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Interactions with a VOCA: Experiences from the evaluation of Multi-Talk II

Parimala Raghavendra and Elisabet Rosengren

Abstract
Multi-Talk II, a voice output communication aid (VOCA) was evaluated by five adults who were physically disabled augmentative and alternative communication (AAC) users. The aim of the project was to evaluate the effectiveness of Multi-Talk II as a VOCA using single-subject design, supplementing it with descriptive feedback from participants. Videotaped interactions provided the quantitative information such as communication rate. The completed questionnaires from subjects, their familiar speaking partners and speech pathologists provided detailed information on what they thought about the device. The findings are discussed in terms of overall issues related to using a VOCA and the importance of evaluations.

Introduction
With ever more and ever changing technology, it becomes increasingly important to evaluate new communication devices not only in laboratory settings, but also in functional contexts. Detailed evaluations of VOCAs by users in a variety of contexts need to be documented. The literature in the AAC field has innumerable technical descriptions of augmentative devices, some research on users' satisfaction with devices (Jinks, 1992), several single-case studies in evaluating devices (e.g. Alm et al., 1992; Scull & Hill, 1988), and consumer-based criteria for the evaluation of assistive devices (Batavia & Hammer, 1990). Some manufacturers of AAC devices request consumers and professionals to evaluate their new devices (Kusler, 1992). Heckathorn et al. (1987) designed and evaluated the Portable Anticipatory Communication Aid (PACA) with three users. Personal comments from users and formal observations of their use of PACA were recorded. However, the authors do not provide any quantitative information about increase/speed of text output, time taken to create a certain amount of text or amount of text created with and without the PACA.

Users of AAC systems have made significant contributions as to the effectiveness of devices (Creech, 1981; May, 1991). Professionals and families of users have reported success stories in publications such as Communication Outlook and Communicating Together, and in autobiographies (Kissick, 1984, cited in Smith-Lewis & Ford, 1987). These offer significant but brief glimpses of what happens when a VOCA is used. There is limited research in the area of long-term, functional evaluations with multiple users that would provide us with information on the effectiveness of the device, suggestions for future design, and factors that could assist users and professionals in making decisions regarding the selection of suitable devices so that a device prescribed would not be abandoned. Thus, the aim of the investigation was to conduct a comprehensive evaluation of Multi-Talk II, a VOCA developed in Sweden.

Multi-Talk was the first multi-lingual, portable VOCA to be developed in Sweden (Foncma, 1986). Initial investigations of the use of Multi-Talk by both younger and
older AAC users were positive and encouraging (Galyas & Rosengren, 1990). However, follow-up investigations revealed that successful use of the device was limited, partly due to the negative attitude to synthetic speech by users and their conversational partners. Feedback from users indicated the need for a smaller and lighter device.

Multi-Talk II (Fonema, 1993), an updated version of Multi-Talk, consists of a communication program that can be installed on any IBM or IBM-compatible computer, and an Infovox speech synthesiser. Currently, the program is available in Swedish, English, German and French. Multi-Talk II contains the basic features of the first Multi-Talk such as text-to-speech, access to pre-programmed expressions with single keystrokes, and a user's lexicon. However, these features have been developed further for new portable computers. There are two ways to store and retrieve messages; one is the "quick store," wherein messages that are commonly used are stored under each key and only one keystroke is needed to retrieve a message. The second is called the "sentence store" where messages can be stored under combinations of two letters or numbers or a letter and number. Each message can be a line long consisting of a maximum of 60 characters. In addition, the memory demands on the user are reduced as the codes, and the messages stored under each code, can be easily displayed on the screen.

The users' lexicon is an important feature of the device by means of which the pronunciation of mispronounced words can be easily changed. There is a permanent lexicon in the speech synthesis system that contains the correct pronunciations of many frequent words that are not pronounced according to the rules. However, there are still a number of words that can be mispronounced, e.g., names of people. It is important for AAC users to be able to have their vocabulary correctly pronounced. A person with some knowledge of the phonetic text can easily write a desired word with the necessary symbols and store it in the user's lexicon. When that word is used the next time, it is pronounced correctly. The users' lexicon can also be used to store abbreviations which can then be used in communication mode.

The advantages of having a PC-based aid are several (Mizuko, 1993), most of which are applicable to Multi-Talk II. An important advantage is the flexibility of using a PC for communication as well as other applications. The user can interrupt any running program to switch into the communication mode of Multi-Talk II and can switch from one language to another easily. The display size of the text can be changed as well and it is more cost-effective to update or change the program. The device will accept different kinds of input such as single switch, scanning, Wivik (head mouse) and expanded keyboard. In the writing program, the user can store and retrieve large amounts of text which can be spoken at a meeting or in a talk to a group.

The aim of the current investigation, then, was to evaluate the effectiveness of Multi-Talk II as a VOCA using single-subject $A_1B_1A_2B_2$ design (McReynolds & Kearns, 1983), with replication across subjects, supplementing it with social validation measures.
Method

Subjects

Speech-language pathologists in the Stockholm area were requested to recommend subjects who met the following criteria: 1) AAC users who were not using a VOCA before the project and were interested in trying a VOCA; 2) adults with acquired or congenital conditions who had adequate literacy skills and normal linguistic skills. Five adults who were severely physically disabled and users of AAC agreed to participate in the project. A brief description of the subjects is included in Table 1. In addition, further information is given below for all subjects.

