Auditory Tracking by Hearing-Impaired Preschoolers: Two Case Studies

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The connected discourse tracking technique was adapted to an auditory story modeling procedure with two 4- to 5-year-old children with moderately-severe hearing losses. Over 4 academic quarters, the two children's words per minute (wpm) scores increased from 43 to 80 wpm and 22 to 62 wpm, respectively, demonstrating the feasibility of this task for children in this age range.

The connected discourse tracking procedure developed by De Filippo and Scott (1978) has been utilized as a training and evaluation technique that approximates aspects of everyday communication. Tracking can be used to evaluate the efficiency of a communication modality for accurate reception of connected discourse. The number of words of text correctly repeated in a specified time period are reported in a word per minute (wpm) score.

The tracking technique has been used to assess and train speech reception via speechreading alone or in combination with acoustic cues from hearing aids, vibrotactile aids, or cochlear implants (e.g., De Filippo & Scott, 1978; Owens & Raggio, 1987; Owens & Telleen, 1981; Robbins, Osberger, Miyamoto, Kienle, & Myres, 1985; Roeser, Friel-Patti, & Scott, 1983). Reservations concerning the use of tracking for evaluation have been discussed by Tye-Murray and Tyler (1988).

In an adaptation of tracking, "story modeling," a child is asked to repeat after the clinician, one phrase at a time (Beebe, Pearson, & Koch, 1984). Story modeling as practiced at the Beebe Speech and Hearing Center (Easton, PA) is a technique developed for hearing-impaired children that shares some features of tracking. In story modeling, though a child also repeats after the clinician one phrase at a time, the interaction is not timed, and verbatim responses are not always required. Whereas the story modeling technique is potentially more suited to preschool children, in part due to the lack of the requirement of verbatim repetition, tracking allows for some objective measure of a child's performance. However, it was not known if the requirements of the tracking task

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— such as sustained attention and a cooperative nature that accepts repeated correction — could be met by hearing-impaired preschoolers.

At the University of Montana Speech, Hearing and Language Clinic (UM Clinic), the investigator introduced the tracking task in therapy with two preschool hearing-impaired children. The purpose of this study was to provide case descriptions of the response of two hearing-impaired children to tracking.

METHOD

Subjects

Two hearing-impaired males participated. D.K. was identified at the chronological age (CA) of 3 years, 3 months (3;3) as having a moderate to moderately-severe hearing loss. He was provided with binaural behind-the-ear (BTE) hearing aids one month after the identification of his hearing loss. His most current unaided pure tone averages (PTA) were 50 dB HL and 53 dB HL for the right and left ears, respectively. Aided responses were within normal limits between 500 and 4000 Hz. An aided word recognition score using a PBK word list was good (84%) at a presentation level of 50 dB HL. D.K. began aural rehabilitation intervention at the UM Clinic at CA 3;7 and attended for 2½ years with breaks from therapy each summer. D.K. had also been seen concurrently by other speech-language pathologists from another agency; services were coordinated between the two centers.

J.H. was identified at 3;3 as having a moderate to moderately-severe hearing loss in the right ear and a moderate-sloping-to-severe hearing loss in the left ear. Testing at 3;9 revealed a moderate-sloping-to-profound hearing loss in the left ear. He was provided with binaural BTE hearing aids within a week of the confirmation of the hearing loss. His most current unaided PTAs were 50 dB HL and 48 dB HL for the right and left ears, respectively. Aided responses were within normal limits or in the mild hearing loss range between 500 and 4000 Hz. His aided speech reception threshold was 20 dB HL. His aided word recognition score using the WIPI (Ross & Lerman, 1971) was good (80%) at a presentation level of 50 dB HL. J.H. began to attend the UM Clinic at age 3;3 and continued for 2 years, 2 months with the exception of one summer. He too received concurrent speech-language therapy.

Procedures

Aural rehabilitation activities included auditory training/learning tasks; formal vocabulary, semantic, and syntactic intervention procedures; articulation remediation; as well as tracking. The two hearing-impaired children had participated in the less formal, story modeling task, two quarters prior to the data collection period of tracking to be reported. Tracking was conducted periodically at the UM Clinic over 4 academic quarters. For D.K., there were 3-6 tracking trials per quarter with a total of 18 samples. For J.H., there were 2-5 tracking trials per quarter with a total of 13 samples.

