Tracking As An Aural
Rehabilitative Process

Elmer Owens and Christine C. Telleen
University of California

In the tracking process a series of persons with hearing impairment (receivers) repeated groups of words read by another person (talker). Improvement was shown by an increased tracking rate (words per minute), but results were inconclusive regarding transfer of the increased rates to another talker. Of several coping strategies available to the receivers in resolving blockages that occurred, the one most often used was to repeat any portion of the word group that was understood, thus signaling the talker to fill in or make corrections. This strategy was clearly preferred by the subjects and was seemingly more effective than the second-ranked one of asking for a repetition of the word group. A request for fingerspelling was a useful adjunct when blockages centered on single words that provided few or no lipreading cues.

Various terms have been employed to describe the process in which one person's utterances lag only slightly behind those of another person, such that the utterances seem to occur almost in unison. For example, the Jena method of lipreading instruction described by Bunger (1961) includes practice in which hearing-impaired students say syllables or words along with the instructor, concentrating on kinesthetic sensations while imitating the instructor's articulatory movements. Cherry (1953) used a "shadowing" process in dichotic and diotic listening tasks; Huggins (1964) employed an "echoing" (word-for-word) response to continuous speech in studying effects of alternating the speech from ear to ear; and Kozhevnikov and Chistovich (1965) referred to "flowing imitation" of syllables in their work of mapping the articulatory movements in speech. Marslen-Wilson (1973) utilized a "word-shadowing" response in a study of sentence perception.

The term "tracking" has been applied by De Filippo and Scott (1978) to a procedure in which one person repeats groups of words rather than a succession of separate words read aloud by another person. The aim was to evaluate aided and unaided lipreading ability, the aids being vibrotactile and

electrotactile transducers. Materials were short stories and a novel; and the length of each word group, "a logical linguistic constituent," was arbitrarily determined by the talker as the reading progressed. When errors occurred in a word group, the talker employed various strategies to obtain a correct repetition before proceeding. Two normal-hearing adults took turns as talker and receiver. The receiver in each case was "deafened" with a combination of earplugs and noise, the latter being delivered through earphones. Overall improvement in terms of increased rate of repetition (words per minute) was shown both for aided and unaided conditions.

The immediate appeal of De Filippo and Scott's (1978) use of word groups for purposes of aural rehabilitation was that it permitted the quantification of a communication process emphasizing meaningful units of speech with their appropriate rhythm and stress components. The shadowing technique had generally not stressed meaning. For example, Cherry (1953) observed that his subjects typically responded with monotonous voice and often had little idea of the meaning of the material when they were doing word-for-word shadowing. One investigator (Marslen-Wilson, 1975) did mention questioning subjects on material that they had shadowed but the author offered few details of the measurements or the amount of information retained.

Several authors have directly or indirectly supported the use of word groups as stimuli in training procedures for speech reception. Cherry (1953) reported an experiment in which two recorded messages were presented simultaneously to one ear of a listener who was asked to repeat one of the messages word-for-word or phrase-by-phrase, playing the recordings as often as needed. Although the repetitions were often in error, they were usually expressed in meaningful phrases, suggesting a tendency to listen for meaningful units. Kozhevnikov and Chistovich (1965) observed responses to units of speech (syntagmas) consisting of two to five words with varying numbers of syllables. These units were distorted by frequency filtering, and subjects were asked to write down what they heard. Analysis of the responses indicated that when errors were made, the rhythm and stress components of the message remained intact. The authors concluded that rhythm and stress were powerful cues in the perception of the message. Clark and Clark (1977) have defined syntactic and semantic strategies as the two major approaches used by normal-hearing listeners in auditory sentence perception. In the syntactic approach, listeners use function words, suffixes, prefixes, and grammatical properties of content words in identifying the constituents (short, meaningful units). In the semantic approach, listeners assume that sentences refer to real objects, states, and events in the context of ongoing discourse. Therefore, the attention of these listeners is directed to context words and their meanings.