Table 1. Information on subjects

<table>
<thead>
<tr>
<th>SUBJECT</th>
<th>AGE</th>
<th>SEX</th>
<th>DIAGNOSIS</th>
<th>CURRENT COMMUNICATION SYSTEM</th>
<th>PERIOD OF USE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sara</td>
<td>28 yrs</td>
<td>F</td>
<td>C.P., Severe dysarthria</td>
<td>Speech, letter/word board</td>
<td>~ 10 yrs</td>
</tr>
<tr>
<td>Cissi</td>
<td>38 yrs</td>
<td>F</td>
<td>Acquired brain damage, Anarthria</td>
<td>Polycom</td>
<td>4-5 yrs</td>
</tr>
<tr>
<td>Peter</td>
<td>25 yrs</td>
<td>M</td>
<td>C.P., Anarthria</td>
<td>Polycom, Canon communicator</td>
<td>~ 10 yrs</td>
</tr>
<tr>
<td>Nora</td>
<td>22 yrs</td>
<td>F</td>
<td>Acquired brain damage, Anarthria</td>
<td>Letter/phrase board</td>
<td>4-5 yrs</td>
</tr>
<tr>
<td>Ivar</td>
<td>25 yrs</td>
<td>M</td>
<td>C.P., Severe dysarthria</td>
<td>Speech, Bliss</td>
<td>~ 10 yrs</td>
</tr>
</tbody>
</table>

Four of the subjects, all except Ivar, had normal linguistic and literacy skills as reported by their speech pathologists. Subjects Sara, Ivar, and Peter used electric wheelchairs for mobility, while Cissi and Nora used manual wheelchairs and needed to be pushed. Sara had completed her high-school education, while Ivar and Peter had completed their education at a special school. These three had basic training in the use of computers or data entry. Cissi had studied to be an architect and had worked as a journalist before her illness; she was attending a rehabilitation program during the study. Nora, who had started high school before her accident, was completing her studies. Sara and Ivar were working at an army museum making an inventory of museum pieces on a computer with other employees who were also disabled, while Peter had been without work for the last few years. All five lived independently with round-the-clock assistance.

Sara used vocalisations and gestures in addition to her severely dysarthric speech and letter/word board for communication. She pointed to letters or words using her left thumb tucked inside her palm. She used an expanded keyboard for text-telephone and for computer entry. Her speech pathologist described her as motivated and wanting to communicate.
Cissi had quadriplegia resulting from cerebral haemorrhage five years ago. She was anarthric and used vocalisations, her own signs for "yes" and "no," and a Polycom, an electronic communication device (without speech synthesis) for communication. She typed with her right index finger and had excellent spelling and writing skills. Cissi had not accepted her disability completely, and had refused to use a VOCA before this investigation.

Peter had no speech, and used vocalisations, eye pointing and facial expressions. He used a Polycom for indoor communication and as a text telephone, and a Canon Communicator for outdoor communication. He typed his messages using a head pointer attached to an ice hockey helmet, and had good spelling skills. His speech pathologist described him as an independent person with high motivation to communicate.

Nora had severe spastic quadriplegia, resulting from lack of oxygen, during surgery seven years ago. She was anarthric and used vocalisations, her own signs for "yes" and "no," and a letter/word board for communication. She mostly spelt out words by pointing to the letters with her right index finger or with her eyes and had excellent spelling and writing skills. She was the most severely physically disabled subject among the five users. She had severe spasms of the upper limbs resulting in frequently not being able to move her hands and in involuntary closure of her eyes. Nora had been depressed and had not accepted her disability for the first few years. She had briefly tried other VOCAs (Multi Talk, Parrot) before, but had decided to use a letter/phrase board. Her speech pathologist commented that she was curious, asked questions and was motivated to communicate, but her interest fluctuated.

Ivar used severely dysarthric speech, mostly one or two words at a time, spelt out words, or used Blissymbols using partner-assisted scanning for communication. He pointed to the symbols using a head pointer attached to an ice hockey helmet, and had limited spelling skills. Ivar was considered to be mildly mentally retarded.

Text material
There were four "news items" that the users narrated to their partners at various stages of the investigation. These items were selected by the investigators after reading several pieces of text from newspapers and magazines. The material was considered to be interesting and about a topic that was familiar to the users, but the information was new. Based on this criteria, one item about twins was selected from a magazine, and three items about birds, polar bears and "the first car accident" were taken from translated texts used by Carlson et al. (1992). The items were randomly assigned to baseline condition (birds), post-training with Multi-Talk I1 (twins), 2nd baseline (first car accident), and after longer use of the device (polar bears). The texts were on average nine sentences long with 11 words/sentence.

Equipment
The subjects used the Multi-Talk II installed either on a Texas Instruments TravelMate 2000 or a Sharp PC-6240 286 laptop computer connected to an Infovox miniVoxbox speech synthesiser, which was mounted on the back of the laptop screen.
Procedure

The objective and the procedure of the study were explained to the subjects and their speech pathologists, and the subjects' consent to participate was obtained. The participation of the subjects' speech pathologists was extensive since they trained the users on Multi-Talk II and were in direct contact with the subjects for the entire period of the investigation. Peter and Ivar worked with the same speech pathologist. The subjects were then asked to select a normal speaker, with whom they felt comfortable interacting, to be their familiar partner (FP). Subjects Sara, Peter, Ivar, and Nora chose one of their personal assistants and Cissi chose her occupational therapist as FP. Peter and his FP had known each other for about four years while Sara and Cissi had known their FPs for two and half years. Peter's FP spent about seven and half hours/day with Peter and said that she knew Peter really well, whereas Cissi's FP worked with her once in two weeks and reported that she did not know her that well. Sara's FP mentioned that she and Sara were peers, and they had about five to six hours of contact everyday. Ivar's FP had known him for four years, whereas Nora's FP had been working with her for about eight months. Nora's FP spent the day with Nora at her school and knew Nora's physical problems and her way of communicating really well.

Two video cameras were used to videotape all interactions; one camera focused on the communication aid, and a second camera was placed in front of the subject and FP taping their interaction.

The four speech pathologists were trained on Multi-Talk II by one of the investigators following the sequence and structure presented in a training program developed by the investigators (Rosengren & Raghavendra, 1992).

Design

$A_1 = \text{first baseline}$

training with Multi-Talk II following a structured program

$B_1 = \text{first test with Multi-Talk II}$

$A_2 = \text{second baseline (in the same session)}$

further training and use of Multi-Talk II without a structured program,

$B_2 = \text{second test with Multi-Talk II}$

$A_1 \text{ first baseline}$

The subjects were given the first news item about birds (News Item 1), and asked to read through the text with their speech pathologist and familiarise themselves with the text. They usually read the text one or two days before the first videotaping. The FPs did not know the content of News Item 1. The users interacted with their FPs, first having a general conversation and then describing News Item 1. The subjects used their regular communication system(s) described above to communicate and the interactions were videotaped. The communicative behaviours measured from these tasks were taken as the baseline measure ($A_1$) of the subjects' communication.