Materials were taken from the first four books in the early reading program (primary series) of Houghton Mifflin. D.K. completed the books, *Bears, Balloons,* and *Boats*, and began the fourth book in the series, *Sunshine.* J.H. completed *Bears* and *Balloons* and approximately one-third of the book, *Boats.* These were selected because the investigator wanted to control for readability levels, beginning at a pre-primer level and progressing systematically to more advanced readers.

The objective during tracking was verbatim repetition of each phrase or sentence by the child. Articulation was not corrected routinely during the tracking task; however, correction was provided occasionally to clarify a response. Formal articulation and phonological intervention was periodically conducted within the context of the therapy sessions, but outside of the time devoted to tracking. The same clinician was the talker for all tracking trials with both children. All trials lasted 5 min. The clinician covered his mouth with his hand to eliminate speechreading cues. The children used their hearing aids for all rehabilitation activities. After the successful repetition of the contents on a page, the children were shown the illustration as a form of reinforcement. No formal hierarchies for resolution of communication breakdowns during tracking were defined prior to the initiation of this study. When the child did not successively repeat the presented phrase or sentence, the talker said the same segment again. Depending on the child's response, a shortened phrase was provided to resolve the communication breakdown. This was always sufficient to elicit a verbatim response.

The children were also administered numerous speech, language, and auditory functioning protocols to evaluate their communicative status, development, and progress. The Test of Auditory Comprehension (TAC) (Trammell, 1981) was administered on an approximately yearly schedule.

RESULTS

Tracking

The results of the auditory tracking procedures with D.K. and J.H. are depicted in Figures 1 and 2, respectively. D.K. began with a tracking score of 43 words per minute (wpm) at CA 4;7. His last two scores were 80 and 75 wpm (CA = 6;0). That is, D.K. almost doubled his tracking rate over time. J.H. had an initial tracking score of 22 wpm at CA 4;1 and ended with a score of 62 wpm (CA = 5;5), approximately tripling his tracking rate.

Both children responded readily to the tracking procedure. The story material, enhanced excitement by the reader, and the promise of seeing the picture as a reinforcement for repeating the material accurately were generally sufficient to keep the children's attention. The tracking samples were short in duration, contributing to the subjects' participation. The two hearing-impaired children were agreeable and willing participants in the verbatim tracking procedures even when correction was necessary. By the talker's use of the adaptive

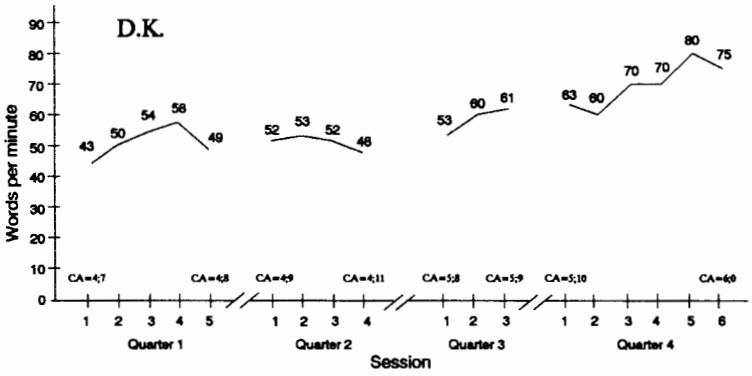

Figure 1. Results of auditory tracking for D.K.

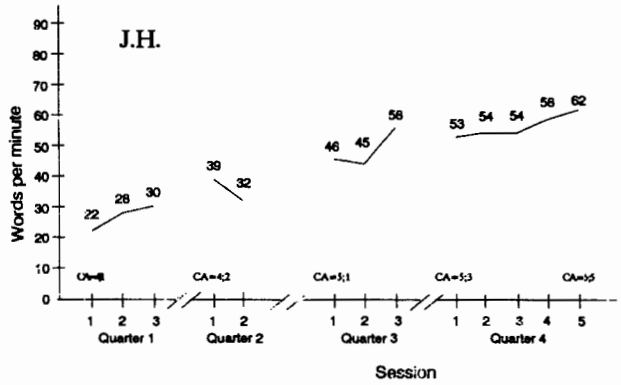

Figure 2. Results of auditory tracking for J.H.

strategy of presenting a shorter linguistic message, both children demonstrated success and increased confidence in their listening skills.

