Do we understand the speech of deaf adolescents?

An evaluation and comparison of the intelligibility in two similar research projects from 1979 and 1995

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The intelligibility of the speech of orally educated deaf pupils was the subject of a research project conducted in Norway in 1979. The sample consisted of all 15 adolescents from the 7th, 8th and 9th grades of a school that offered boarding accommodation. The pupils were videotaped as they uttered pre-constructed phrases. Normal hearing adults evaluated the speech. Some pupils were understood, while the speech of others was practically impossible to decipher. On average, about half of the words were understood. In the 1980s, teaching through sign language became common and articulation training became rare. To see if this change in teaching method reduced the intelligibility of oral speech, a replication study was conducted in 1995. The results of the two studies, however, were very similar.

Key words: deaf pupils, articulation, intelligibility.

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INTRODUCTION

In Norway, deaf children aged 6–16 years usually attend one of four state elementary schools for the deaf, all of which offer boarding accommodation. Despite today’s policy of integrating handicapped pupils into ordinary schools, most deaf children still prefer a segregated education, even though this may involve staying away from home during the week.

Before the 1970s, hardly any deaf children received a systematic pre-school training. These children began their schooling aged 7 years with little or no spoken language (8). The schools used the oral method of education, and lip-reading was deemed important. Some teachers used a few signs to support the lip-reading; however, as a group, they had little or no proficiency in sign language (4).

All of the pupils had a body-worn hearing aid, which was routinely checked in the classroom every morning. Both the staff and the parents were instructed to follow-up the use of amplification. Much time was spent during the common lessons and in separate training lessons teaching the pupils to speak distinctly so that normal-hearing people could understand and accept their articulation.

No formal tests were used to evaluate whether the speech of the pupils was understandable. Two studies have shown that about half of the words pronounced by deaf adolescents in Sweden are understood (1, 6). Roughly similar results were found in England (3). These studies had presented audiotapes of deaf persons’ speech to their evaluators.

Kvaam (8) conducted the first Norwegian research in this field in 1979. The study made use of videotapes in order to make the situation more lifelike and to make lip-reading possible. The videotaping was carried out by professionals.

One of the main conclusions from that study was that some of the deaf adolescents—about one-third of them—had a pronunciation that was understandable for strangers, while the remainder were either very hard or almost impossible to understand, even though some words were understood. The common conclusion among the staff was that more training would lead to better speech, despite the fact that the least understandable pupils were offered more separate speech training than the rest of the group for several years.

Although not documented, the philosophy and methods of education in Norway gradually changed after the end of the 1970s. More and more deaf children were attending pre-schools using signed Norwegian or sign language, and they learned spoken,
written and sign language through play. Today, Norwegian sign language is by law acknowledged to be the mother tongue of deaf persons. Hence, sign language has been an important part of the study schedule in the education of teachers of deaf children.

Teachers in the schools of the deaf are now more concerned about the topics of the curriculum than about the pupils' articulation. They have a poorer proficiency in teaching articulation than the teachers in the 1979 study (14). In addition, separate articulation skill training with pupils has, for the most part, been removed from both the curriculum and the practical daily work. Many pupils do not use their hearing aids and teachers practising sign language do not use their voices during lectures.

One would expect this change in teaching methods to influence the outcome of the compulsory school education. The pupils' opportunity to be educated in their "mother tongue" will probably lead to them becoming more knowledgeable in the different areas of the curriculum. However, the reduced use of hearing aids and the reduced emphasis on oral speech could, on the other hand, lead to poorer articulation.

To test this latter hypothesis and to describe the intelligibility of the speech of deaf adolescents in schools for the deaf in the 1990s, Bredal (2) decided to conduct a replication of the 1979 study.

MATERIAL AND METHODS

Samples
The sample in the 1979 study comprised the total number of pupils attending the 7th, 8th and 9th grades in one school for the deaf. All 15 of them—7 boys and 8 girls—consented to take part in the study. Only 3 of them had received an approximate satisfactory pre-school training according to current standard, while 9 of them had not had any pre-school training. None of the pupils was instructed to use a hearing aid during the test but all of them did, thus mirroring their daily life situation.