Training with Multi-Talk II

Following baseline, the subjects were trained on the Multi-Talk II by their speech pathologists for several sessions. The speech pathologists followed the training
program developed by the investigators (Rosengren & Raghavendra, 1992) with their subjects. The training program consisted of eight sections and introduced the different features of Multi-Talk II, providing immediate opportunities for the subjects to use each feature in a communicative context. As part of the training, scripts were used to role-play contexts, e.g., shopping, going to a restaurant, calling for a taxi on the telephone. The speech pathologists kept a detailed account of each session. Sara was trained for eight sessions over a month and a half, and each session lasted on an average for an hour. Cissi took about 24 sessions over six months, but Nora completed the same number in a year's time with each session lasting for about 40 minutes. Peter required 11 sessions of training and this took place over seven months, each session for 90 minutes. Ivar met with his speech pathologist 11 times, over almost a year, each time for about 70 minutes. The training period was long for Ivar because he met with his speech pathologist only once a month and also had long breaks over holidays. The difference in the number of sessions were due to motoric and learning abilities of the subjects and technical problems with the device that needed to be solved. Based on feedback from users, additional features were added, e.g., large text for Nora.

The subjects had access to Multi-Talk II only during the training sessions. Sara used a keyguard for the computer, while Cissi needed a drool protection cover for her keyboard.

**B₁ first test**

At the end of the training period, the subjects were given News Item 2 (twins) and were asked to use the Multi-Talk II to narrate it to their FP. They also had a conversation using the VOCA. The subjects prepared the texts with the help of their speech pathologists and used the sentence store of Multi-Talk II to store them.

**A₂ second baseline**

A second baseline was taken to see whether changes in communication under B₁ were due only to using Multi-Talk II. For this, they narrated News Item 3 (first car accident) with their regular communication system.

They were videotaped narrating the above news items and having a conversation with the same FPs (for Sara, Peter, and Cissi). Since a year had passed for Ivar and Nora since baseline measurement, their FPs were not available. Hence, two "new" FPs were chosen by the users. Ivar's second FP was another of his personal assistants who also worked with Peter and hence, was familiar with Multi-Talk II, and Nora had a social worker from school as her FP. Nora's new FP had been working at the school for a year and said that she met Nora regularly, but did not know Nora's physical problems or her way of communicating very well.

**Use of Multi-Talk II**

The subjects were then given the Multi-Talk II and encouraged to use it in various contexts for at least three months. Suggestions were given to the speech pathologists about how they could encourage the use of Multi-Talk II. For example, it was suggested that the subjects could use Multi-Talk II 1) to talk with familiar people on the telephone first, and then with unfamiliar people; 2) they could communicate with a stranger in a non-noisy environment without any time stress and then try in more
demanding environments. The speech pathologists met their subjects less frequently during this period. They completed session sheets after every session and the questions related to whether the subjects had used the Multi-Talk II outside the clinic, if so whether their partners understood the messages, and whether the users had any problems with Multi-Talk II.

Sara did not use the Multi-Talk II during the post-training period except twice at group meetings for the disabled and when seeing her speech pathologist, but had it in her possession for almost nine months. She was allowed to try the device for longer period than others because her original device (the computer) broke during this period, and a new computer was given, resulting in some delays. Cissi used Multi-Talk II occasionally over a six month period, once with her son. Peter used it for his everyday communication for about six months before the final videotaping.

Due to Nora's very severe motoric disability and frequent spasms, it took a very long time for her to communicate with the device, and it was very effortful. Proper positioning and mounting of the device was a crucial issue for Nora. "The Technical Aids Centre" (Hjalpmedelscentralen) made a mounting for the Multi-Talk II on the wheelchair, but Nora was never satisfied with it. After the initial training period she was not interested in taking the device home to use it or in trying it in the classroom. Ivar suddenly seemed to have lost interest, also after the initial training. His speech pathologist moved to another job and could not continue to give him the necessary support. His assistants did not encourage him to use the device and he later moved to another town without taking the Multi-Talk II with him.

**B, second test with Multi-Talk II**

Hence, only three subjects, Sara, Cissi and Peter, were videotaped after longer use of the device with the same FP, narrating News Item 4 (polar bears) and having a conversation using Multi-Talk II.

All the videotaping was done either at the subjects' residence, work place, school or at therapy. There were six people present at most of the videotaping sessions: the subject, the FP, the subject's speech pathologist, both the investigators, and the person videotaping. Videotaping for Sara, Cissi, and Peter were done in three visits. The first visit was taping for the baseline, the second visit was taping after training (B1) and second baseline, and the third visit was the taping after longer use of Multi-Talk II (B2). Videotaping for Ivar was done in two visits and due to Nora's severe physical disability, two visits to her had to be split up into three.

**Questionnaires**

As a final part of the evaluation, subjects, their familiar partners, and their speech pathologists completed a questionnaire providing feedback and comments on the effectiveness of Multi-Talk II as a VOCA. Each group had a different questionnaire. The objective of using questionnaires was to obtain information from individuals involved in the evaluation as to the effectiveness of Multi-Talk II as a VOCA. Initial drafts of the questionnaires were reviewed by various professionals and were edited following each review. Questions related to the following issues were addressed to all three groups: changes in communicative interaction with the use of Multi-Talk II,
amount of use, situations in which the aid had been and could be used, enhanced independence with Multi-Talk II, comprehension of and attitude to synthetic speech, acceptability of the device, support from partners in the environment regarding the use, and overall, whether quality of life had improved with the use of Multi-Talk II. The types of questions were: multiple-choice, open-ended, and rating type.