Test of Auditory Comprehension

D.K. first took the TAC prior to his fourth birthday and before the first tracking trial. At that time his T-score of 43 placed him at approximately 1 *SD* below the mean. At the age of 4;9, after five tracking trials, he passed subtests 1-6, with a T-score of 49, placing him at the mean for moderately hearing-impaired children ages 4-6. At the age of 5;7, after a total of nine tracking trials, D.K. passed subtests 1-8. His T-score of 59 placed him at approximately 1 *SD* above the mean for children of similar age with a similar degree of hearing loss (better PTA, 41-55 dB HL).

J.H., at the age of 4;0 passed 5 subtests of the TAC, obtaining a T-score of 42. This is approximately 1 *SD* below the mean for 4- to 6-year-old moderately hearing-impaired children. One year later at 5;0, after five tracking trials, he passed 7 subtests. His T-score of 54 was approximately 0.5 *SD* above the mean.

DISCUSSION

As can be seen from the tracking results, auditory tracking with 4- to 5-year-olds appears to be a feasible therapy technique. It is not the investigator's contention that the tracking procedure alone resulted in the TAC score improvements and the suggested auditory growth by these two hearing-impaired children. However, auditory training with this technique is a viable procedure for hearing-impaired children which can contribute to their listening skills development.

The reading materials utilized were considered to be appropriate for these preschoolers because of their level of readability for the preschool population. In the present study, the clinician did not preview the stories with the children. However, it is recommended that training of new vocabulary items occur prior to their being encountered during a tracking session. In addition, listening comprehension questions should be asked periodically to evaluate how much information the child is processing during tracking.

Tracking scores will be dependent on numerous variables, including the intensity and rate of the speech. Although in this study the investigator covered his mouth with his hand while presenting the materials, others should consider presenting information with other screens such as the padding/mesh material used on recording microphones. Such materials will decrease any acoustic distortion which may occur when using a hand to cover the mouth. If auditory-only tasks are too difficult for a given client, or if an adaptive correction strategy is desirable, tracking can be implemented in an auditory-visual mode.

In conclusion, the tracking technique is suggested as an intervention procedure which can be implemented with young hearing-impaired children. (One subject was 4;1 when this study was initiated.) Tracking provides quantifiable data to aid the clinician in regards to accountability. Auditory tracking or modified story modeling should be considered by others working with hearing-impaired children, with the potential of heightening their auditory performance.

REFERENCES

Beebe, H., Pearson, H., & Koch, M.E. (1984). The Helen Beebe Speech and Hearing Center. In D. Ling (Ed.), *Early intervention for hearing-impaired children: Oral options* (pp. 15-63). San Diego: College Hill Press.

De Filippo, C., & Scott, B. (1978). A method for training and evaluating the reception of ongoing speech. *Journal of the Acoustical Society of America, 63,* 1186-1192.

Owens, E., & Raggio, M. (1987). The UCSF tracking procedure for evaluation and training of speech reception by hearing-impaired adults. *Journal of Speech and Hearing Disorders, 52,* 120-128.

Owens, E., & Telleen, C.C. (1981). Tracking as an aural rehabilitative process. *Journal of the Academy of Rehabilitative Audiology, 14,* 259-273.

Robbins, A., Osberger, M.J., Miyamoto, R., Kienle, M., & Myres, W. (1985). Speech tracking performance in single channel cochlear implant subjects. *Journal of Speech and Hearing Research, 28,* 565-578.

Roeser, R., Friel-Patti, S., & Scott, B. (1983). Development and evaluation of a tactile aid for the reception of speech. *Audiology, 8,* 79-94.

Ross, M., & Lerman, J. (1971). *Word Intelligibility by Picture Identification.* Pittsburgh: Stanwix House, Inc.

Trammell, J. (1981). *Test of Auditory Comprehension.* North Hollywood, CA: Foreworks.

Tye-Murray, N., & Tyler, R. (1988). A critique of continuous discourse tracking as a test procedure. *Journal of Speech and Hearing Disorders, 53,* 226-231.