially be particularly useful for AAC users, yet may not be used spontaneously by those who have never been able to speak.

There were again two training sessions, each lasting about 1 hour. In the first session, Sylvia was taken through transcripts of some of her previous conversations, and occasions where a phrase from the comment menu might have provided a more effective response than one she used (often after a long search) were identified. Sylvia was then presented with utterances made by her partners during previous conversations and practiced responding with phrases from the comment menu. She was also encouraged to add new phrases to the comment menu when there was nothing suitable already entered. She took additional transcripts home to engage in similar practice with a new set of partner utterances. In the second session, Sylvia practiced incorporating general comments in a conversation with a research assistant.

Intervention 3: Quick-fires

This refers to phrases that can be produced through direct selection of labeled buttons that are permanently available on screen. These quick-fire responses make it possible for a user to provide rapid feedback during and following a partner's turn at speech and facilitate rapid delivery of other categories of utterance, such as "repairs," where any delay would seriously compromise their effectiveness. In this version of TALK, activation of a quick-fire label resulted in random selection of one of several exemplars stored by the user under the label. For example, a user might have stored phrases such as "That's right," "True enough," "Agreed," and so forth under an "Agree" label. When the Agree label is selected, any one of these phrases might be produced. Although AAC users are often able to effect rapid nonverbal feedback, it is possible that augmentation with well-timed verbal feedback may contribute to an impression of involvement and social competence.

There was one training session related to this technique that lasted approximately 1 hour. Again, transcripts from previous conversations were used to identify occasions on which the available quick-fire responses might have been used appropriately. Sylvia practiced making feedback remarks during extended sections of narrative that were read from the transcripts. She was shown how to improve her timing by synchronizing her feedback remarks with her nonverbal feedback, such as nodding and smiling. It was suggested that she could practice further at home using narrative spoken on the radio.

Intervention 4: Perspective Shifts

The organization of topic content within the intersecting (person, time, and issue) perspectives (Todman et al., 1994a; Todman & Mackay, 1996) potentially provides a stable structure that may permit a user to engage in to-and-fro chat without long pauses between turns. This depends on the user taking a full share in control of topic direction in order to lead the conversation into areas in which they have contributions to make. It also depends on their being able to anticipate where their partner is likely to move the conversation to next so that they can be ready with an appropriate response. For users who have never been able to speak and have previously been dependent on AAC systems that require topic content to be entered at the time it is needed, these are skills that are unlikely to be mastered without training.

Training took place in one session lasting approximately 1 hour. Using her topic content, it was demonstrated to Sylvia how she could plan flexible conversational routes, shifting one perspective at a time to string together several phrases. She was shown how to end the string with a question in an area where she had plenty of content with which to respond to her partner's answer. Using transcripts from previous conversations, she was shown how it was sometimes possible to anticipate where a partner was likely to move the conversation next. For example, if the partner is telling stories about her school days, she is quite likely to end up asking Sylvia about hers. Sylvia then practiced these skills in conversation with a research assistant. It was suggested that she might try at home to plan additional, alternative routes from the same starting points so that her conversation would remain flexible and varied.

Data Analysis

In the absence of an adequate random procedure for the assignment of treatments to conversations (the random ordering of training phases is not sufficient in this case), there are no fully valid procedures for making statistical inferences about the data. However, nonparametric tests (such as the Mann-Whitney and Wilcoxon tests and Tryon's [1982] procedure for testing slopes within and across phases) do provide a useful indication of whether variables warrant further research. Edgington (1995), Levin, Marascuilo, and Hubert (1978), and Todman, Rankin, and File (1999) have all argued for the cautious use of such inferential statistics in single-case experimental designs in which random assignment procedures are lacking. It is in this spirit that inferential statistics are reported in the present study.

Effects are described as statistically significant whenever the probability was <.05 in a two-tailed test. Where effects were significant with a lower probability, this is specified. The reason for specifying lower probabilities is that we can be more confident in the replicability of such effects. This is particularly important in view of the number of tests that are reported. With multiple testing, the proportion of nonreplicable effects identified as statistically significant will be greater than the proportion implied by the p value reported (i.e., the Type I error rate will be inflated). This means that effects reported as significant at the .05 level should be treated with considerable caution until replicated in other studies.