The sample in the 1995 study included the total number of pupils attending the 8th grade in three schools for the deaf (including the school in the 1979 study). All 15 of them—9 boys and 6 girls—consented to take part in the study. They were not specifically instructed to use a hearing aid during the test but 6 of them did so naturally. The whole group had received professional pre-school counselling and training.

The mean hearing loss of the two sample groups was about the same: 99 and 98 dB, respectively, in the best ear (mean on 0.5−1.0−2.0 kHz). The best hearing was 84 dB in 1979 and 86 dB in 1995. None was expected to have a progressive loss and the audiogrammes were no more than 2 years old. All were deaf before the age of 2 years; none had undergone a cochlea implant operation. In this paper, the expression "deaf" is used for all participants.

Intelligence testing was not carried out for this study but all participants were registered within the normal range in earlier tests. No additional handicaps were recorded and their reading capacity was regarded as normal. In the 1979 study, 9 pupils were boarding in the school during the week, while this was the case for 6 pupils in the 1995 study.

The number of home visits is not registered but we know that boarding pupils in the 1990s as a rule go home during the weekends, while the 1979 pupils generally had 6 free trips home every year. Apart from this, and apart from the differences in pre-school and school education and the use of hearing aid, no systematic differences were apparent.

To evaluate the speech of the sample, volunteers were collected among adult university students and health workers, all with expected normal hearing and Norwegian as their mother tongue. The number of evaluators differed in the two studies: 38 in the 1979 study and 48 in the 1995 study. This was owing to different numbers of students in the two corresponding lecture groups, all of whom wanted to participate in the study. For this reason, a percentage distribution will be used. Six out of ten volunteers in both evaluating groups had no advance experience with deaf persons.

Text material: words and sentences
As the aim of the study was to reveal pronunciation and not language capacity, sentences were constructed in advance by the 1979 project leader. Each sentence, which was made up of 5, 6 or 7 daily life words, had a logic content and was phonetically balanced (according to the Norwegian language). There were 6 sentences for each pupil; thus, altogether there were 90 different sentences. The same sentences were used in the 1995 study.

The pupils were randomly assigned numbers 1−15. Immediately prior to being videotaped, the deaf pupil was given a sheet containing 6 different common sentences to pronounce. The sentences covered different combinations of the phonemes in the Norwegian language. The pupils were allowed a pause (6 sec) after each sentence so that they could become familiar with the next one.

The videotapes were then presented to groups of evaluators. During the pause between each pronounced sentence, the evaluators wrote down what they thought the pupil had been saying.
RESULTS

Words

The written interpretation of the evaluators was compared word by word to the original sentence. The number of correct words obtained by each evaluator for each pupil was registered. The total number of correctly understood words for the whole group was then recorded.

The two studies showed relatively small differences with regard to the total number of correctly understood words (Table 1). Approximately half of the words were interpreted properly in both studies: 50.4% in 1979 and 51.4% in 1995. The dispersion was large. The evaluators interpreted about 1 out of 10 words when spoken by the least understandable pupil in both studies. The best pupil had a higher score in the 1995 study: 97.2% compared with 88.3% in 1979.

Sentences

Six sentences from each pupil were evaluated. The sentences were defined into one of three groups according to the following categories:

1. not understood (none or only 1–2 words understood);
2. partly understood (at least the 2 most significant words understood); and
3. understood (the meaning was clear, even though the words may have differed a little from the original).

As can be seen in Fig. 1, there were slightly better results in 1995 than in 1979. In both studies, the meaning was understood in more than one-third of the sentences, while around half of them were not understood at all. The sentence intelligibility did not follow the Gauss curve as very few sentences were partly understood. Evaluators either understood the meaning completely or not at all. It appears that the evaluators guessed the meaning of some sentences, similar to a crossword puzzle being solved when enough clues are given.