The questionnaire to users consisted of 42 questions and addressed specific issues related to use such as whether it had been easier and faster to communicate with the device, and whether the user felt like communicating more with Multi-Talk II. In addition, users were asked their views on usability with little stress or fatigue, learnability, ability to interrupt conversation and gain attention, and what they thought would be an ideal communication device. Familiar partners were asked 48 questions, some of which addressed whether the user was able to express his/her ideas and feelings better with Multi-Talk II than with his/her regular communication system, overall communicative competence with the device, and ways in which they encouraged the use of Multi-Talk II. The questionnaire to users' speech pathologists consisted of 68 questions. They were asked about the training provided to them, the training program, cognitive demands placed on the users, vocabulary organisation, problems with the device, and future possibilities with the device for that user. Twenty-six of the questions were common to all three groups.

Results

Analysis

Five to eight minutes of the middle portion of the videotaped interactions between the subjects and their FPs were transcribed in detail for the above contexts for all except Nora. It took longer time for Nora to convey any information and hence, fifteen minute samples of her interactions were transcribed to calculate the communicative measures mentioned below. The interactions were transcribed by developing notations for the current project and using some of the notations developed by Bailey and Shane (1983). The following measures were calculated from the transcribed parts:

*Communication rate in words*

As a measure of efficiency, total number of words in a message divided by the sum of the time taken to access a board or a device plus the time taken for the message to be transmitted.

*Communication breakdowns*

As a measure of effectiveness, number of breakdowns divided by the total number of opportunities provided where a breakdown could have occurred, expressed as percentage. For example, if part of a message or the complete message was not understood by the partner and if the partner asked, "What did you say?" "I didn't understand," "Can you repeat that?" or had a puzzled look on the face, these were taken as breakdowns.
Amount of participation

Number of words spoken by the FP or number of words spoken, pointed to on the letter/word board or typed by the subjects was divided by the total number of words produced by FP and the subject. These were converted to percentages.

The answers to the questionnaires were analysed in detail and correlation between the quantitative findings and the results from the questionnaires were investigated.

Quantitative results

The results will be presented for all the subjects, for the three variables in a chronological sequence: baseline, data with Multi-Talk II just after training, second baseline and data with Multi-Talk II after a longer period of use.

A, baseline

Communication rate

Figure 1 presents the communication rate for all subjects under all the conditions. The communication rate varied within and among subjects depending on the condition. At baseline (Fig. 1, baseline), the communication rate was extremely slow, ranging from 5 to 12 words/minute when describing News Item 1 and between 7 and 29 words/minute during conversation. Ivar's rate could not be measured as he spoke mostly in single words. Sara's rate during conversation was 29 words/minute, the highest since she spoke mostly, and used her letter/word board only few times. However, when describing News Item 1, she pointed to or spelled words resulting in a slower rate of communication. For all four, their rate was higher during conversation than when presenting new information with their regular system. This could have been due to the familiarity of topics and vocabulary used during conversation.

Communication breakdowns

Figure 2 shows the percentage of breakdowns that occurred at baseline and while using Multi-Talk II for Sara and Ivar. The other three subjects and their FPs did not have similar breakdowns. At baseline, (Fig. 2, baseline) Sara had 10% breakdown in conversation while none during the description of News Item 1. This was because Sara used speech for conversation, and her FP found it difficult to understand her occasionally. When Sara used her board, there were just occasional errors by her FP in identifying a letter or a word due to pointing, or predicting a wrong word. These were corrected with feedback from Sara or self corrected by the FP, and the conversation flow was maintained. Ivar had 22% breakdown during News Item 1 and 7% during conversation. Ivar used his severely dysarthric speech and a few Blissymbols to convey new information, resulting in more breakdowns during description of News Item 1 than during conversation when they talked about more familiar topics. The breakdowns were due to improper introduction of news item topic, causing the partner not to follow what he was talking about, resulting in breakdowns. Peter and Cissi used a Polycom to type their messages and Nora used her letter board. Their partners also only had occasional letter or word identification errors and no breakdowns.
Amount of participation

Figure 3 shows the amount of participation by subjects and their FPs while describing news items and engaging in conversation under all conditions. The amount of participation during baseline (Fig. 3, baseline) showed that Sara contributed 37% during description of News Item 1 and 23% during conversation. Sara was more in control during news description as the partner did not know the information. Ivar and Peter contributed about the same in both conditions (Ivar = 25%, Peter = 34%). Cissi’s FP dominated the interaction during baseline, interrupting Cissi constantly and contributing 88% during News Item 1 and 92% during conversation. Nora also contributed only 20% and 14%. However, none of the FPs, except for Cissi’s partner, was perceived by the investigators as dominant. They waited for their turns and spoke appropriately.

Figure 3. Amount of participation by all users and their partners under all conditions
first test with Multi-Talk II

Communication rate

MT II-B₁ of Figure 1 shows communication rate during description of News Item 2 (the story about twins) and conversation using Multi-Talk II. For all subjects, the rate was higher with Multi-Talk II than with their regular communication system when describing the News Item. Cissi showed the largest increase from 5 to 19 words/minute, followed by Nora who showed an increase from 6 to 15. Sara increased from 12 to 19 and Peter's rate increased from 7 to 11 words/minute. Ivar's rate was 17 words/minute similar to other users' rate with the device. Cissi used the sentence store to narrate her news item and retrieved sentences easily, but made a monologue presentation of the story. Peter also used the sentence store, but he typed some appropriate comments and questions and the communication interaction was more natural. However, in general, the rate reduced while using Multi-Talk II for conversation when compared to baseline rate for conversation and News Item 2. This was because they chose to type their messages instead of using any of the stored phrases.

Communication breakdowns

MT II-B₁ of Figure 2 presents the percentage of breakdowns while using Multi-Talk II. For Sara, communication breakdowns increased to 38% when describing News Item 2 with Multi-Talk II. We believe that this was because her FP was hearing the synthetic speech for the first time and had some difficulty in understanding it. Sara's FP laughed as soon as she heard the first sentence. The first three sentences had to be repeated several times, and finally the FP changed modes and looked at the screen to understand the message for those sentences. Since Sara had not used Multi-Talk II extensively, she was not able to use the strategies that she had been taught to repair breakdowns. Ivar's FP did not follow the first sentence of News Item 2, but followed the rest of the story well. However, when Ivar conversed using Multi-Talk II, there was 25% breakdown as he just typed single words and it was difficult to follow his train of thought. Interestingly, Peter and Cissi's partners did not have any problems in following the synthetic speech. One reason could be that the subjects worked with their speech pathologists in improving the pronunciations of certain words by entering them in the user's lexicon. It could also be that Peter and Cissi presented the new information better. Nora's new FP looked at the screen for every sentence even though she had been instructed not to do so. It seemed as if she did not want to appear "foolish" when she could not understand the story. There were also problems with the presentation of the story as Nora had half sentences stored in the quick store and did not retrieve them in the right sequence. This made it difficult for her FP to follow the story.