Another concern is the possible effect of autocorrelation on the error rate (Busk & Marascuilo, 1992). Autocorrelation refers to a tendency for scores in a time series to be nonindependent of one another, such that an observation at one point in the series has an influence on subsequent observations. Positive autocorrelation (i.e., a tendency for high scores to be followed by high scores and low scores to be followed by low scores) is known to inflate error rates. As Busk and Marascuillo demonstrated, it is impossible to get precise estimates of autocorrelation for short time series (shorter than 50 observations, they suggest), and it is not acceptable to calculate autocorrelation across phases (Huitema, 1985). Nonetheless, autocorrelations at lag 1 (adjacent observations) to lag 5 (observations following after four intervening observations) were computed for baseline conversation rates and pause times (across a total of 10 observations), since intervention and maintenance phases were too short to permit any meaningful calculations (at four observations each). Lag 1 autocorrelations were –0.06 and 0.29, respectively. At higher lags, most of the autocorrelations were negative, and none were statistically significant. Although these results do not suggest that autocorrelation is a serious problem in these time series, the tests are not powerful enough to allow the conclusion that positive autocorrelations do not exist in the data. This is another reason for treating the reported effects with caution.

RESULTS

Conversational Rates and Pause Times over Phases

One dependent variable was Sylvia's conversational rate in wpm. This was the total number of words spoken by Sylvia in a conversation, divided by the total time for her turns at speech, where her turns at speech included the pauses preceding her utterances. Another dependent variable was Sylvia's average pause time before her utterances. These variables are clearly related, but they can also change independently of one another. For example, conversational rate could be increased simply by entering longer stored phrases, although this might have little effect on average pause time. Conversely, by frequently selecting single-word feedback utterances during a partner's narrative, average pause time could be dramatically reduced with very little effect on conversational rate. For this reason, it is important to monitor both variables and, additionally, to report data pertaining to the number of utterances and utterance times for conversations in each phase.

Sylvia's conversation rates for all 30 conversations are shown in Figure 2, and her median pause times for the conversations are shown in Figure 3.

The means and standard deviations of her conversation rates and medians and interquartile ranges (middle 50%) of her pause times are shown for baseline, training, and maintenance phases in Table 2. Medians, rather than means, were reported for pause times because these are less affected by occasional

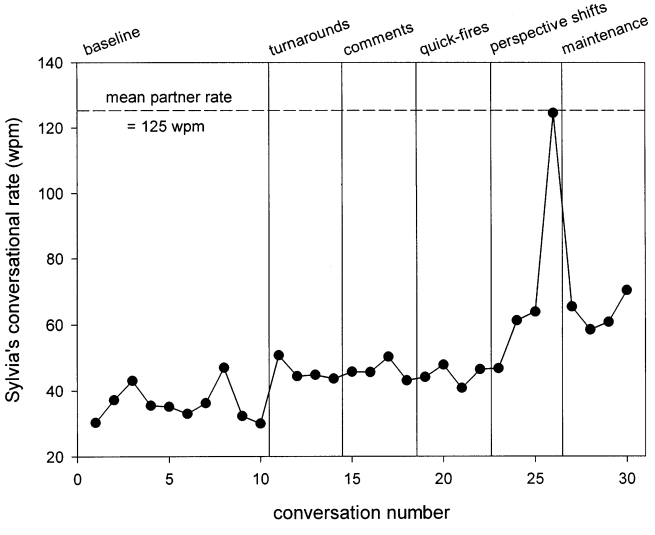

Figure 2. TALK user's conversation rate for conversations in baseline, training, and maintenance phases.

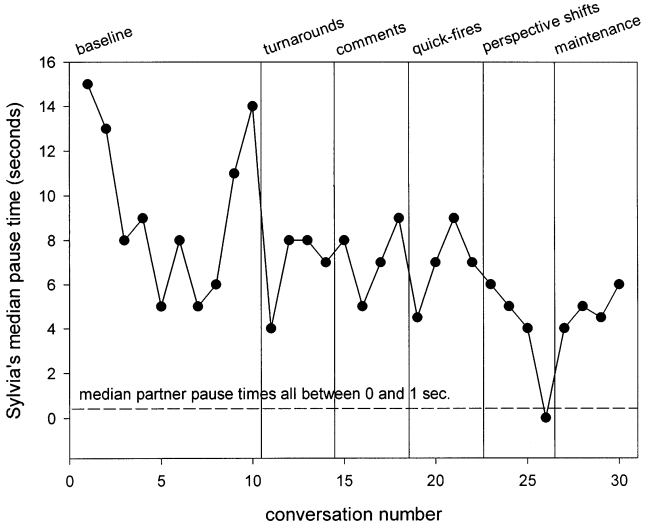

Figure 3. TALK user's median prespeech pause times for conversations in baseline, training, and maintenance phases.