Each sentence from each evaluator was given a score of 0–5 in accordance with the size of the sentence (0 points = no correct words referred; 1

![Graph showing percentage of words understood across different years and conditions]

Fig. 1. Ninety sentences divided into three groups according to the intelligibility in the two studies (%).

point = 1 word correct; 2 points = 2 correct words out of 5, 3 out of 6 or 7; 3 points = 3 out of 5, 4 out of 6 or 5 out of 7; 4 points = 4 out of 5, 5 out of 6 or 6 out of 7; 5 points = quite correctly reproduced). The points were compared with the pupils’ hearing loss (mean on 0.5–1.0–2.0 kHz, best ear).

Pupils with a hearing loss in the range 80–99 dB were better understood than the group with 100–119 dB hearing loss (Rank correlation p < 0.01; Table 2). The difference between the two groups was larger in the 1979 study. An explanation may be that all of the pupils in 1979, also during the videotaping, used hearing aids, which favoured the speech of those with some residual hearing.

The 1979 study found that the boys were slightly better understood, even though their average hearing loss was more serious than that of the girls. The 1995 study found an opposite tendency: the girls were slightly better understood, even though their average hearing loss was more serious than that of the boys. The difference is probably owing to chance.

Table 2. Mean points (0–5) on understanding of sentences in the two studies, divided into groups according to hearing loss

<table>
<thead>
<tr>
<th>Hearing loss (dB)</th>
<th>Sentences—mean points</th>
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<tbody>
<tr>
<td></td>
<td>1979</td>
</tr>
<tr>
<td>80–99</td>
<td>2.9 (N = 7)</td>
</tr>
<tr>
<td>100–119</td>
<td>1.7 (N = 8)</td>
</tr>
<tr>
<td>Total</td>
<td>2.2 (N = 15)</td>
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</tbody>
</table>
The evaluator group

The evaluators were divided into two groups according to previous experience with deaf persons. Both studies showed a better, although non-significant, understanding of the sentences evaluated by persons that had previous experience as compared with the non-experienced ($p < 0.2$). This indicates that even though strangers may not understand them, a deaf adolescent will be able to communicate orally with family and friends.

In order to evaluate whether the evaluators become familiar with the deaf pupil’s speech during the evaluation, the understanding rate of the first sentence was compared with the last one. No statistically significant difference was found, which indicated that listeners did not become familiar with the deaf person’s special way of talking in a short time. No statistical differences were found between sentences of 5, 6 or 7 words. Sounds that were invisible for a lip-reader were less understandable, particularly for words containing the Norwegian /kj/, /skj/, /sh/ and /ng/.

DISCUSSION

Even though the two studies used the same method and procedures, they were not identical. The two samples varied randomly and one single pupil can make a substantial difference to the average values when the sample consists of only 15 people. The situation for videotaping may also differ, as could the evaluator groups and their conditions. However, the two studies have so many similarities in their method that a comparison between them may be undertaken.

The main conclusion of the comparison is that the speech of deaf adolescents in schools for the deaf is as easy—or as difficult—to understand today as it was in 1979. Approximately half of the spoken words were correctly interpreted in both studies. This is also in accordance with earlier results from Sweden (1, 6) and England (3).

A little more than one-third of the sentences were fully understood. Smale (13), who studied the speech of orally educated deaf adolescents in the Netherlands, found that hearing persons who were not familiar with the speech of deaf people understood more than half of their speech “well” to “very well”. Smale’s results show a better intelligibility than the two Norwegian studies. The Norwegian results are more in accordance with those of Hyde and Power (7), who found that about 60% of the 15 severely deaf and 15 profoundly deaf students in their study were rated by their teacher to have a speech that was “very hard to understand” or “not understandable at all”.

