A Response to Treatment in a Case of Cortical Deafness

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Cortical deafness is rare. Typically, reports focus on localization of the lesions causing it or description of the deficits (Albert and Bear, 1957; Albert et al., 1972; Gazzaniga et al., 1973; Kanshepolsky et al., 1973; Kelly and Waggener, 1973; Denes and Semenza, 1975; Goldstein et al., 1975; Shoumaker et al., 1977; Ernst et al., 1977; Oppenheimer and Newcomb, 1978; Micele, 1981; Averbach et al., 1982; Rosati et al., 1982; Von Stockert, 1982). Few treatment studies exist, and these (Kirshner and Webb, 1981; Doyle and Holland, 1982) have employed sign language as an alternative means of communication. Thus, cortical deafness has been observed more than it has been managed. And when it has been managed, treatment did not focus on improving auditory comprehension. The purpose of this paper is to report a cortically deaf patient's response to treatment designed to improve auditory comprehension.

REPORT OF CASE

Our Patient, V.B., is a 66 year-old, right handed male who suffered multiple CVA's. A left CVA in February, 1980 left him severely aphasic. Performance was at the 42%ile overall on the PICA. Time and treatment improved his performance to the 93%ile. Following a right CVA in August, 1981, his performance on the PICA was essentially unchanged, at the 92%ile. A third CVA, again in the right hemisphere, in December, 1981, resulted in a mild to moderate aphasia and severe cortical deafness. Without visual cues, he failed to respond to any auditory stimuli. The diagnosis of cortical deafness was based on several signs. First, the PICA was administered three times; once using written instructions, once using standardized procedures that permitted speech reading, and once using standardized procedures without speech reading. Performance was significantly lower (50th percentile), on auditory subtests VI and X without speech reading than on the standardized and written administrations (Figure 1). He required more repetitions during this administration than during the written and standardized administrations. The significantly better performance on subtests VI and X with printed instructions and with speech reading cues suggested that aphasia did not entirely explain his communicative deficits. Second, an audiometric evaluation revealed normal hearing through 2000 Hz and a sloping bilateral high frequency hearing loss. Impedance audiometry revealed normal middle ear reflexes. Speech discrimination was particularly poor, four percent in his right ear and zero percent in his left ear. Third, Brainstem Auditory Evoked Potentials (BAEPs) were normal and included waves VI and VII which indicated conduction through the thalamus. Fourth, a CT scan showed bilateral lesions involving right and left superior temporal planes and auditory cortex. Therefore, the behavioral, electrophysiological, and neuroradiological data were similar to those reported in most cases of cortical deafness.

Prior to this study, V.B. received several individual treatment sessions designed to improve his speechreading ability, improve attention and concentration on auditory stimuli, and to teach him to request a repetition of auditory stimuli. He mastered all tasks and began to attend a weekly aphasia maintenance group to maintain his skills and permit us to monitor them. By September 1982,

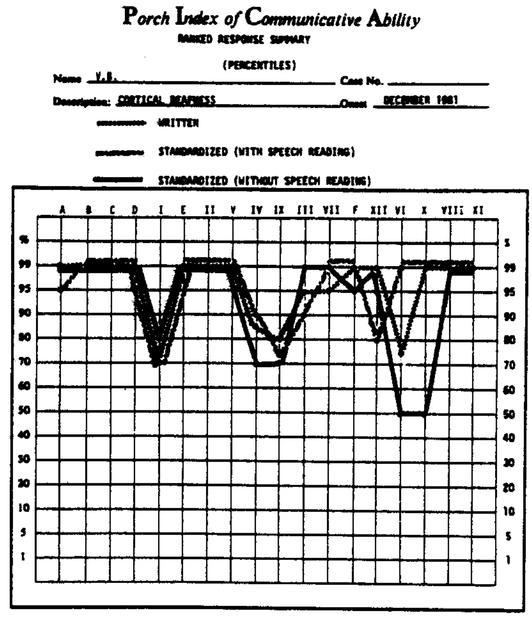

Figure 1. Results of the Porch Index of Communicative Ability administered with written commands, standardized procedures with speech reading, and standardized procedures without speech reading (auditory only).

his PICA overall score had risen to the 95%ile with standardized instructions. However, without visual cues, he continued to demonstrate severe auditory comprehension deficits. His audiometric and BAEP results were unchanged. In October 1982, V.B. was placed in an individual treatment program designed to improve his auditory comprehension performance.