In short, it seemed to us that tracking can provide a quantifiable rehabilitative procedure in which hearing-impaired persons, through concomitant use of the visual, auditory, and kinesthetic modalities may take maximum advan-

tage of the rhythm, stress, syntactic, and semantic properties of speech. Moreover, it appeared that the training situation in tracking might provide the hearing-impaired person with information on the kind of coping skills needed when the communicative process breaks down. This paper presents some observations on the tracking procedure.

EXPERIMENT I

The purpose of the initial observations was to determine whether improvement in tracking rate can be shown in persons with severe to profound post-lingual hearing impairment who wear hearing aids.

Subjects and Materials

Subjects were four patients with hearing levels ranging from 73 to 100 dB (500-2000 Hz PTA) and ranging in age from 31 to 65 years. All wore hearing aids. There was no particular selection process except that all were willing to engage in a number of individual training sessions.

Thirty-two paragraphs on different topics were selected from materials in an in-house manual on English as a second language developed at the University of California-Berkley. These materials conformed generally to everyday speech. Each paragraph, which contained about five sentences, was divided into short segments such that the segment boundaries coincided with natural pauses. The segments themselves comprised independent and dependent clauses and noun and verb phrases. The segments averaged seven words (11 syllables) and the paragraphs averaged 11 segments.

Procedure

In a preliminary trial of the materials and procedure, the thirty-two paragraphs were presented to four normal hearers seated in a sound-treated audiometric test booth. They viewed the talker through a double-pane glass window for lipreading cues. The paragraphs were presented through a speaker system at a level 5 dB above each subject's threshold of speech detection. The talker (female, general American dialect) attempted to keep her intensity variations within a 5 dB excursion range on the VU meter. These controls provided sufficient difficulty to achieve a ranking of the paragraphs from easy to difficult along with two sets of four paragraphs that could be used for test-retest purposes. The two sets (Tests A and B) were matched in length and in word-per-minute tracking rates for the four normal hearers.

In this preliminary work, each subject (receiver) repeated each section verbatim immediately after the talker. The talker paused just long enough between segments for completion of the repetition. The talker could proceed only after all words of the segment had been repeated correctly. The talker followed the printed paragraphs in which the segments were marked but looked directly at the listener in presenting each segment, as in face-to-face

conversation. For her part in resolving blockages, the talker used most of the strategies described by De Filippo and Scott (1978). These included (a) repeating all or part of a segment; (b) repeating a segment but changing the rate or style of presentation; (c) repeating the portion missed along with preceding or following segments, thus adding contextual information; and (d) providing nontextual verbal clues, such as in rephrasing or in adding modifiers related semantically to the portion missed or in using synonyms. No attempt was made to repeat isolated sounds, and no gestures or other nonverbal cues were employed except an affirmative or negative nod of the head after a subject's response. Each paragraph was timed with a stopwatch in full view of the receiver, who was directed to proceed as rapidly as possible.

The procedure was the same for the four experimental subjects except that live voice was used with the talker and receiver sitting face-to-face about one meter apart. Each subject adjusted her/his hearing aid to a comfortable level for the face-to-face situation. After a warm-up period on two or three paragraphs similar to the training paragraphs (to ensure that the subjects understood the task), Test A or Test B were given. Two of the subjects were given Test A as a pre-test and B as post-test. The order was reversed for the other two subjects. A background of white noise at 40 dB SL was introduced over a speaker system for one subject who experienced relatively little difficulty in tracking during the warm-up period. The twenty-four training paragraphs, ordered from easy to difficult, were presented once to each of the four subjects. Training sessions of 20 to 30 minutes in length were given twice a week for a period of four weeks.

Results and Discussions

All four subjects improved in repetition rate (words per minute) as shown in Table 1, supporting the findings of De Filippo and Scott (1978) despite our use of different materials and a slightly modified procedure. The difference in pre- and post-test scores was statistically significant ($p < 0.01$).