exceptional gaps caused by software difficulties. Sylvia's mean number of utterances and utterance times, together with standard deviations, are shown for each phase in Table 3.

Tryon (1982) provided a statistical procedure for testing the existence of trend across baseline and subsequent treatment phases of time-series experiments. Using his procedure, no significant baseline trend was found for conversational rate ($p > .05$) or for median pause times ($p > .05$). Over all phases, however, the procedure confirmed a significant upward trend in conversational rate ($p < .01$) and a downward trend in pause times ($p < .01$). In the case of conversational rate, the upward trend was already established by the end of the four conversations that followed the first (turnarounds) training phase ($p < .05$).

Differences across phases in the average conversational rates and pause times shown in Table 2 were analyzed using the nonparametric Kruskal-Wallis test. Mean levels of conversational rate differed significantly between phases, χ^2 (df = 5) = 21.70; $p < .001$, as did median levels of pause times, χ^2 (df = 5) = 17.75; $p < .01$. The changes from baseline to maintenance were also examined statistically, using the Mann-Whitney U test, and were found to be significant for both conversational rate ($p < .01$) and pause times ($p < .05$).

Frequency of Trained Techniques

The effectiveness of the training interventions, from the point of view of whether they actually resulted in an increased use of the trained techniques, was also examined. The frequency of occurrence of each technique in each phase of the experiment is shown in Table 4.

In each case, a binomial test confirmed that the frequency of occurrence of a technique was greater in the phase immediately following training on the technique than in the preceding phases ($p < .01$). For example, there were 13 quick-fires in the phase following the quick-fire training, compared to an average of 3.1 in the three preceding phases (baseline = 6.4, turnarounds = 2, comments = 1).

Ratings on Individual Questions

Mean ratings over all phases by Sylvia, her partners, and the family observer were generally fairly high for all of the questions. The ratings ranged from 3.79 (Sylvia Q3: "How well are you able to say things in good time?") to 6.33 (Partners Q4: "How well did she seem able to share in control of the conversation?").

Among Sylvia's responses to individual questions, it was notable that her highest mean rating was for "enjoyment"' (Sylvia Q1, mean = 4.87). A Wilcoxon T test showed this to be significantly greater than that of her next highest mean rating, which was for "satisfaction" (Sylvia Q6, mean = 4.47). In general, rating responses to individual questions did not show great

TABLE 2: **Conversation Rate and Pause Time Data for Baseline, Training, and Maintenance Phases**

	Conversation Rate		*Pause Times (Seconds)*	
Phase	*Mean wpm*	*SD*	*Median*	*Interquartile Range*
Baseline	36	5.4	9	4–16
Turnarounds	46	3.3	7	3–13
Comments	46	3.0	7	3–12
Quick-fires	45	3.1	7	2–12
Perspective shifts	74	34.5	4	0–10
Maintenance	64	5.3	5	1–10

TABLE 3: **Means and SDs of TALK User's Number of Utterances and Utterance Times for Conversations in Baseline, Training, and Maintenance Phases**

	Number of Utterances		*Utterance Times (Seconds)*	
Phase	*Mean*	*SD*	*Mean*	*SD*
Baseline	49	5.5	4.1	0.49
Turnarounds	53	3.9	4.5	0.60
Comments	53	7.1	3.9	0.91
Quick-fires	62	11.2	3.8	0.26
Perspective shifts	51	3.1	5.9	0.92
Maintenance	53	3.0	6.5	0.52

variability, as indicated by the average standard deviations for Sylvia (mean SD = 0.65), partners (mean SD = 0.99), and the observer (mean SD = 0.57). However, it was apparent that Sylvia's enjoyment ratings were more variable (SD = 0.78) than were her other ratings and that they appeared to show an increase over phases (means from baseline to maintenance: 4.3, 4.3, 5.3, 5.5, 5.5, 5.3). Using the nonparametric Jonckheere test of trend over treatment conditions (Siegel & Castellan, 1988), this increase over phases was found to be significant, $J = 274$; $N = 30$; $p < .001$.