TREATMENT

V.B. was seen three times a week for 50-minute sessions for a total of 28 sessions. We selected stimuli and procedures similar to those in the Revised Token Test (RTT) (McNeil and Prescott, 1978). A modified A-B-A multiple baseline and withdrawal treatment design was used (Figure 2). Both pre- and post-treatment phases consisted of three administrations of the RTT. Each treatment phase was a single A-B-A design for a specific RTT level. A total of five levels were treated. Each was baselined for at least three sessions. Baseline measures and daily criterion runs were comprised of the actual 10 items from the RTT level being treated.

Treatment began at Level IV, because baseline measures indicated this was where V.B. began to experience obvious difficulty. Levels IX and X were not treated, because testing following treatment of Level VIII indicated that V.B. had already mastered these levels. Treatment consisted of dividing a level into sublevels. In each sublevel, the critical elements of the RTT stimuli--color, shape, size--were systematically manipulated. Passing criteria for each level was 80 percent correct in three consecutive sessions on the daily criterion runs. Once the passing criterion was met, treatment was discontinued and baseline measures were repeated in the next three sessions. The entire RTT was also readministered after the completion of each treatment level to determine generalization.

Each treatment session consisted of 50 trials. The RTT multidimensional scoring system was used to rate performance. The treatment consisted of first providing the command in the auditory modality only. The examiner sat behind

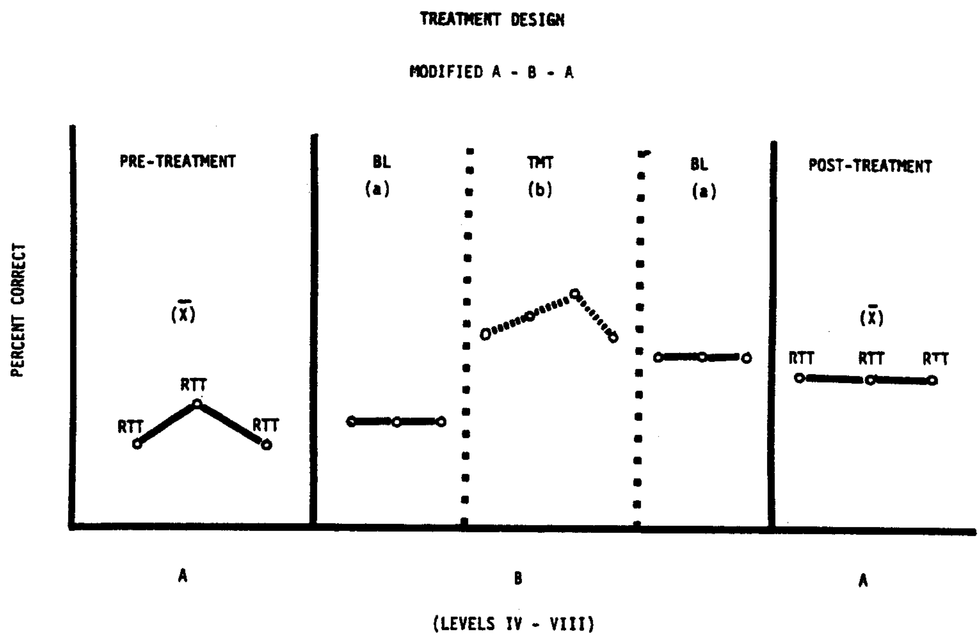

Figure 2. A modified A-B-A multiple baseline and withdrawal treatment design.

and to the right of the patient's better ear to eliminate visual cues. A trial was considered correct if a score of 11 (self-correction) or better was achieved. If the patient did not understand all of the critical elements in a trial (a score of less than 11), the item was repeated with visual cues. That is, the patient could see the clinician's face as the item was repeated. Speech reading was selected as a cue because it usually allowed the patient to comprehend a command correctly. If the response was still incorrect, a written version of the command was placed before the patient. He read this aloud and then performed the command. Then the written version of the command was removed, and the patient listened and performed the command again. Thus, speech reading and written cues were used to improve his auditory comprehension. Feedback was given for all responses.