Amount of participation

MT II-B₁ of Figure 3 presents the amount of participation by subjects while using Multi-Talk II just after the training. Sara contributed 27%, 10% less than baseline, while narrating News Item 2. Her FP talked continuously as she was uncertain what to do during the long silence while Sara was retrieving messages. This was a slow process for Sara due to difficulties in accessing the keys. There was a dramatic change in Cissi's contribution, when she used Multi-Talk II to describe News Item 2. Her FP
was impressed and distracted by how Cissi used the device and contributed only 39% compared to 88% at baseline. However, Cissi's FP took over again during conversation. Peter's amount of participation in terms of number of words spoken was similar during the baseline and when using the Multi-Talk II (33% and 35%) and lesser during conversation with Multi-Talk II. His FP was patient, waited until he completed his messages and never held on to her turn for too long. Ivar contributed 40%, 15% more than at baseline, while narrating News Item 2. This became less during conversation with Multi-Talk II as he typed and answered in single words. Nora contributed 37%, with Multi-Talk II while narrating News Item 2, 17% more than at baseline. However, her contribution was less while conversing with Multi-Talk II as she found it very difficult to type and converse. Ivar and Nora had their highest amount of participation when they narrated News Item 2 with Multi-Talk II compared to other conditions.

A₂ second baseline
The communication rate for all subjects during description of News Item 3 was close to their first baseline, i.e., 4 to 16 words/minute (See A₂, Fig. 1). Sara and Nora had varied degrees of communication breakdowns while narrating News Item 3 whereas they had not had any breakdowns during the first baseline (See A₂, Fig. 2). Sara had 24% and we attribute this partly to her being tired when we filmed. Her right hand was in a cast, she used a communication board that she had not used frequently, and chose to speak, all of which contributed to more breakdowns. Nora used eye pointing with her letter board instead of finger pointing and her new FP was not very familiar with this, resulting in 11% breakdowns. It took several turns, (from 3 to 15) to repair the breakdowns. Ivar had the same amount of breakdown at both baselines. Figure 3 (A₂) shows the amount of participation at second baseline. Sara contributed less than at 1st baseline due to the reasons given above, while Cissi seemed to continue to be in control for description of News Item 3 with almost equal participation. Peter, Nora and Ivar contributed about the same amount as the first baseline. For most subjects the second baseline was similar to the first for the above variables showing that changes seen with Multi-Talk II were only due to using the device.

B₂ second test with Multi-Talk II
Communication rate
MT II-B₂ in Figure 1 shows the rate during final filming or after having used Multi-Talk II for more than three months after the basic training. As mentioned before, only Sara, Cissi and Peter completed this part. Sara's rate of 21 words/minute was higher than at B₁ since she used an expanded keyboard making it easier for her to retrieve sentences about the polar bears. Cissi's rate reduced to 11 words/minute from 19 words/minute. The partner asked questions and commented and Cissi responded by typing her answers, resulting in slower rate. Peter's speech pathologist had taken up a new job and had been unable to work with Peter in storing News Item 4. So Peter decided to type the whole story during the interaction, reducing the rate to 6 words/minute. The rate during conversation was similar to B₁.
**Communication breakdowns**

During the final filming, Sara's partner did not follow parts of the synthetic speech resulting in 17% breakdowns during description of the polar bears (See MT II-B₂, Fig. 2). Peter's and Cissi's FPs seemed to follow the speech without major difficulties. However, Cissi's FP did not understand one word and looked at the screen and Peter's partner said that during conversation it was difficult for her to follow the speech and that she wanted to see the screen sometimes.

**Amount of participation**

MT II-B₂ in Figure 3 presents the amount of participation after some use of the device. Sara contributed the same amount as at B₁ for news item description, but only 11% during conversation. The values were lower for Cissi, 25% and 12%. Peter contributed the highest, 44%, while describing News Item 4, higher than at B₁. During conversation, all three contributed less than while describing News Item 4. Since they typed mostly one or two words, and the FPs spoke more, the quantitative data indicated that the FPs dominated the interaction. However, except for Cissi's partner, the other FPs responded appropriately.

In summarising the quantitative results, communication rate increased with Multi-Talk II for all users immediately after the training, while narrating News Item 2. There was no further increase in the rate of communication with longer use of the device for the three users. The rate did not increase for conversations with Multi-Talk II. The amount of communication breakdowns ranged from no breakdown to not being able to understand about 30% of the messages. Three users contributed more during description of news item with Multi-Talk II just after the training. However, during conversation the amount of user contribution was reduced.

**Results from the questionnaires**

Informal interviews after each stage revealed the following: Cissi became more positive during the evaluation period which represented a great deal of progress as she had been very negative towards synthetic speech before. Her FP was impressed with the way Cissi could retrieve complete sentences with few keystrokes. Peter mentioned after the videotaping that he really enjoyed using Multi-Talk II and that it was easier for him to describe new information with it. Peter's partner also commented that it seemed natural with voice output and that everyone could hear Peter without peering over his shoulders. Nora was prepared to take part in the evaluation study, although she had had a negative attitude toward communication aids with synthetic speech before. She seemed interested sometimes during the training and enjoyed parts of it. Ivar seemed positive and interested during the whole training period. The training sessions went well, he was creative and wanted to put his own phrases in the stores. After the dialogue training, he commented that it was fun to be able to talk in a restaurant and on the phone.