Another difference of particular interest was between the partners' ratings of Sylvia's ability "to say what she wanted to say" (Partner Q3, mean = 5.53) and her ability "to say things in good time" (Partner Q4, mean = 4.70). For each conversation, the partner provided a "matched pair" of ratings on Q3 and Q4. The difference between these matched pairs of ratings was statistically significant (Wilcoxon $T = 5$; N for test = 21; $p < .001$). The difference between Sylvia's responses to the equivalent questions was in the same direction but nonsignificant.

Factor Analysis of Ratings

The limited variability of ratings for most of the questions made it unlikely that clear trends over phases would be discernible for the individual questions. However, it seemed likely that several questions may have targeted the same underlying characteristic (or factor). For example, ratings by partners of how confident (Q5), relaxed (Q6), and lively (Q7) Sylvia seemed to be during the conversations may have all tapped into their general perceptions of her personal attributes. It seemed prudent to determine if such groupings did, indeed, exist in case an examination of the aggregate scores for those groupings might reveal trends over phases. To this end, a principal components factor analysis, with Varimax rotation, was carried out on each of the three sets of rating data. This is the most commonly used procedure for identifying groupings of items indicative of underlying common factors. Ratings from all phases of the study were included in each factor analysis because although ratings may vary over the course of the inter-

TABLE 4: **Frequency of Trained Techniques across Four Conversations over Phases**

	Technique Trained			
Phase	*Turnarounds*	*Comments*	*Quick-fires*	*Perspective Shifts*
Baseline*	0	12	6.4	0
Turnarounds	**10**†	15	2	0
Comments	3	**33**	1	0
Quick-fires	4	22	**13**	1
Perspective shifts	2	15	1	**16**
Maintenance	4	13	0	14

*To make baseline frequencies (10 conversations) comparable with the other phases (4 conversations each), they were divided by 2.5.
†Frequencies of techniques within their own training phase are shown in bold.

TABLE 5: **Loadings of Sylvia's Questions on Two Rotated Rating Factors**

Question	*Factor 1 (Quality)*	*Factor 2 (Speed)*
Q1. enjoyment	0.84	
Q5. flow	0.83	
Q6. satisfaction	0.73	
Q2. content	0.68	
Q3. speed		–0.82
Q4. control		–0.74

ventions, ratings on some questions may vary together; that is what the factor analysis is designed to reveal. The question of whether an identified grouping (i.e., factor) changes over phases is then answered by a statistical test of differences between aggregate scores on the factor over phases.

For Sylvia's ratings, two interpretable rotated factors accounted for 64% of the variance. The factors have been labeled "quality" and "speed." The loadings of questions on these factors (i.e., the extent to which individual questions are related to factors) are shown in Table 5.

The internal consistencies of items comprising quality and speed scales were alpha = 0.71 and alpha = 0.44, respectively.

For the partner ratings, three interpretable rotated factors accounted for 70% of the variance. The loadings of questions on the factors, which have been labeled "quality," "personal" (i.e., impressions of Sylvia's personal attributes), and "competence" (i.e., impressions of Sylvia's ability to use the system effectively), are shown in Table 6.

TABLE 6: **Loadings of Partners' Questions on Three Rotated Rating Factors**

Question	*Factor 1 (Quality)*	*Factor 2 (Personal)*	*Factor 3 (Competence)*
Q10. naturalness	0.82		
Q1. enjoyment	0.79		
Q11. satisfaction	0.71		
Q8. interest	0.63		
Q5. confident		0.82	
Q6. relaxed		0.71	
Q7. lively		0.69	
Q4. control		0.68	
Q2. content			0.90
Q3. speed			0.78
Q9. flow			0.64