RESULTS

Figure 3 shows the Daily Criterion Runs for treatment Levels IV through VIII. Performance on Level IV improved from an average of 13% correct in baseline to 80 to 90 percent correct during treatment. Performance dropped to a low of 50% post-treatment and then returned to 90% correct. Improvement on Level V was not marked. Baseline performance was variable. The 80% criterion level was reached in three treatment sessions. Post-treatment performance was variable, but stabilized near 95% correct. On Level VI, performance during the baseline was extremely variable, with a high of 60% correct. Criterion performance was reached after four treatment sessions. Post-treatment performance reverted to the variability seen in baseline. This also occurred in

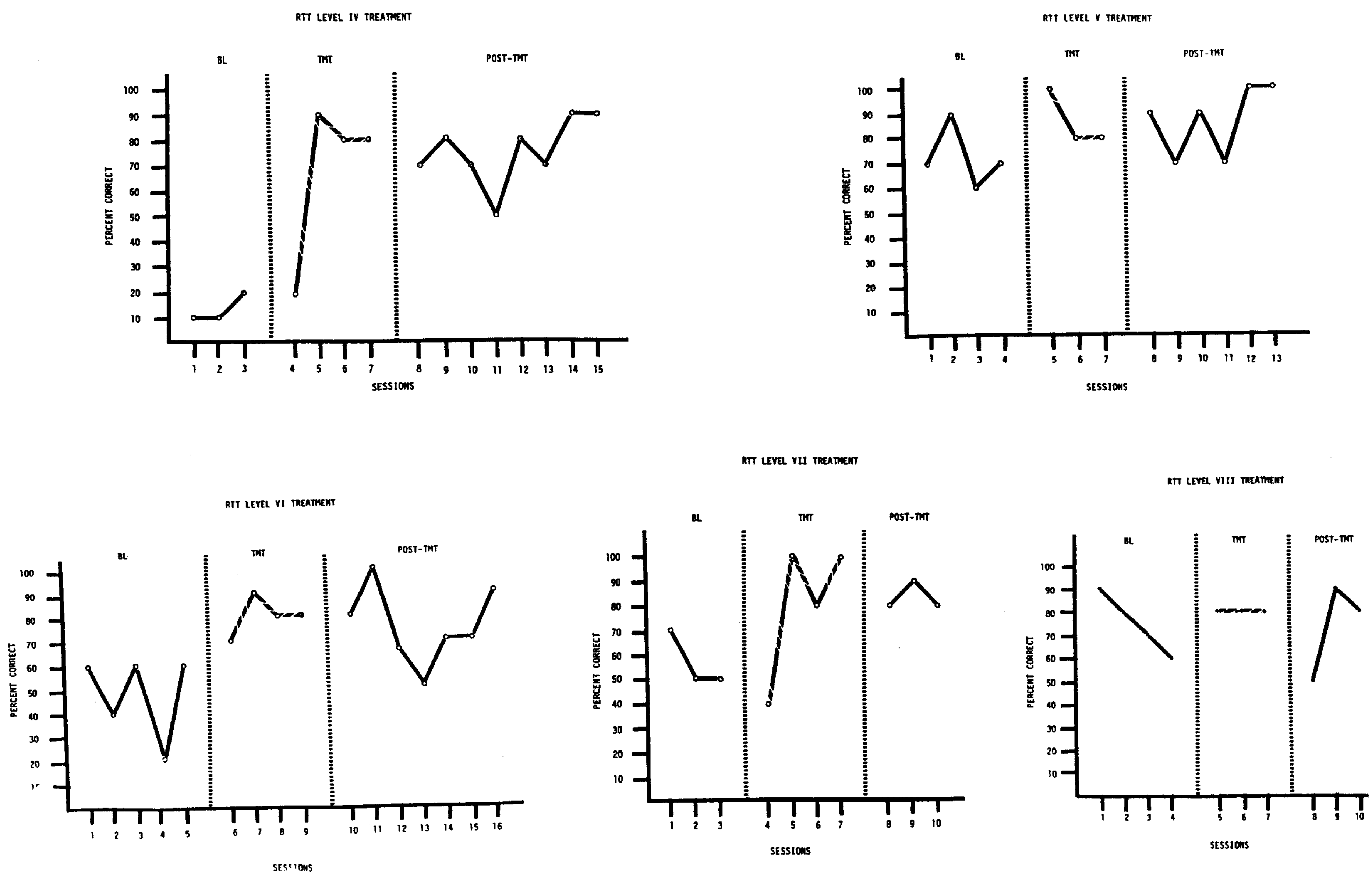

Figure 3. Percent correct responses on Daily Criterion runs for Levels IV, V, VI, VII, and VIII of treatment.

post-treatment testing following treatment on Levels IV and V. However, while post-treatment performance was variable in all three of these levels, it eventually returned to a level of performance equivalent to or better than performance during the treatment phase. This may have been cuased by initiating treatment on the next level while collecting post-treatment data. For example, we collected baseline measures and began to treat Level VII while obtaining post-treatment measures for Level VI.

