Phonological Analysis of Deaf Speech Using Auditory-Visual Samples: A Clinical Report

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One of the challenges in providing communication training to profoundly hearing-impaired adults is speech assessment. One approach to this problem is to include a phonological analysis using auditory-visual samples as part of the ongoing diagnostic process during communication training.

The evaluation of spoken English skills of profoundly hearing-impaired persons usually includes intelligibility ratings and phonological analyses of what a clinician hears (Boothroyd, 1985; Subtelny, 1982). In real communication encounters, a client's speech intelligibility may be enhanced by the listener seeing the client's face (Monsen, 1983), knowing the context or communication situation (McGarr, 1983; Monsen, 1983; Sitler, Schiavetti, & Metz, 1983; Subtelny, 1982), and having prior experience with deaf speech (McGarr, 1983; Monsen, 1978, 1983).

Numerous studies support the fact that speech perception involves the simultaneous reception of visual and auditory information (Binnie, Montgomery, & Jackson, 1974; Dodd, 1977; Erber, 1975; Kuhl & Meltzoff, 1982; McGurk & MacDonald, 1976; Seewald, Ross, Giolas, & Yonovitz, 1985). A recent review of speech perception research revealed a number of studies that analyzed connected speech, a more natural context than isolated speech sounds (Pisoni, 1985).

As a part of speech assessment, analysis of a hearing-impaired client's visi-

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ble speech movements may suggest which targets are appropriate for therapy, assist in formulating strategies for communication training, and provide the client and clinician with evidence of progress. This positive feedback, in turn, can help stimulate and maintain the motivation of both teacher and client.

The purpose of the present paper is to describe the use of a visual assessment to supplement the typical phoneme assessment of the speech of a profoundly hearing-impaired young man.

CASE REPORT

Background Information

The client was a 21-year-old male who was referred by a rehabilitation counselor to a university clinic for communication training. He reported having a bilateral hearing loss since birth. The etiology was unknown. His educational background included a classroom for deaf students and a state school for the deaf; both programs included some speech therapy. The client reported using amplification since he was a year old and was wearing two in-the-ear hearing aids. He attempted to communicate orally but could not be understood. He seemed more comfortable and could be understood when he used sign language and speech together. Audiometric evaluation revealed a profound sensorineural hearing loss in both ears. His better ear (left) had hearing sensitivity up to 1000 Hz. A selected-spondee threshold was obtained for the better ear at 95 dB HL. Speech detection thresholds were obtained at 85 dB HL for the left ear and 90 dB HL for the right. His aided speech detection threshold was 35 dB HL. An aided audiogram (warble tones) clearly suggested that he might benefit from more powerful hearing aids. The client expressed a desire to improve his speech, language, speechreading, and reading skills.

Pre-therapy Evaluation

As part of the initial evaluation, a spontaneous speech sample was recorded in a therapy room. Due to the severe unintelligibility of the client's speech, a transcription could not be performed. Stimuli with a known referent were needed to complete the assessment.

The next step in the speech assessment was to find words and simple sentences to use for analysis. Twelve three-syllable sentences (McGarr, 1983) and 30 words from the *Diagnostic Test of Speechreading* (Myklebust & Neyhus, 1970) were selected. A student clinician printed each of the stimuli on a separate card and instructed the client to read the word or sentences on the card. The client's responses were audio- and videotaped. Although not optimally fitted, the client wore his two in-the-ear hearing aids during the evaluations reported in this paper.

Transcription was completed by one of the clinic's speech pathologists who had prior experience transcribing deaf speech. Her experience with this client,

however, was limited to the recorded (audio and audio-visual) samples of speech. Initially, the transcription was attempted using the audiotape sample only. Due to therapy room noise and the client's unintelligible hypernasal speech, the audio sample could not be reliably analyzed. It was then decided to use the videotaped sample. When comparing the attempted audiotape transcription and the videotaped (audio-visual) transcription, the following observations were noted. The articulatory placement for /f/ and the liprounding for /r/ were observed on the videotape but not heard on the audiotape. In addition, the production of /ð/ was perceived as a /d/ on the audiotape but was visually observed as /ð/ on the videotape. No other discrepancies between the audio and audio-visual samples were identified. The effect of the client's severe hypernasality on speech perception was, however, reduced during the transcription of the videotape. The simultaneous reception of visual and auditory information enhanced intelligibility.

A phonological analysis of the videotaped (audio-visual) sample was then completed using the procedures described by Hodsen and Paden (1983). When the patterns or processes were unique to the client, a process describing the client's production was used. For example, use of a continuant for stop was one type of process identified (Hodsen & Paden, 1983).

Therapy

Subsequent to the pre-therapy evaluation, the client was enrolled in speech therapy which targeted decreasing the deletion of consonants, improving control of pitch and volume, and improving articulatory placement for sound production. As previously noted, the client was not optimally fit with amplification. During therapy he preferred to wear his in-the-ear hearing aids; however, when one aid was being repaired, an auditory trainer was employed.

Post-therapy Evaluation

An evaluation was performed following sixteen 90-minute sessions. The words and sentences were videotaped in the same manner as for the pre-therapy sample.

Results

The 12 three-syllable McGarr (1983) sentences had a total of 35 word productions. Each word production was individually analyzed as to the types of articulation errors the client produced. Each error (e.g., /t/ for /s/) was catagorized as a deficient pattern (e.g., stopping). Each word transcribed may have had one or more deficient patterns.