TABLE 7: **Loadings of Observer's Questions on Three Rotated Rating Factors**

Question	*Factor 1 (Quality/Personal)*	*Factor 2 (Competence)*	*Factor 3 (Control)*
Q8. lively	0.92		
Q2. partner enjoy	0.88		
Q1. Sylvia enjoy	0.80		
Q7. relaxed	0.75		
Q6. confident	0.70		
Q11. satisfaction	0.63		
Q3. content		0.89	
Q10. natural		0.80	
Q9. flow		0.78	
Q4. speed		0.71	
Q5. control			0.92

It should be noted that although the two factors labeled "quality" overlap considerably and each seems to reflect the quality of the conversations from the different perspectives of Sylvia and her partners, they are not identical in terms of factor composition. The internal consistencies of items comprising quality, personal, and competence scales were alpha = 0.82, alpha = 0.76, and alpha = 0.78, respectively.

For the family observer, there were again three rotated factors, in this case accounting for 87% of the variance. The loadings of questions on the factors are shown in Table 7.

The first factor appeared to be a composite of factors 1 and 2 obtained for partner ratings (i.e., quality plus personal attributes). The second observer factor was similar to the third factor for the partner ratings (i.e., competence), and the third factor was represented by the single question on Sylvia's ability to share in the control of the conversation. The internal consistencies of items comprising quality/personal and competence were alpha = 0.90 and alpha = 0.85, respectively. The concept of internal consistency is, of course, inapplicable to the single-item third factor (control).

Rating Factors over Phases

Factor scores are aggregate scores on questions related to the factor, weighted according to how strongly each is related (i.e., as indicated by question loadings on the factor). Mean factor scores over the six phases of the experiment are shown in Table 8.

TABLE 8: **Mean Rating Factor Scores over the Six Phases of the Experiment**

	Sylvia		*Partners*			*Observer*		
Phase	*F1*	*F2*	*F1*	*F2*	*F3*	*F1*	*F2*	*F3*
Baseline	4.15	4.00	4.93	5.73	4.63	5.68	5.25	5.70
Turnarounds	3.81	3.63	5.38	6.00	4.83	5.83	5.06	6.00
Comments	4.50	4.38	5.81	6.63	5.17	5.50	5.25	6.00
Quick-fires	4.69	4.38	4.75	6.06	4.75	5.71	5.63	5.75
Perspective shifts	4.75	4.13	5.19	6.00	5.50	6.00	5.75	5.75
Maintenance	4.50	4.50	5.81	6.25	5.67	5.96	5.50	6.00

It was predicted that ratings of the conversations would become more favorable as Sylvia mastered techniques introduced in the training phases. Improvements in rating factors over phases were analyzed using the Jonckheere trend test. This showed significant upward trends for Sylvia Factor 1 (quality), Sylvia Factor 2 (speed), Partner Factor 3 (competence), Observer Factor 1 (quality/personal), and Observer Factor 2 (competence).

Correlations

As expected, there was a strong negative correlation between conversation rate and pause times ($r = -.79$; $N = 30$; $p < .001$). There were also significant correlations of both conversational rate and pause times with Sylvia and Partner rating factors. These correlations are shown in Table 9.

In addition to the correlations between ratings and the objective measures (conversational rate and pause times), there were some correlations between ratings from different sources (Sylvia and her partners) that were of interest. For both enjoyment and satisfaction ratings, there were significant positive correlations between ratings by Sylvia and those made by her partners. The fact that there was no significant correlation between Sylvia Factor 1 and Partner Factor 1, which both had loadings from the enjoyment and satisfaction questions, underlines that quality of the conversations meant different things to Sylvia and her partners. For Sylvia, with additional loadings from the flow and content questions, her Factor 1 seems to reflect her ability to sustain the conversation. For her partners, on the other hand, with additional loadings from the naturalness and interest questions, their Factor 1 seems to focus more on how similar the conversation is to their familiar experience of unaided conversations. Finally, there was a significant correlation between Sylvia Factor 1 (quality—from Sylvia's perspective) and Partner Factor 2 (personal impressions of Sylvia).

TABLE 9: **Significant Correlations of Conversational Rate and Pause Times with Sylvia and Partner Rating Factors**

Rating Source	*Factor*	*Conversational Rate*	*Pause Times*
Sylvia	F1 (quality)	.43*	−.55**
Sylvia	F2 (speed)		−.41*
Partners	F1 (quality)	.54**	−.41*
Partners	F2 (personal)		−.37*
Partners	F3 (competence)	.47**	−.40*

*$p < .05$; **$p < .01$.