Treatment for Level VII shows an improvement in performance from an average of 63% correct in baseline to an average of 80% correct during treatment and to an average of 83% correct post-treatment. The last level treated was Level VIII. Here, we obtained a descending baseline, stable performance during treatment, and inconsistent performance post-treatment.

Figure 4 displays a comparison of performance at three points in time on each RTT Level treated. These were prior to any treatment, immediately following completion of an individual treatment level, and following the completion of all five treatment levels. Improvement is obvious when pretreatment performance is compared with performance immediately following the completion of each level. Performance also improved between the completion of each treatment level and the end of treatment on all levels except Level VI.

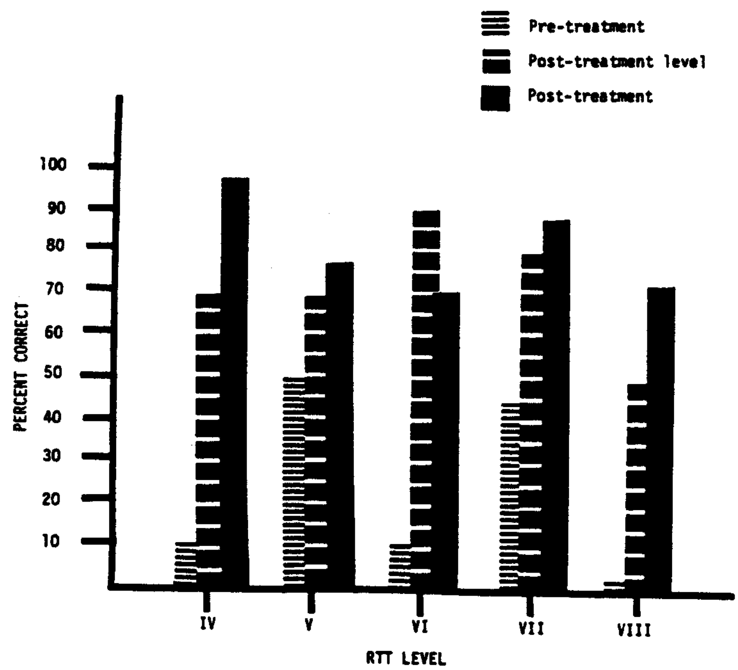

Figure 4. Percent correct on the Revised Token Test prior to treatment, immediately following a treatment level, and following the completion of all treatment levels.

Figure 5 shows change in performance and maintenance of performance over time on the five levels treated. The first bar represents pre-treatment performance, and each successive bar represents performance immediately post-treatment, one month post-treatment, and three months post-treatment. Post-treatment performance was significantly better than pre-treatment performance on all levels. Further, performance at one and three months post-treatment was at or near immediately post-treatment performance. Thus, V.B. improved during the treatment trial, and he maintained his improvement post-treatment.