Pupils with hearing loss in the range 80–99 dB were better understood than the group with 100–119 dB hearing loss (Rank correlation $p < 0.01$). This is in agreement with results from all researchers in the field (3, 5–7, 10–13, 15). The difference between the two groups is larger in the 1979 study. An explanation may be that all of the pupils in 1979, also during the videotaping, used hearing aids, which favoured the speech of those with some residual hearing. Words containing sounds that are visible to a lip-reader were better understood than words with invisible sounds. This highlights the importance of seeing the deaf person when talking with him or her and of making video-telephones accessible to hearing-impaired people.

For the project leaders, the similarity in the results between the 1979 and the 1995 studies was unexpected, as education in the 1970s favoured articulation training. A substantial part of the school lessons for the pupils in the 1979 study had included articulation training during the primary school years, both in class and in separate lessons. An important official aim of the education was proficiency in Norwegian spoken language. During the secondary school years, the pupils had received articulation training with a specialist outside of the classroom for, on average, 15 min, three times a week, while the 1995 pupils had practically no articulation training.

Hence, proficiency in speech is influenced by conditions other than speech training. However, no conclusion about the weight of these factors can be drawn from such a small study.

A partial explanation may be that the 1995 group has also profited phonetically from the sign language education. Another, and probably more valid, explanation may be the structured pre-school training of the 1995 group, which was rare in the 1970s. Another explanation may be attached to the proficiency of the teachers. Even if speech training is not emphasized today, the general education of teachers is more extensive and at a higher level than before (2 years in addition to teachers training college instead of 1 year).

A fourth explanation may be found in the general attitude towards deaf people. Today, deaf people are more integrated into society. Some pupils travel home by bus or taxi every afternoon. Others go home every weekend. This was the case for only 6 out of 15 in the 1979 study. Thus, deaf pupils today have more opportunities to be in contact with their hearing peers and family members, often through oral language. Research has shown that integration promotes good articulation (9). However, little research has been carried out in this field. The two compared studies support the hypothesis that sign language education
does not obstruct speech performance. It is also obvious that more speech training does not always result in better speech.

There probably exist both known and unknown factors in the brain, which allow for good articulation with a minimum of training in some people, while others will always fail despite continuous training. This is supported by the fact that the three least understandable pupils in the 1979 study had received during the previous 2 years more than twice as much separate speech training as the three best pupils. What are these factors? To what degree is deafness combined with crucial apraxia, arhythmy, delayed visuo-motoric or other neurological factors influencing articulation ability? What is the optimal age for learning articulation? What are the best ways to ensure motivation and prosperity? To what degree is the necessity of speech a decisive factor for success?

To ensure the best use of time and economical resources, more research and better prospective tests to reveal the ability for learning good articulation will be of great importance.

REFERENCES


SAMMENFATTING

Blir døves tale forstått? En undersøkelse av hvordan hørende forstår døve ungdommers tale foretatt ved to nesten identiske undersøkelser fra 1979 og 1995

Fram til 1975 var i hovedsak undervisningen av døve i Norge basert på den orale metoden. Tale- og artikulasjonstrening var en viktig del av opplæringen.


Artikulasjonstrening er dermed ikke eneste middel til å lære barn god uttale. Bedre førsøkte tilbud i 1995-gruppen, større språklige ferdigheter gjennom tegnspråkbruk i skolen og til dels i hjemmene, hyppigere kontakt med talespråklige personer i hjemmemiljøet, større aksept av døves kommunikasjonsform i samfunnet, samt mer omfattende ut-
Yhteenveto

Ymmärretäänkö kuoron puhetta?
Vuoteen 1975 asti Norjassa noudatettiin kuurojen opetuksessa oralistista traditiota. Opetuksen olennaisena osana oli puhe- ja ääntämisharjoittelu.
Näin ollen artikulaatio-opetus ei ole ainoa tapa opettaa lapselle ääntämystä. Tulokseen ovat ilmeisesti vaikuttaneet kehittyneet esikoululot, kielellisten valmiuksien kehittyminen viittomakien myötä ja laajentunut audiopedagogien koulutus.