DISCUSSION

Overall, the results of this study suggest that whereas practice alone was insufficient to raise Sylvia's conversational rate to the level of an unimpaired researcher, about 6 hours of training were effective in raising her rate to 64 wpm during maintenance. This is comparable to a nondisabled researcher's rate of 67 wpm using the TALK system (Todman et al., 1994a). At the same time, Sylvia's median pause time during maintenance (5 seconds) was not much longer than that of this user's (3.4 seconds). This suggests that Sylvia's motor impairments played a relatively small role in limiting her pretraining performance and that her relative unfamiliarity with the pragmatics of conversation (i.e., how to make it "work" effectively) may have been more of an impediment. The training may have helped in two ways: (1) it may have provided Sylvia with practice in using some features of TALK and (2) it may have alerted her to some pragmatic possibilities for maintaining conversational momentum.

Rate and Pause Time Analyses

The changes in conversational rate and pause times that are apparent in Figures 2 and 3 and Table 2 were confirmed in the analyses of these measures over phases. There were no significant trends within

the baseline phase, but over all phases (baseline, training, and maintenance) there was a significant increase in Sylvia's conversational rate and a corresponding decrease in her pause times. In the case of conversational rate, a significant upward trend (from 36 to 46 wpm) was already established by the end of the first training phase (turnarounds). It appears from Figure 2 that following the increase from baseline to the first training phase, conversational rate remained stable until the final training phase (perspective shifts), when it showed a sharp increase (from 45 to 74 wpm) before stabilizing at 64 wpm during the maintenance phase. As can be seen in Figure 3, median pause times were more variable than conversational rate, and the only marked drop (from 7 seconds to 4 seconds) was between the third and fourth training phases. The median pause time then stabilized at around 5 seconds during the maintenance phase.

Sylvia's first increase in conversational rate, immediately following baseline and sustained at around 45 wpm throughout the first three training phases, brought her to a level comparable to that achieved by the user with MND described previously (Todman & Lewins, 1996). As a person used to conducting conversations, the user with MND may have been expected to be familiar with the uses of "turnarounds," general comments, and rapid feedback. As the operation of these facilities within TALK are relatively straightforward, it is likely that she learned to use them without the need for specific training. Sylvia, on the other hand, would not have been used to using these techniques and thus required some training to at least alert her to their potential usefulness. Although Sylvia's pause times when using these techniques may have been shorter than usual, that would only affect her median pause time if she used these techniques for at least 50% of her utterances. In this respect, the decrease in mean pause time (from 11.29 to 8.97 seconds) may be more informative. It is, of course, important that gains in conversational rate were accompanied by decreases in pause times because this provides some assurance that the gains in speed of output were not merely a consequence of stringing together sequences of adjacent entries.

Although all of the training interventions were effective, to the extent that they all resulted in increased use of the trained technique during the relevant phase, it remains uncertain how many of the first three techniques were effective with respect to increasing conversational rate. It appears, on the basis of the slope analysis, that the first training intervention (turnarounds) probably had an effect on conversational rate. It is unclear, however, what part the second and third training interventions (comments and quick-fires) played in sustaining conversational rate at the level achieved in the first training phase. It is, of course, possible that conversational rate would have remained at the new plateau even if the second and third training interventions had not occurred.

The second jump in Sylvia's conversational rate, accompanied in this case by a reduction in median pause time, was from the third to the fourth (perspective shifts) training phase. Unlike the first three techniques, perspective shifting to control topic direction and to be ready for anticipated questions was not a straightforward facility within TALK. Rather, it depended on exploitation of the perspective organization of topic content, which would not have been part of a user's explicit experience of unaided conversation even if the user had previously been able to speak (as was the case with the user with MND described previously) or was merely simulating a person without speech (as did the nondisabled researcher in Todman et al., 1994a). In the case of the researcher, she had been involved in the development of TALK and was fully aware of the potential offered by the perspective organization. It seems that just 1 hour of training was sufficient to enable Sylvia to exploit this organization about as effectively as the researcher, motor impairments notwithstanding. With this amount of specific training, Sylvia was able to surpass the performance of the user with MND.