Added evidence of improvement in tracking speed is related to the easy-to-difficult ranking of the successive paragraphs. That is, continuous improvement would be inferred if tracking speed were maintained as the difficulty of

Table 1

Tracking Rates for Subjects of Experiment I

	Tracking Rate (Wds/Min)	
Subject	Pre-test	Post-test
1	62.4	71.4
2	42.6	53.4
3	55.2	66.0
4	40.2	54.0

the material increased. The Wilcoxon Sign-rank Test (Guilford, 1956) showed that for each of the subjects there was no significant difference ($p > 0.05$) between the scores for the first and last twelve paragraphs, thus indicating that the tracking speed was maintained.

The additional evidence of improvement reassured us with respect to a possible tester bias inherent in the design. Because of a basic interest in whether two persons working together could improve their communicative efficiency in a face-to-face situation, we had purposely maintained the same two-person situation throughout the pre- and post-testing and training exercises. Therefore, the talker had to guard against any tendency to influence the outcome of the experiment. It turned out, however, that she had little or no leeway in her rate of presentation, because the maximum speed she attempted to maintain was largely controlled by the speed and accuracy of subject responses. Therefore, we are reasonably confident that tester bias did not affect the results materially.

A similar concern was the necessity of using live-voice presentation, which in a sense precluded each subject being given the same treatment. In a larger sense, however, the two-way process we were measuring contained inherent constraints upon the talker that were the same for all four subjects; i.e., the talker's responses depended upon those of the receiver. For example, the talker proceeded to the next segment upon a correct receiver response; she repeated the segment or tried other approaches when the receiver understood no part of it; and she filled in, or made corrections, when the receiver responded with any portion of the segment. Undoubtedly, nuances were operating in each situation, and the skills of the talker as well as the receiver were amenable to improvement as the process continued. Changes continuously occurred in the number and kind of responses and counterresponses required for correct reception of the segments. Nevertheless, the primary controlling element in the rate of presentation was the receiver's skill in responding.

The fact that the subject with the highest tracking speeds had the most pronounced hearing loss of the group suggested that severity of loss need not be a deterrent to the use of this procedure in rehabilitation. In this connection, a fairly wide range in tracking speeds may be noted among the subjects.

EXPERIMENT II

The purpose of the second study was twofold: (a) to ascertain whether increased rates of tracking can be transferred immediately to another talker and (b) to observe the tracking procedure in relation to appropriate coping strategies in resolving blockages.

Subjects and Materials

Four patients with no prior experience in the tracking procedure served as subjects. They had sensorineural hearing losses ranging from severe to pro-

found. Three were adults ranging in age from 35 to 55 years whose hearing loss onset occurred in adulthood, and the fourth subject was a fifteen-year-old high school student who had experienced a gradual progression of loss since early elementary school. All wore hearing aids. There were no requirements for participation except a willingness to visit regularly for the training sessions. Materials for testing and training were the same as described in Experiment I.

Procedure

The talker described under Experiment I also presented the training paragraphs, but a second talker (also female, general American dialect) presented the pre- and post-tests. Before each of the pre-tests for the subjects, the test talker and the subject practiced tracking with two or three nonexperimental paragraphs, ensuring the subject's familiarization with the procedure.

In order to control for strategy differences by the two talkers in resolving blockages during the tracking procedure, each talker was instructed to offer repetition and other aids only as directed by the subject. That is, the talker offered no unsolicited help but simply waited for the subject to take the lead in

Table 2
Coping Strategies and their Percentages of Use

Strategies	Patients				Averages
	MC	JR	JD	DS	
	%	%	%	%	%
Repeat the previous phrase	0	0	0	0	0
Go to the next phrase	0	0	0	1	0
Speak louder	1	0	0	0	0
Repeat the first part	1	2	1	0	1
Repeat the last part	1	1	0	1	1
Write the word missed	0	2	0	2	1
Speak slower	0	1	0	2	1
Say in other words	3	2	1	2	2
Repeat one word	4	8	4	3	5
Spell the word	4	11	1	9	6
Repeat the whole phrase	13	26	20	22	20
Repeat a portion of the phrase*	73	47	73	58	63
					100%

*This strategy is unique because it is not a request for further help or information from the talker but an immediate effort by the receiver to repeat whatever s/he heard.