In the pre-therapy sample, 6 out of the 35 word productions (17%) were produced correctly as judged from what was seen *and* heard on the videotape. In the second sample, 15 out of 35 (43%) were correctly produced. A comparison of both samples revealed 17 of the initial 29 misarticulated words (49%) improved in the second sample.

Table 1 shows the pre- and post-phonological analysis of the McGarr (1983) sentences. A total of 40 deficient patterns were produced in the pre-therapy sample and 28 in the post-therapy sample. The percentage of occurrence of each pattern is listed. The improvements noted are also provided. Most significant in Table 1 is the reduction of the deletion of initial and final consonants, the increase in continuants, and the sound preference for /ʃ/. Although the latter two deviant patterns increased in occurrence, these were judged to improve speech intelligibility. These processes indicated the client was producing more sounds instead of omitting the sounds. However, they were not always produced correctly, resulting in an increase of these deviant patterns.

Table 1

Auditory-Visual Phonological Analysis of the McGarr Sentences

Deficient Patterns	Pre-therapy (40 Errors) Percentage of Occurrence	Post-therapy (28 Errors) Percentage of Occurrence
1. Deletion of Final Consonant	43	18
2. Deletion of Initial Consonant	18	3
3. Vowel Deviation (e.g., /ʌ/ for /o/)	18	11
4. Stopping (e.g., /t/ for /z/)	7	7
5. Cluster Reduction (e.g., /w/ for /dr/)	5	0
6. Addition of /h/	5	0
7. Liquid Simplification (e.g., /w/ for /r/)	2	0
8. Continuant for Stop (e.g., /s/ for /g/)	2	14
9. Sound Preference[a] /ʃ/ (e.g., /ʃu/ for /ju/)	0	21
10. Addition of vowel	0	18
11. Devoicing (e.g., /k/ for /g/)	0	3
12. Fronting (e.g., /d/ for /g/)	0	3

IMPROVEMENTS

1. Eight additional occurrences of final consonants
2. Six additional occurrences of initial consonants
3. Two additional occurrences of clusters
4. One appropriate usage of a vowel

[a]A pattern in which one or more classes of sounds are replaced by a single sound (Weiner, 1981).

Table 2 shows the results of the analysis of 30 words from the *Diagnostic Test of Speechreading* (Myklebust & Neyhus, 1970). A total of 51 deficient patterns were produced within the pre-therapy sample and 62 in the post-therapy sample. Although an increase was observed in the post-therapy sample, these changes did not decrease intelligibility for reasons stated previously.

DISCUSSION

As part of the speech assessment of a profoundly, hearing-impaired adult, a videotape was utilized. An analysis of the videotape revealed information

Table 2

Auditory-Visual Phonological Analysis
of 30 words from the Diagnostic Test of Speechreading

Deficient Patterns	Pre-therapy (51 Errors) Percentage of Occurrence	Post-therapy (62 Errors) Percentage of Occurrence
1. Deletion of Final Consonant	29	5
2. Cluster Reduction	14	14
3. Vowel Deviation	12	16
4. Liquid Simplification	10	5
5. Deletion of Initial Consonant	10	3
6. Stopping	6	3
7. Backing (e.g., /g/ for /t/)	4	8
8. Addition of Vowel	2	19
9. Deletion of Medial Consonant	2	0
10. Weak Syllable Deletion (e.g., /eɪ ə/ for /kændɪ keɪn/)	2	0
11. Continuant for Stop	0	8
12. Sound Preference /ʃ/	0	8
13. Devoicing	0	8
14. Stridency Deviation (e.g., /θ/ for /s/)	0	1

IMPROVEMENTS

1. Ten Additional Occurrences of Final Consonants
2. Two Additional Occurrences of Initial Consonants
3. Two Additional Occurrences of Medial Consonants
4. One Additional Occurrence of a Cluster
5. One Addition of a Continuant

which was observable but not heard on the audiotape. The visual information, as expected, improved intelligibility. These observations suggested the importance of visual cues in understanding speech of the hearing impaired and the need to consider an auditory-visual analysis. For the client described in this report, after 16 sessions of speech therapy, phonological analysis of auditory-visual speech samples provided results which indicated progress.

This evaluation provided additional motivators for the client. The client has continued in therapy with speech and language objectives. He recently reported with pride a willingness to use speech in any situation. His motivation and improved speech, in turn, have provided motivation for three student clinicians who had no previous experience with profoundly hearing-impaired clients.

We are not recommending that a videotape analysis be used exclusive of other means. If one of the major goals of therapy is to improve intelligibility on the telephone, for example, the utilization of visual cues may not be appropriate. On the other hand, it may be helpful to have speech samples (audio and audio-visual) available to be analyzed by someone other than the clinician who is providing the therapy.

As a result of this clinical experience, we suggest that visual cues be considered in the assessment of profoundly hearing-impaired clients, especially those with severely unintelligible speech. In addition, we encourage the use of a phonological analysis using auditory-visual samples. This approach could be employed with any standardized speech assessment procedure, including those which incorporate intelligibility ratings. A comparison of the auditory and auditory-visual analyses might provide the clinician with a hierarchy of appropriate targets and assist in the formulation of strategies for different aspects of the therapy program.

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