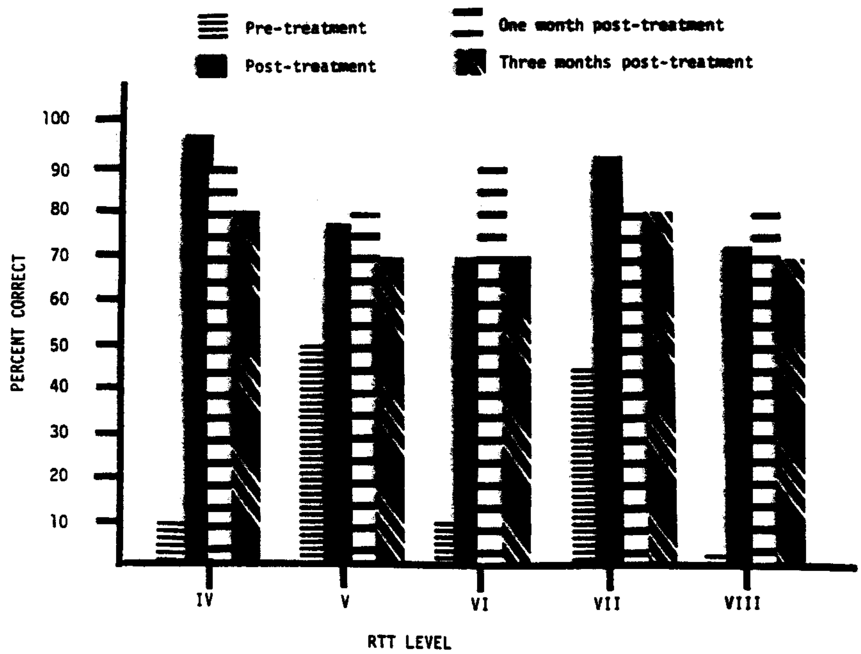

Figure 5. Percent correct on the Revised Token Test for pre-treatment, immediately post-treatment of all five levels, one month post-treatment, and three months post-treatment.

V.B.'s pre-treatment and post-treatment performance on all RTT Levels, both those treated and those not treated is presented in Figure 6. Comparison of pre- and post-treatment performance indicates that our cortically deaf patient improved on both treated and untreated levels.

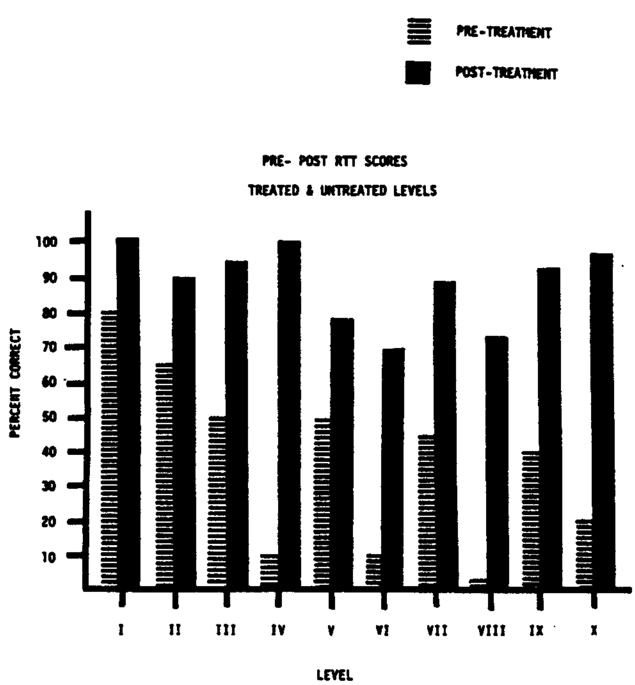

Figure 6. Comparison of percent correct scores on the Revised Token Test.

To determine whether improvement in auditory discrimination and comprehension would generalize to other communication behaviors, five language measures were administered pre- and post-treatment. These were the PICA, Western Aphasia Battery (WAB), the Token Test (Spreen and Benton, 1969), the CADL, and the Auditory Comprehension Test for Sentences (ACTS). Results are presented in Table 1. Significant improvement was noted only on the Token Test which, of course, is very similar to the Revised Token Test. Post-treatment performance did not improve markedly on the other language measures.

Table 1. Pre- and Post-Treatment Language Performance.

TEST	PRE-TREATMENT	POST-TREATMENT
PICA (Bilateral Norms)		
Overall	95%ile	95%ile
Gestural	99%	95%
Verbal	75%	75%
Graphic	99%	99%
WAB		
Aphasia Quotient	89.10	87.80
Spontaneous Speech	18.00	19.00
Repetition	7.80	7.70
Comprehension	9.55	9.70
Naming	9.20	8.50
Token Test	56%ile	76%ile
CADL	88%	91%
ACTS	76%	67%

CONCLUSIONS

We believe that our patient was able to master the treatment task because of its structured and redundant nature. Although the critical elements differed from trial to trial, the patient could expect the syntax and the required response to be similar. The presence or absence of redundancy would explain our patient's significantly improved performance on the treatment task, and his failure to improve on other measures such as the WAB and the PICA. Our results are supported by Saffran et al. (1976), who found their cortically deaf patient comprehended redundant material (sentences) better than nonredundant material (single words).

We have learned, perhaps, what may improve the cortically deaf patient's auditory discrimination and comprehension performance. An essential ingredient for improvement appears to be systematic redundancy in the auditory stimuli. Larger portions of the old are more easily understood than different and meager portions of the new.