resolving the blockage. This change in procedure also enabled us to study the effects of encouraging subjects to take major responsibility for responding correctly. To aid in resolving blockages, each subject was given a list of coping strategies, some of which were taken from Erber and Greer (1973). Strategies on the list are shown in Table 2. No special emphasis was placed on any of them in the process of ascertaining that they were understood by the subjects. All strategies were direct requests by the receiver except "repeat a portion," which was an indirect request; that is, the receiver repeated as much of the segment as s/he thought might be correct, thus implicitly requesting the talker to fill in the rest of the segment or to make appropriate corrections. The receiver was instructed to use the given strategies for resolving blockages and was informed that the talker would respond only according to her/his directions.

The proceedings of all sessions were recorded on tape, and strategies employed by each subject were analyzed afterwards. Two scorers independently tallied the results for the first two subjects. The agreement was sufficiently close to justify use of only one scorer for the last two subjects.

Results and Discussion

Transfer of increased rates of tracking. Pre- and post-training test results are shown in Table 3. Subject 1 in the table indicated an increased rate of tracking from pre- to post-test, implying an improvement with training and a transference of this improvement to the test talker. The remaining three subjects, however, failed to show any difference in the pre- and post-test scores. The Wilcoxon Sign-rank Test for Subject 2 showed no difference ($p > 0.05$) between the scores of the first and last twelve training paragraphs; i.e., Subject 2 seemingly improved during the course of the training sessions as indicated by the maintenance of a steady words-per-minute rate as the paragraphs became more difficult, but the improvement did not carry over to the post-test situation.

The remaining two subjects are best described together. Subject 3 was the fifteen-year-old high school student, and Subject 4 was a young adult who was accustomed to Black dialect in daily conversation. Both experienced

Table 3

Tracking Rates for Subjects of Experiment II

Subject	Tracking Rate (Wds/Min)	
	Pre-test	Post-test
1	33.6	43.2
2	37.2	34.8
3	23.4	23.4
4	13.2	13.2

extreme difficulty in tracking, scoring 23 and 13 words per minute, respectively. Both complained that they were unfamiliar with many of the words and that the topics and construction of the paragraphs were not like everyday speech to them. Also, both scored significantly lower on the last twelve paragraphs compared with the first twelve paragraphs (Wilcoxon Sign-rank Test, $p < 0.05$), indicating that their skills did not improve sufficiently to maintain their rates of response.

We believe that the most likely explanation for the lack of improvement in tracking by these two subjects lay in the training and test materials. For example, the topics of our paragraphs were of a general nature and may indeed have been decidedly uninteresting or unfamiliar to them. Observations during the tracking sessions indicated that vocabulary was a particular obstacle for them and that many of the segments may have included too large a span of words for them. Doubtless there were interaction effects between vocabulary difficulty, segment length, and their profound hearing losses. It should be pointed out here that the normal hearers participating in the preliminary trials of the tracking materials were graduate students and that the average of eleven syllables per segment for our materials was well above the upper limit of seven syllables per syntagma (in Russian) found by Kozhevnikov and Chistovich (1965) to be comfortable for their subjects. In any event, the results are inconclusive regarding whether increased rates in tracking can be maintained with a different talker.

Coping Strategies. An analysis indicated that all four subjects adopted certain strategies in resolving blockages during the first few paragraphs and maintained these strategies with little change for the remainder of the material. Table 2 shows the percentages of times each strategy was used. "Repeat a portion" (63% of the responses) clearly occurred most often, and "repeat the whole phrase" (averaging 20%) was second. "Spell the word" averaged 6% of the responses; "repeat one word" averaged 5%; and "say in other words," 2%.

The stong preference for repeating the portion heard is inconsistent with the findings of Lamb, Owens and Schubert (1981) in a survey of the everyday communication of 354 hearing-impaired adults. This group employed repeating a portion significantly less often than asking for a repetition. In other words, it would seem that many hearing-impaired individuals are not aware of the "repeat a portion" response until it is brought to their attention.