In responding to the questions, what they thought the best thing about Multi-Talk II was and what they did not like at all about the device, the following answers were given: Sara said that the best thing about Multi-Talk II was: *I can sit opposite to a person and talk.* However, she commented that she found it *bulky to have.* She had
difficulty in accessing the standard keyboard of a laptop computer, but could use Multi-Talk II with greater ease with an expanded keyboard. Sara’s FP commented: The social closeness and the eye contact that Sara and I have when Sara speaks and uses the board is lost when Sara uses the Multi-Talk II. On a positive note, she suggested: Sara could use Multi-Talk II in meetings or when communicating with individuals who can not see. The speech pathologist was positive about the device in general. However, she answered the above questions with reference to Sara: It's relatively light to carry with you if you can use the normal keyboard (Sara needs to use an expanded keyboard) and, It was difficult to open the device (Sara would not be able to do it independently).

Cissi thought that she could communicate better with Multi-Talk II. She said: It doesn't get broken easily (probably compared to her regular communication aid). Cissi also commented that the device was heavy to use (compared to Polycom). She used the device once with her five-year-old son who is visually impaired and it did not go well as her son did not understand that it was she who was communicating with him. Her FP commented that the best thing was: The voice. Cissi received positive reaction from others. She also added: I would like the keyboard to be smaller. Her speech pathologist said the best thing about Multi-Talk II was: The quick store, user's lexicon, the fine intonation. Communication felt more natural when Cissi communicated with Multi-Talk II. She liked all of its features, but added: The (computer) battery lasts only for a short time.

Peter thought that the best thing about Multi-Talk II was: To be able to express my opinion. He thought that the possibility of storing messages was an important feature of communication devices. Peter was the most positive about Multi-Talk II and said: It is superb for me. He thought that it was easier to communicate with Multi-Talk II; he had become more social and communicated with more people. The only negative thing he said was: People can't hear what I am saying (in noisy environments). Peter's FP said: He now has speech/sound for communication. She added that in the beginning it was difficult to get used to the fact that Peter now had a voice, but that communication felt more natural because he had a voice. She also commented: It (communication) can be a little stiff sometimes as the "voice" didn't vary so much and Peter couldn't speak "angrily" or "with joy". The speech pathologist commented: (Multi-Talk II) is easy to use, good for those who wish for synthetic speech and need a quicker way to communicate. He added that the device was a valuable aid for Peter in most daily situations. He thought that using the device made him feel more independent and more self-confident.

We review below the response to certain questions by the three users, their speech pathologists and FP’s.

Impressions about Multi-Talk II

The subjects were asked what they thought of Multi-Talk II, what their first impression was and if it had changed over the evaluation period. Peter was positive to a lot of the questions, while Sara said that she did not like the Multi-Talk II and that her impression had changed from positive to negative. She explained that this change was due to the time it took for her to communicate and said that she found it difficult to
Cissi's impression changed from negative to positive and commented that it was because of good speech.

Cissi's FP wrote that her impression had become more positive as she realised the possibilities of the device. Peter's FP was positive in the beginning, but later she thought that it would be difficult for the user to take the device with him (as it had not been mounted). Sara's FP's mixed impression did not change. The FPs' comments on the users' impressions were similar to what the users themselves had said. Peter's FP thought that Multi-Talk II was a good communication device for Peter, whereas both Sara's and Cissi's FPs thought that is was an "OK" device for the users.

The speech pathologists, except Sara's, were impressed with the device and thought that it was a good device for their users. Sara's speech pathologist was not so certain about the device for Sara. However, they all interpreted their subjects' impressions correctly.

Acceptability
Peter and Cissi said that Multi-Talk II was acceptable to them and to some people in their environment, whereas Sara said the opposite. According to Peter's FP, the device was acceptable to others in Peter's environment, whereas it was only moderately acceptable by people in the environment of Sara and Cissi, according to their FPs. The speech pathologists echoed the answers of their subjects.

Synthetic speech
The users and their FPs commented that it was easy to understand the speech when they were near but not in noisy environments or at a distance. Peter said that everyone had a positive reaction to the synthetic speech in his environment whereas Sara and Cissi said that reactions were mixed. Two of the FPs said that they looked at the screen to see what the user had written. Theirs and the speech pathologists' reaction and attitude were either positive or mixed, Sara's FP said: *It speaks fast and words sound strange.*

Peter used the man's voice, Cissi the woman's voice, and interestingly Sara selected the child's voice. Most of the respondents thought that the voice quality of the male was "OK," but the woman's voice was not good. However, Cissi's FP thought that the female voice was good and the male voice was bad.

When speech pathologists were asked about what they thought of the use of synthetic speech in communication aids, Peter's and Sara's speech pathologists said that the attitudes and reactions were very individualised, that it was easily accepted by some users and others, whereas some rejected it. Cissi's speech pathologist thought that it was better than being silent and the listener had more freedom than when other AAC techniques were used.

Use of Multi-Talk II
The amount of use varied from everyday use by Peter to only on a few occasions by Sara. They were asked in what environments they had used the device and the purposes of use. They replied that they had used it at home or meeting, with friends, mostly for face-to-face conversation, with one person or a small group. When asked whether it was easier, or faster, or if they had felt like communicating more with Multi-Talk II,
Peter was positive whereas Sara was negative and Cissi had mixed responses. Peter commented that it was difficult to use the device outside, e.g., at a disco. They could get someone's attention with Multi-Talk II and could interrupt conversations. Their FPs and speech pathologists gave similar answers.

Support from the environment
Except for Peter, the other two users mentioned that encouragement from people in their environment to use the device was little. Agreeing with Peter's comments, his FP said that she encouraged the use of the device and gave positive feedback.

Physical aspects/easy to use
Both Sara and Cissi thought Multi-Talk II was not physically easy to use, whereas Peter thought it was easy to use. They had problems in using the keyboard, and became tired easily. The speech pathologists also thought it was difficult to open the device, and to start and stop the computer.

Functions of Multi-Talk II
They learned the various functions of Multi-Talk II and used the stores and text-to-speech functions rather well. Cissi and Sara said that it was not easy to remember the function keys to repeat words or a sentence, and hence did not use them. Cissi's speech pathologist, on commenting about the way the vocabulary was organised, said that the quick store and user's lexicon were very good features of the device.