The term cortical deafness, unlike most of our terminology, may have been coined appropriately. The cortically deaf patient resembles the sensorineural hearing loss patient more than the aphasic patient. The difference, of course, is that the cortically deaf patient's deficits cannot be explained by peripheral hearing loss. Auerbach et al., (1982) suggests that the fundamental problem in cortical deafness is auditory discrimination. Poor auditory discrimination results in perceptual confusions and distortions which make it difficult for the cortically deaf to understand what is heard, as is true for those patients with severe sensori-neural hearing loss. Because our treatment tasks were highly structured and redundant, they may have permitted V.B. to compensate for his poor auditory discrimination enough to decode the verbal messages. Therefore, systematic redundancy in the auditory stimulus may be an appropriate key for unlocking some of the auditory discrimination and comprehension deficits seen in cortical deafness. Unfortunately, it is not the master kay. It is difficult, as we know from working with the hearing impaired population, to provide the necessary redundancy in the patient's own environment to improve his functional communication.

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DISCUSSION

Q: I didn't hear what the treatment consisted of. Can you describe the treatment again?

A: Basically what we did was to teach him the Revised Token Test. I systematically manipulated the critical elements color, shape and size. For example on Level IVA--touch the blue square and the green circle--all of the critical elements remained exactly the same from item to item except for the first color element. This was done so he could concentrate on one part of the command at a time. After he mastered Level IVA, I manipulated color and shape at the same time and gradually worked up to manipulating all of the critical elements at one time. I sat behind the patient so the treatment forced him to rely on the auditory channel. If a response was incorrect, the item was repeated so he could speechread. If the response was still incorrect, I gave him a written version of the command to read, then removed it, had him listen to the command again, and then perform it. Basically, we tried to help him decode the auditory message with speechreading and written cues, then we removed the cues and let him try to decode the same message again using only the auditory channel.

Q: Did you score all of the items plus-minus or did you use the RTT scoring system?

A: We used the RTT scoring system. We considered scores of 11 and above correct to obtain our percent correct response data points.

Q: Too bad he didn't improve on all of those other measures that you gave him. He improved a little on the CADL, didn't he? I wonder did you ask the family how he was doing? Did they say anything about his comprehension?

A: We asked the family and also asked the members of the aphasia maintenance group which he participated in. Both the patient and his wife felt he was doing better. Specifically, they said that he could now use the telephone a little bit. Prior to treatment, he would not even attempt to answer the phone when it rang at home. He surprised us on the portion of the CADL requiring the patient to call "time." At post-treatment he was able to hear the recorded time message. Now, at home, he can pick up the phone and understand the first couple of sentences. First exchanges on the phone are generally redundant in nature. He could expect someone to say something like "Hi Dad, this is Karen. How are you?" After the initial exchanges he was completely at a loss as to what was said. The maintenance group members say that he was understanding more. Again, those were subjective opinions which the test measures didn't reflect. I don't know if that is wishful thinking on their part or if there is an improvement our tests don't reflect.

Q: I'm a little bit confused about your design. You said you used an A-B-A multiple baseline. Where is the multiple baseline? Did you use the different levels of the RTT as your baselines?

A: Yes the multiple baseline was across levels. For example, I would work on level IV and baseline Level V at the same time.

Q: That's what I thought. Also, did you see generalization to the different levels?

A: Yes.

C: That's what it looked like and I think that was an important point that you didn't stress. Although he didn't generalize to the more global tests I think it's interesting and important that you did see generalization to the higher-level auditory comprehension tasks.
A: Yes we definitely did see generalization across levels. For example, we did not treat Levels IX and X because he improved from twenty to forty percent correct on the pretest to an average of 90 percent correct following level VIII.

Q: Did you use a withdrawal design?
A: Yes the last phase was a withdrawal.

Q: Could you explain that a little bit more?
A: I think there may be a confusion of the terms withdrawal and reversal. A withdrawal just means that you return to the baseline. I baselined the behavior in the first A phase, treated it during the B phase, removed the treatment during the second A phase, and returned to baseline.

Q: In your treatment, were those points based on daily sessions?
A: Yes.

Q: I noticed on the second day of treatment that you got a dramatic increase in performance across at least a couple of levels. I was wondering what happened between session one and sesison two. Could you explain or speculate what happened?
A: I can't think of anything that happened between sessions that would explain the increase. However, V.B. made the most errors on the first critical element of a command, and this was the element we manipulated first. Perhaps this caused him to pay specific attention to the first element which, in turn, significantly improved his score on the daily criterion run.