"Repeat a portion" is actually an attempt to verify a message, an important skill for anyone to develop. Moreover, all of the receiver's ongoing repetitions of the segments can be viewed as verifications of messages. As an example, Subject 1 (see Table 3) reported some time after the experiment that he succeeds best in everyday communication when he uses a questioning tone in repeating any fragments that he hears. The average talker responds immediately by nodding in agreement and then filling in the remainder of the message.

Frequently, blockages resulted from one word that provided few or no

lipreading cues, particularly any word with blend sounds such as /sl/, /sk/, /sn/, /kl/. Such blockages often caused an inordinate delay. Repetition of the word by the talker was seldom helpful. Spelling the word was often useful and, of course, writing the word generally resolved the blockage; but the subjects typically hesitated to ask for spelling or for the word to be written. It may be that cued speech (Cornett, 1967) and fingerspelling (see Experiment III) are useful strategies when resolution of a blockage depends on a single word. Once having learned either system, it should be a relatively simple matter for a motivated hearing-impaired person to teach it to a few of the significant people in her/his daily life.

In connection with the single-word blockages, the use of timing and the requirement of verbatim repetition probably precluded a fair test of the request, "Say in other words." Subjects seemed aware of, or they actually experienced, the loss of time that could occur with this strategy. If the talker reconstructed or rephrased the segment with the help of other words (but with the inclusion of the troublesome word) and the receiver successfully repeated this reconstruction or rephrasing, the talker would then have to return to the original segment to obtain a verbatim repetion before proceeding. If the troublesome word were not included in the reconstruction or rephrasing, it might still elude the receiver when the talker returned to the original segment. A modification in the procedure might resolve this problem while generally retaining the requirement of verbatim responses and the use of timing. (These two features are important in that they are related directly to the exigencies of everyday communication.) The receiver could ask the talker to "say that another way" when a troublesome single word is encountered, whereupon the talker could offer a rephrasing or a restructuring. If the receiver understands the revised segment, the talker may proceed to the next sentence, thus waiving the verbatim repetition requirement in this particular instance and preventing a prolonged blockage.

Regarding the question of whether the talker or the receiver should take the lead in attempting to resolve blockages in everyday situations, it seems clear to us that interaction is the primary need. The talker, either in the tracking exercises or in everyday situations, being privy to what s/he is planning to say, is in a position to lead in working out a blockage without losing the context of the entire passage. On the other hand, the receiver seems to know from experience whether a straight repetition might help, for example, or whether one of the other strategies should be attempted immediately. In any case, an appropriate aim of the tracking process would be to encourage the hearing-impaired person to take an active part.

EXPERIMENT III

The purposes of the third study were (a) to explore further the response strategies including the use of fingerspelling for blockages on specific words

and (b) to explore the use of continuous material of specific interest to a given subject in tracking.

Subject and Materials

The subject was a 19-year-old male high school graduate who had had a profound sensorineural unilateral loss and had subsequently suffered a sudden profound sensorineural loss in the other ear as a result of a motorcycle accident. The only measurable pure-tone thresholds in the better ear were 105 dB HL at 500 and 1000 Hz. Use of a hearing aid provided an awareness of voice at a comfortable loudness level in face-to-face situations, but his aided speech discrimination score (NU-6) was zero percent. He had been using fingerspelling for several months prior to the experiment.

With knowledge that the subject had recently taken up photography as a hobby, we chose a basic photography book that we assumed would be of special interest to him. The vocabulary level was easily within high school reading ability, and the writing style was in the familiar form found commonly in how-to-do-it books for the layperson. We made no attempt at modifying the material in the direction of the spoken idiom, and segment length was determined by the talker during the actual tracking process.

Procedure

The tracking situation and the talker were the same as in Experiment I. As in Experiment II, the subject was instructed to take the lead in resolving blockages, the talker waiting for directions in each instance. Three options in handling blockages were given to the subject: (a) to ask for a repetition of the segment or parts of it; (b) to repeat any part he understood, or thought he understood, implicitly directing the talker to fill in the rest or make corrections; and (c) to ask that a word be fingerspelled. The first two options were provided on the basis of our findings in Experiment II, and the third was introduced to explore the use of fingerspelling in resolving blockages on single words difficult to understand. Again, the subject's task was verbatim repetition of each segment.