Features that need to be improved
Peter asked that the writing program be improved (this part of the program was under development, hence it did not work well). Sara would like the device to be lighter and quicker to use. Some of the FPs and speech pathologists wanted the "voice" to be better and the keyboard to be smaller.

How they would like their communication device to be
Peter would like a program with writing options and stores (like Multi-Talk II). He seemed to be satisfied with Multi-Talk II. Cissi said: It (the device) should be easy and light to carry and robust to use. Sara also said: I would like a device that is simple and does not take up space. The speech pathologists also wanted some of the above features and wanted the aid to be functional, based on each user's needs.

Improvement in quality of life
Peter said that the use of Multi-Talk II had improved his quality of life overall. It was easier to socialise, easier to communicate with people, and he felt less frustrated. Cissi and Sara disagreed with Peter and said that it had not changed their quality of life. The speech pathologists and FPs answered that some improvements were seen in some areas, but no dramatic changes were noticed.

The speech pathologists were asked whether factors such as user's life experiences, training, education, and type of disability had influenced the way the users had "taken to" the device. Peter and Cissi's speech pathologists responded that initial training was necessary and familiarity with computers was a must. They did not think that level of
education was related to accepting or rejecting the device. The user's personality was an important factor, i.e., they needed to be motivated to communicate.

When asked about the evaluation process, the time and effort that was involved, the speech pathologists said that it was an appropriate procedure and did not think that too much of their time was involved. However, Peter's FP thought the study was long (both the quantitative aspect and the questionnaire), and said that he would have worked with only one user if he had understood this before. The investigators had explained the project, and given an estimate of the time frame since it would differ for each of the subjects.

In summarising the responses to the questionnaires, it can be stated that the users, their FPs and speech pathologists agreed on many of the issues related to Multi-Talk II. Peter was the most positive about the device and was extremely motivated to use it. This was also reflected in the responses given by his FP and speech pathologist. Sara and her FP were negative about the device, and Sara's speech pathologist's responses were influenced by this. Cissi's reactions were mixed, just as her FP's, but her speech pathologist was very positive.

**Discussion**

The study investigated the effectiveness of Multi-Talk II as a VOCA with five users. The quantitative and qualitative data revealed varied and interesting results. For all users, communication rate increased with Multi-Talk II, immediately after the training, in structured tasks indicating the benefit of using pre-stored messages. It was predicted that with longer use of the device there would be further increase in the rate of communication. However, this did not occur. The rate did not increase for conversations with Multi-Talk II as the users mostly typed their messages.

The number of communication breakdowns varied for the different partners depending on whether the user was using their regular communication system or Multi-Talk II and whether they were conveying new information. Sara's FP appeared to have had more problems in understanding the synthetic speech than other FPs. This was probably due to limited exposure as Sara did not use her device at work. The amount of participation was influenced by the context, the task and the interactants. Three users contributed more during description of the news item with Multi-Talk II just after the training. Except Sara, all users contributed more when narrating news items with Multi-Talk II than at baseline. However, during conversation their participation reduced as they took time to formulate what they had to say and typed most of their messages. Some of the FPs used this time to talk continuously, increasing their amount of participation. We expect this to change when the users have used the device more and have learned to use a combination of stored phrases and written responses, and when partners get accustomed to interacting with a VOCA user and find a comfortable way of waiting for responses. The excess contributions made by all FPs could not be considered as intrusive. Sara's FP made "small talk" to fill in the silences, whereas Cissi's partner interrupted her while she was preparing the message distracting Cissi.

The general increases seen in rate and amount of participation immediately after training with Multi-Talk II did not increase further after longer use of the device. This
could be due to the following: 1) Initial interest and motivation to try a new device might have later reduced; 2) The speech pathologists did not see them as regularly as they did during the training period, so the users could have forgotten some of the functions/features of the device that they had learnt during the intensive training period; 3) Even though guidelines were given to speech pathologists about how they could create and provide opportunities for the use of the device, it appears that another structured program like the training program would have been more helpful; 4) Smith-Lewis & Ford (1987) argued that the social climate in which the user functioned, and the environment that she lived in, provided opportunities that supported communication interactions which were important for success. To address this, the speech pathologists had been requested to train a personal assistant or family member in the use of Multi-Talk II so that this person could encourage and support the user to use the device. Due to limited time and other constraints, this may not have been accomplished; 5) Technical difficulties during this period might have discouraged some users and speech pathologists. If the use of VOCA is a new concept, then the use should be made easy showing immediate and lasting positive results, and 6) the importance of best input, placement and mounting of the device. It took considerable time to try to optimise these practical matters and some of the users were not satisfied with the results.

The responses to questionnaires provided us with the in-depth information about what the users and others thought of the device. There was no strong correlation between the quantitative and qualitative findings as there were several factors that influenced both. For example, Sara's communication rate increased with Multi-Talk II and the use of the device provided the possibility for her to be more independent, especially in her communication with unfamiliar partners. However, Sara was negative about the device which was reflected in the questionnaires, and decided not to use Multi-Talk II after the evaluation. On the other hand, some increases were seen in Peter's rate and amount of participation with the VOCA, but it was not dramatic. He was, however, extremely positive about the device.

These results point up the importance of evaluating a communication aid both qualitatively and quantitatively to gain a full understanding of the value of a device for a particular user. The methods used in the evaluation, i.e., the videotaped interactions and the questionnaires, provide us with two different types of information.

The importance of evaluation over a period of time cannot be stressed enough. Short-term evaluation might have shown that the users liked the device, as in Sara's case. The longer-term evaluation, however, showed the device to be later abandoned. It gave the users and the investigators an opportunity to discover what the participants really thought about the device.