In order to ensure that the trends reported for the data were not excessively dependent on a single atypical conversation, it is necessary to address the atypical conversation following perspective shift training. This conversation is the one represented by the peak in Figure 2 (rate = 124 wpm) and the trough in Figure 3 (median pause = 0 seconds). Changes from preintervention (baseline: rate = 36 wpm, median pause = 9 seconds) to postintervention (maintenance: rate = 64 wpm, median pause = 5 seconds) did not involve this exceptional data point, yet each of these changes was significant. Also, when the mean of the other three perspective shift conversation rates is substituted for the exceptional fourth rate, the increase from the third to the fourth training phase is still significant ($p < .05$). We can conclude, therefore, that the changes over phases were not due exclusively to the single atypical conversation. However, that exceptional conversation remains intriguing and invites further investigation, if only because it seems to suggest that circumstances exist in which the conversational rate and median pause time of a TALK user can match those of speaking partners.

The exceptionally high conversation rate and low pause times during the atypical conversation appear to have resulted from a combination of the characteristics of the speaking partner and Sylvia's strategy at this stage in the training schedule. The speaking partner in the atypical conversation had an above average conversational rate (144 wpm, compared with the mean of 125 wpm for the speaking partners overall), but the most striking aspect of her data was that she said more than twice as much as the average speaking partner (1,878 words, compared with the mean of 901 words). There were two patterns apparent in this conversation. One was where Sylvia asked a question

and, while her partner replied at length, Sylvia shifted perspectives to be ready with an observation and possibly another question immediately after her partner paused. Her partner would then begin her next extended narrative. The other pattern was where Sylvia initiated and controlled a series of short back-and-forth exchanges using perspective shift sequences that she had practiced in the preceding three conversations. Overall, the impression gained was that Sylvia used the perspective shift technique adaptively in the face of a very talkative partner who might normally be expected to make it difficult for an AAC user to "get a word in edgewise."

Although it is obvious that we must anticipate large differences between individual users, we can nonetheless suggest some approximate expectations on the basis of the results with TALK to date. We anticipate that TALK users who have previously been able to speak will require training only on perspective shifts in order to achieve conversational rates of around 64 wpm, which was Sylvia's rate during the maintenance phase. For users like Sylvia, however, who have never been able to speak, our expectation is that they will require additional training on turnarounds, and possibly comments and quick-fires, to bring them up to the same conversational rate.

Ratings and Factors

It is important to note that none of the gains in conversational rate and reductions in pause times would be meaningful if they were achieved at the expense of the quality of the conversations. It would be possible, for example, to routinize the content to such an extent that the conversations would be fast and boring or to respond with non sequiturs so that the conversations were fast and unconnected. The postconversation ratings were designed to address the issue of quality. We attached prime importance to how the conversations seemed to both Sylvia and her speaking partners and were also interested in how they seemed to an interested observer.

A few of the ratings on specific questions were of interest, although, in general, the variability of responses from one conversation to another was small. Therefore, most of our analyses focused on scales comprising groupings of questions. The question to which Sylvia gave the most variable responses related to her enjoyment of the conversation. This was also the question for which her responses were most positive overall. Although her appraisal of her own performance in the conversations remained modest throughout, her enjoyment of the conversations increased over successive phases, along with her conversational rate. The fact that her ratings of enjoyment (and satisfaction) were correlated with those of her partners argues against the possibility that she was more able to enjoy later conversations simply because she was more relaxed, without their quality necessarily having improved.

Another pair of questions, those relating to Sylvia's ability to "say what she wanted to say" and her ability to "say things in good time," was of particular interest because the comparison between the ratings on these items is revealing as to whether flexibility or speed was more problematic for her. Even though her conversational output was much faster than in typical aided conversations, her partners perceived her to have less trouble with content than with speed. It would therefore be difficult to argue that the increased speed made possible by using prestored material was bought at the expense of reduced flexibility and appropriateness of responses. From her partners' points of view, Sylvia needed to be even faster, more so than she needed to be able to generate more precise responses.