Two paragraphs of tracking materials used in Experiment I served for practice to ensure that the subject understood the procedure. The work was completed in two sessions of two hours each, separated by a lunch break. To avoid subject fatigue, the tracking work was divided into approximately 10-minute periods, depending upon natural stopping places in the text. A friend of the subject kept time, and the sessions were tape recorded.

Results and Discussion

Improvement in tracking rate. Rates of tracking in words per minute are shown in Figure 1 for sequential sections of approximately five minutes each. Since the text was assumed to be of the same difficulty throughout in terms of

syntax, vocabulary, and the like, an increase in speed of tracking would be shown by an upward trend in Figure 1, which seems clearly to be the case. The sharp decrement for Section 7 is probably best explained as a lapse in the subject's response technique associated with this section, since it was the first attempted after the lunch break.
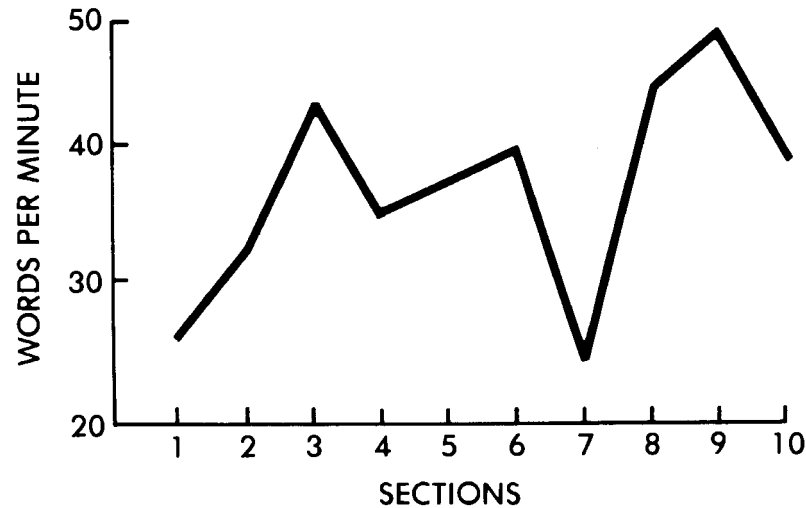

Figure 1. Average tracking speed for 10 sequential sections.

Resolutions of blockages without fingerspelling. Of a total 184 blockages, 134 were resolved without fingerspelling. Of these 134 blockages, as shown in Table 4, 110 were resolved in one interchange, an interchange being defined by the combination of the receiver's response to a spoken segment and a rejoinder by the talker. Two interchanges were necessitated for resolution in 16 of the 134 blockages and three interchanges were necessitated in the remaining eight of the 134.

Table 5 shows a comparison of the two strategies—ask for repetition and repeat a portion—in relation to resolution of blockages without fingerspelling. It may be seen that in 67 of the 110 one-interchange resolutions the receiver repeated a portion, with the talker filling in or making corrections; in the remaining 43, the receiver requested and obtained a repetition of the segment, or part of it. Where 2 interchanges were necessary for resolution, the receiver in the first (unsuccessful) interchange asked for a repetition in 13 instances and repeated a portion in 3. In the second (successful) interchange he asked for a repetition in 4 instances and repeated a portion in 12. Where three interchanges were required for resolution, the receiver in the first

Table 4

Number of Interchanges Necessitated for Resolution of Blockages Without Fingerspelling and
Number of Unsuccessful Interchanges Preceding Resolution with Fingerspelling,
Numbers in Cells are Blockages

Sections	Interchanges for Resolutions without Fingerspelling			Unsuccessful Interchanges Preceding Resolutions with Fingerspelling				Total Blockages
	1	2	3	1	2	3	4	
1	4		4	1	2	1		12
2	12	3		1	1	2		19
3	15			1	2	1		19
4	10	2	1	1	6			20
5	12	2	1	1	4			20
6	15	1		2	3	1		22
7	10	4	2	1	3	3	1	24
8	8	3		2	2			15
9	15	1		1	3			20
10	9			4				13
Total Blockages	110	16	8 (134)	15	26	8	1 (50)	184