The decisions made by the users regarding whether they wanted to continue using the device or not were influenced by several factors. Sara liked the compactness of a laptop computer, but did not want to use an expanded keyboard or other alternate inputs with Multi-Talk II. She preferred to use her dysarthric speech and communication board. Sara also always has a personal assistant who can interpret her speech for others. Her motivation to use a VOCA is questionable due to the above reasons. There are some differences in the attitude toward the use of Multi-Talk II
between Peter, a user with congenital disability and Cissi, a user with acquired problems. Peter, who has no functional speech, used Multi-Talk II as his primary means of communication and was highly motivated to use the device. Cissi does not have any functional speech either, but it was more difficult for her to accept a new synthetic voice. She needed more support from her environment for successful use of Multi-Talk II. Currently, she uses both Polycom and Multi-Talk II. As mentioned earlier, Nora and Ivar discontinued after the training period. Nora, who has severe motoric problems and also no functional speech, was not motivated to try other inputs; Ivar has limited functional speech. Factors such as whether the user had some functional speech or not, whether he/she had congenital or acquired disability, and the degree of motoric disability seemed to influence the way the user responded to Multi-Talk II. It appeared that it was more difficult for the users with acquired problems to accept their disability and the synthetic speech.

It is important that professionals follow up on the feedback and respect the choices made by each user. We were cautious not to dominate the decision-making process and recognised that "the use of AAC is not an all-or-nothing proposition" as reported by the user in Smith-Lewis and Ford (1987). The field of AAC is recognising the importance of multi-modal communication.

The users definitely wanted their device to be small and easy to use, and the FPs wanted speech to have variations of voice. Blackstone (1993b) found similar requests in her survey of AAC users with cerebral palsy as to what features should be added to the AAC devices that would make them better. They wanted the speech output to offer a wider range of options, i.e., inflection, volume, and voices, and increased rate of communication. Interestingly, Multi-Talk II has good intonation but does not reflect emotions. It is realised that the ability to provide a selection of attitudes and emotions in synthetic speech is of vital importance when synthesis is used as a speech prosthesis. The area of speaker characteristics and emotions are thus currently being investigated in our department.

The findings also tell us that VOCAs are tools that need training and support from the environment until their use becomes internalised or automatic. Is learning and using a VOCA by an adult similar to an adult learning and using a new language? The user not only has to be extremely familiar with the functioning of the device, but has to learn the means (e.g., through codes, Minspeak™, pictures) by which the vocabulary is represented. Is this similar to an adult learning not only the vocabulary of the new language, but other linguistic aspects such as syntax, morphology, etc.? Most adults do this by comparing the new language with their learnt language. However, this adult is aware that one has to use new words differently in the new language. An AAC user or the listener may not be aware that language is represented differently in a VOCA and needs to be used differently. One can learn a new language or a VOCA, but unless opportunities arise and/or are provided to use the language/VOCA to communicate, what is learnt may not be strengthened. The user of a VOCA and the partners have to learn a new (different) way to interact. The interaction can never be exactly like two speaking partners of the same language, but more "normal" compared to communication with a communication board. The partner needs to provide enough time and opportunity for a VOCA user to communicate. A person learning a new
language also often needs a partner who will be responsive to their slow way of communicating when searching for their vocabulary and incorporating the nuances of the language. The partner probably has to use simple vocabulary and syntax and also provide time for the new learner to speak. It seems that the field of AAC can certainly make use of the information available in second language/ new language learning literature.

The advantages of using VOCAs for communication are several and obvious. However, for a VOCA to work effectively in various communication situations, it is not enough just to provide the device. Continued support and training are necessary, not only to users but also to professionals who work with such users and to others in the environment. A VOCA may not be for everyone and certainly is not the best communication method in all situations. There are multi-modality ways to communicate, not just through speech or gestures. Light et al. (1993, cited in Blackstone, 1993a) surveyed AAC users in jobs who said that they used a combination of communication modes: VOCAs, gestures/signs, simple technical devices and speech. Respondents to a survey by Blackstone (1993a) said that users relied mostly on speech, gestures, and non-electronic devices when communicating with their family and friends, and used electronic devices with strangers. A reason that Sara, in our study, decided not to use the Multi-Talk II might be due to the fact that she spent most of her time with familiar people using speech and a communication board and did not see the need for a form of communication more intelligible to unfamiliar persons.

Blackstone (1993b) asks why AAC users continued to rely on speech and gestures in spite of the intelligibility problems, especially with unfamiliar partners. We attribute this to the following observations: 1) Users rely on speech and gestures as they are natural forms of communication not only with familiar people but even with unfamiliar people, whereas using a communication board with pictures or symbols may be different, more difficult for the partners to accept and comprehend unless they have been specifically informed about this. 2) Familiar people in an AAC user’s environment may have limited expectations of users and provide limited opportunities resulting in restricted communication. The motivation or the need to communicate with more "intelligible" forms of communication may not be present. How often do AAC users meet and interact with strangers in their everyday lives? The use of VOCAs to be able to communicate with unfamiliar partners and the opportunities to communicate with those partners are factors that influence each other. Blackstone (1993a) reported that electronic aids were used twice as often with co-workers and strangers as with family. It is important to investigate this area with our current and future users of Multi-Talk II.

Blackstone (1993b) also summarised suggestions given by individuals with cerebral palsy to AAC professionals:

1) the training of communication assistants/interpreters. This practice has been ongoing in Sweden
2) the use of expert AAC users to serve as models and support someone through the process of obtaining, learning and using a device or technique. This is an area that needs to be explored more extensively in Sweden.
Final remarks

This investigation evaluated the effectiveness of Multi-Talk II as a VOCA with five AAC users. Two of the users, Peter and Cissi, completed the evaluation and have their own devices. Peter continues to use Multi-Talk II, and Cissi uses mostly Polycom and sometimes Multi-Talk II. Sara, who also completed the evaluation, decided not to continue to use the device and communicates as before. Nora felt it was time-consuming to use the device and probably did not want to be more different from her classmates. Her severe hypertonia and reflexes seem to make it difficult for her to use her finger or eye pointing as inputs. She continues to use her letter/word-board. Ivar discontinued with the evaluation after training with Multi-Talk II. He probably needed continued support and encouragement to use the device which his speech pathologist could not give.

Was the aim of this project achieved? Is Multi-Talk II an effective VOCA? Yes, for some users. Multi-Talk II can be used effectively as a VOCA provided the users are motivated and there is support and opportunities from the environment to use it. It's important to know who may benefit from the device. Factors mentioned above can be used as guidelines by professionals and others involved in making decisions.

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