Factor analyses were carried out separately for each of Sylvia, partner, and observer ratings. Separate factor analyses were required for the three sets of data because the questions asked of the three rating sources, although overlapping, were not identical. The reasons why identical questions were not appropriate in every case should be apparent from an inspection of Table 1. In addition, it seemed possible that the same question would not always be interpreted in exactly the same way by the different rating sources. This was a caution that turned out to be justified, insofar as the meaning of the first factor (quality) seemed to differ somewhat for Sylvia and her partners. The absence of a correlation between Sylvia's Factor 1 and her partners' Factor 1, even though both enjoyment and satisfaction ratings (with loadings on each of these factors) were correlated between Sylvia and partners, emphasizes the distinctiveness of these two factors. For Sylvia, the quality factor (Factor 1 in Table 5) seemed to reflect her own ability to "keep her end up" in a conversation, whereas for her partners (Factor 1 in Table 6), it seemed to reflect the extent to which their conversations with Sylvia were similar to familiar, unaided conversations.

There were a number of significant correlations between rating factors and the objective measures (i.e., conversational rate and pause time). These were all in the predicted direction. Specifically, the perceived quality of conversations (from the differing perspectives of both Sylvia and her partners) and the partners' perceptions of Sylvia's competence were both correlated with high conversational rate and short pause times. Taking account of the differences in the two quality factors, where Sylvia's included a notion of her own competence, we can summarize these correlations as indicating a relationship between speed and both participants' perceptions of conversational quality and Sylvia's competence.

There were also additional negative correlations involving pause times. These were with Sylvia Factor 2 (speed) and Partner Factor 2 (personal). It seems

that, for Sylvia, her perception of her ability to be speedy was more related to the length of her pause times than to her conversational rate. This makes sense, in that what she was asked to focus on during training was shortening her pause times, from which faster conversational rates automatically followed. It is of particular interest that the shorter she managed to make her pause times, the more positively her partners rated her in terms of personal attributes. In addition, a negative correlation between pause time and Observer Factor 2 (competence) approached significance, which is notable in that the variability of the observer ratings was extremely low, and this was the only correlation that even approached significance. The interested observer (Sylvia's mother) seemed to perceive that shorter pauses were related at least somewhat to increased communicative competence.

With regard to the rating factors, upward trends over phases were found for both of Sylvia's factors (quality and speed), Partner Factor 3 (competence), and Observer Factors 1 (quality/personal) and 2 (competence). Cumulatively, these effects suggest that as Sylvia perceived improvements in the quality of the conversations and her ability to manage them during the training phases, her partners' (and the observer's) impressions of her competence, and possibly her personal attributes, increased concurrently.

Limitations

As with any single-case study, the extent to which these findings can be generalized to other AAC users must await replication. There are also limitations on the interpretation of the data in the present study. In particular, it is uncertain what the outcome would have been if a different random order of training interventions had been used. In other words, order and carryover effects cannot be ruled out. There is a need for replications in which the intervention order is varied systematically. In the meantime, the present study demonstrates that a relatively brief training program was sufficient to raise the conversational rate of one TALK user who has never been able to speak to the level achieved by an nondisabled researcher using the system (Todman et al., 1994). Further, it is particularly important to have found that, far from compromising conversational quality, the effective use of an exclusively prestored messaging system actually appeared to enhance the quality of the conversations and result in more positive attributions of competence and other personal qualities.

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VON TETZCHNER

Von Tetzchner, S. (1997). The use of graphic language intervention among young children in Norway. *European Journal of Disorders of Communication, 32*, 217–234. Knowledge about graphic communication intervention and use among young disabled children has been sparse. The present study is based on a thorough search, and provides reliable information about children who are 10 years old or younger who use graphic communication (for example, photographs, drawings, Blissymbols, PIG, traditional orthography) as their main form of communication. The study covers all such children in three Norwegian counties, comprising a population of 1.1 million people. Detailed descriptions of the children, the systems they use, and their educational settings are presented and implications for the organization of habilitation services are discussed.

OGLETREE, FISCHER, & TUROWSKI

Ogletree, B. T., Fischer, M. A., & Turowski, M. (1996). Assessment targets and protocols for nonsymbolic communicators with profound disabilities, *Focus on Autism and Other Developmental Disabilities, 11*, 53–58. This article proposes assessment targets and protocols for children with profound developmental disabilities who are nonsymbolic communicators. Targets include children's actual or perceived communicative behaviors, their communicative partners, and their communicative environments. Protocols consist of interviews, observations, structured sampling and, if needed, formal assessment measures.