Table 5

Comparison of Two Strategies in Relation to Interchanges in the Resolution
of Blockages without Fingerspelling. Entries Show the Number of Times
Each Strategy was Used

	One Interchange	Two Interchanges		Three Interchanges		
		First*	Second	First*	Second*	Third
Repeat portion	67	3	12	1	3	5
Ask for repetition	43	13	4	7	5	3

*Unsuccessful attempts at resolution.

unsuccessful interchange asked for repetition in 7 instances and repeated a
portion in 1. In the second unsuccessful interchange, he asked for a repetition
in 5 instances and repeated a portion in 3. In the third (successful) inter-
change, he asked for a repetition in 3 instances and repeated a portion in 5.

Thus, in the 134 blockages where fingerspelling was not employed, the
strategy of repeating a portion appeared more effective than asking for a
repetition. Not only did the former strategy constitute the majority of resolu-
tions limited to one interchange, but it was typically part of the successful

interchanges (resolutions) that were preceded by one or two unsuccessful interchanges.

Fingerspelling. The subject reserved fingerspelling for difficult single words, or, rarely, two-word phrases. In all instances, the fingerspelling interchange—that is, a request for fingerspelling by the receiver and compliance by the talker—resolved the blockage. Table 4 shows that of the 50 blockages in which fingerspelling was ultimately requested, 15 of the requests were made after one unsuccessful interchange, 26 after two interchanges, 8 after three interchanges, and 1 after four interchanges. In other words, it took at least one unsuccessful interchange, but most often two, for the subject to decide that neither the strategy of asking for a repetition nor that of repeating a portion would help him in the verbatim repetition required for resolution. Moreover, he usually tried the strategy of repeating a portion in at least one interchange before requesting fingerspelling, further attesting to his reliance on this strategy. For example, in the 15 instances of one unsuccessful interchange before his request for fingerspelling, he repeated a portion in 10. In the 26 instances of two unsuccessful interchanges before a request for fingerspelling, only 11 of his 26 responses in the first unsuccessful interchange were to repeat a portion in contrast to 23 of his 26 responses in the second unsuccessful interchange.

Comparison of sections. In Figure 1 it may be seen that the best rate of tracking occurred in Section 9. Table 4 provides an analysis of the 20 blockages in this section. Resolutions were obtained with fingerspelling in 4 instances and without fingerspelling in 16 instances. In 15 of the 16 resolutions obtained without fingerspelling, blockages were limited to one interchange. The 4 blockages in which fingerspelling was utilized for resolution included 1 instance of one unsuccessful interchange and 3 instances of two unsuccessful interchanges before the fingerspelling request. In short, the subject requested fingerspelling in Section 9 if he had not obtained resolution to a blockage within two interchanges. In Section 10, he allowed no more than one unsuccessful interchange before asking for fingerspelling. That is, in Sections 9 and 10, he seemed to have developed a quickness in acknowledging the need for fingerspelling. In contrast, Sections 1 and 7, showing the slowest tracking rates, were notable in that the request for fingerspelling was sometimes delayed until after three or more unsuccessful interchanges.

Thus, although fingerspelling appeared to be a useful adjunct to the tracking procedure when blockages stemmed from a single difficult word, the request for fingerspelling was always a secondary strategy, occurring only after one or two interchanges that failed to produce a resolution. In these instances, fingerspelling served primarily to avoid prolonged blockages.

Continuous text. The use of continuous text proved satisfactory for tracking purposes in aural rehabilitation. Presumably, the continuous text material offered an advantage to the receiver by virtue of its more redundant

contextual information, compared with the short, individual paragraphs on different topics used in Experiments I and II. Probably both kinds of materials are needed for relevance to everyday communicative situations. We have found that almost all materials in written form must be modified to provide a spoken idiom. Transcripts of some radio or TV talk shows may be among the exceptions.

It is noteworthy that the talker had no difficulty deciding upon the length of segments during the tracking process. For the most part, her selection of segment length was dictated by the material itself in terms of sequences that constituted short, meaningful units. At the same time, she felt that decisions were influenced by her perception of the segment length most generally comfortable for this particular receiver as reflected by his responses; accordingly, the experience of the talker in "tuning in" to the receiver may be an important factor in ongoing decisions. Analysis of the tape recordings indicated that the segments consisted of 5 words (8 syllables) on the average. The number of syllables was less than the 11 per segment employed in Experiments I and II and more in conformity with the 7 per syntagma reported by Koshevnikov and Chistovich (1965) as a comfortable upper limit for normal hearers of Russian.

SUMMARY

Our findings on the tracking procedure suggest that it can be profitably incorporated in aural rehabilitative programs. We, along with De Filippo and Scott (1978), have presented evidence indicating that tracking rates can be increased with practice and that they can be quantified. Tracking offers an auditory-visual-kinesthetic approach to receptive communication that takes advantage of the powerful syntactic, semantic, rhythmic, and stress cues crucial to the decoding of speech. The tracking process also provides practice in the use of coping strategies for resolving communicative blockages. In this regard, the seemingly most preferred and most efficient strategy is repeating the portion heard. Moreover, patients receive practice in the verifying of messages during the course of the tracking process.

The use of positive feedback, so important to any learning task, should be provided throughout the process. A simple gesture such as the nod of the talker's head when a response is correct may prove to be an effective reinforcer.

Furthermore, tracking may offer inherent advantages to patients; e.g., practice in speech conservation and the cultivation of an attentive, relaxed manner of listening. In addition, the procedure may be amenable to several variations and applications such as (a) reversing the roles of the talker and listener and (b) concentrating on certain types of grammatical structures or speech sounds by judicious loading of materials.

Research is needed in two major areas. One is in the circumvention of

blockages associated with words or word combinations practically devoid of lipreading cues. The other is in the transference of improvement in tracking to different talkers.

Although our attention has centered on persons with severe to profound hearing loss, we believe that tracking would be a valuable rehabilitative tool for those with lesser loss. In most instances, however, background noise would probably be required.

ACKNOWLEDGMENT

REFERENCES

Bunger, A.M. *Speech reading--Jena method.* Danville, Ill.: The Interstate Printers and Publishers, 1961.

Cherry, E.C. Some experiments on the recognition of speech with one and two ears. *Journal of Acoustical Society of America,* 1953, *25,* 975-979.

Clark, H.H., & Clark, E.V. *Psychology and language.* New York, N.Y.: Harcourt, Brace, Jovanovich, Inc., 1977.

Cornett, O.R. Cued speech. *American Annals of the Deaf,* 1967, *112,* 3-13.

De Filippo, C.L., & Scott, B.L. A method for training and evaluating the reception of ongoing speech. *Journal of Acoustical Society of America,* 1978, *63*(4), 1186-1192.

Erber, N.P., & Greer, C.W. Communication strategies used by teachers at an oral school for the deaf. *The Volta Review,* 1973, *75*(8), 480-485.

Guilford, J.P. *Fundamental statistics in psychology and education.* New York, N.Y.: McGraw-Hill, 1956.

Huggins, A.W.F. Distortion of the temporal patterns of speech: Interruption and alternation. *Journal of the Acoustical Society of America,* 1964, *36,* 1055-1064.

Kozhevnikov, V.A., & Chistovich, L.A. *Speech: Articulation and perception.* Washington, D.C.: Joint Publications Research Service, 1965, *30*:543.

Lamb, S., Owens, E., & Schubert, E.D. The revised hearing performance inventory, 1981 (submitted for publication to *Ear and Hearing*).

Marslen-Wilson, W.D. Linguistic structure and speech shadowing at very short latencies. *Nature,* 1973, *244,* 522-523.

Marslen-Wilson, W.D. Sentence perception as an interactive parallel process. *Science,* 1975, *189,* 226-227.