SSW Reports

● Assessing Auditory Processing in Two Adults with CVAs
● Cochlear Implants and APD

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Assessing Auditory Processing in Two Patients with CVAs

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With most current emphasis on APD focusing on children, the clinician may lose sight of the "gold standard" around which many of our assessments were developed. When a patient has a known lesion, we are able to examine specific auditory processing and receptive language skills, in ways that provide insights into brain-behavior relationships.

Methods

Two adults were recruited from an aphasia support group. They had posterior temporal lobe lesions (based on CT scans) and no motor involvement. Hearing was essentially normal. Both participants were right handed and at the time of testing Daisy was 53-years-old and Rose was 62.

The auditory processing battery consisted of the Staggered Spondaic Word Test (SSW), CID W-22 words in quiet/noise, Competing Environmental Sounds Test (CES), Pitch Pattern Sequence (PPS), Dichotic Digit Test (DDT), and Binaural Fusion test. The aphasia assessment used was the Comprehensive Aphasia Test (CAT). All assessments were administered according to the most current guidelines.

Results

The SSW- Number of Errors (NOE) scoring and the Traditional Corrected (C-SSW) scoring for CAP problems demonstrated significant outcomes for the Right Non-Competing (RNC), Right Competing (RC), Left Competing (LC), and Left Non-Competing (LNC) conditions for Rose, but just the RE conditions for Daisy (See Figures 1 & 2). Rose also had a significant finding for both Ear Effect (HL) and Order Effect (LH) (See Table 1). Response Biases were not significant for Daisy (See Table 1). Both TEC (site-of-lesion) scores for Daisy and Rose point to left Heschl's gyrus (L-AR).

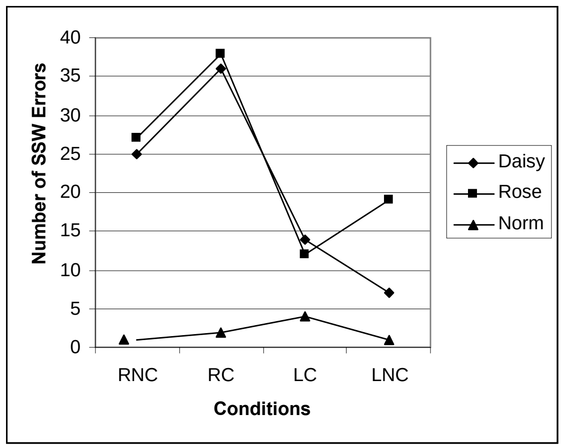

Figure 1. SSW Conditions – Number of Errors (NOE) scores for two posterior left hemisphere lesion subjects.

On the CID W-22 test Rose had significant speech-in-noise scores for both the left and right ears, and signal-noise-difference right ear (SNDR), left ear (SNDL), and interaural difference (ID) as well as right ear in Quiet. Daisy's CID W-22 test revealed significance in Quiet both for the left and right ears, in noise for both the left and right ears, SNDR, SNDL, and ID (See Figure 3).

Table 1. *TEC Analysis for the two left hemisphere posterior lesion participants using NOE and C-SSW scoring.*

			TEC Analysis			
			Reversals	**Ear Effect**	**Order Effect**	**Type A**
Rose						
	NOE					
		Scores	0	5	-29	-2
		Norm Limits	4	2	-2	3
		Significant	No	Yes	Yes	No
		Indication		High/Low	Low/High	
	C-SSW					
		Scores	0	50/45=5	33/62=29	-2
		Norm Limits	4	5	5	2*
		Significant	No	Yes	Yes	No
		Indication		High/Low	Low/High	
Daisy						
	NOE					
		Scores	0	-1	1	-1
		Norm Limits	1	-2	2	3
		Significant	No	No	No	No
	C-SSW					
		Scores	0	41/42	42/41	-
		Norm Limits	4	5	5	2*
		Significant	No	No	No	No
		Indication				

*Note. TEC = Total Ear Condition. NOE = Number of Errors. C-SSW = Corrected Staggered Spondaic Word. * = The number of errors in column B or F also must be at least twice as great as each of the other 7 cardinal numbers.*

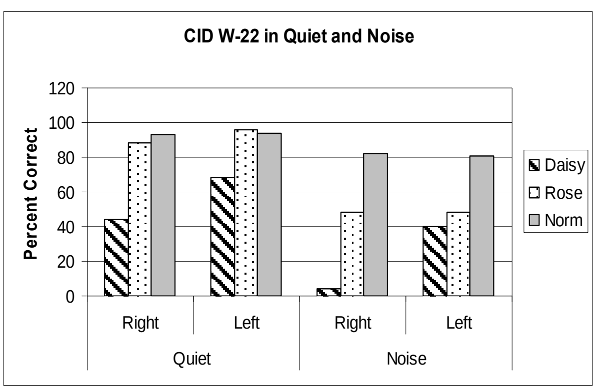

Figure 3. Speech in Quiet and Noise for two left posterior temporal lesion participants.

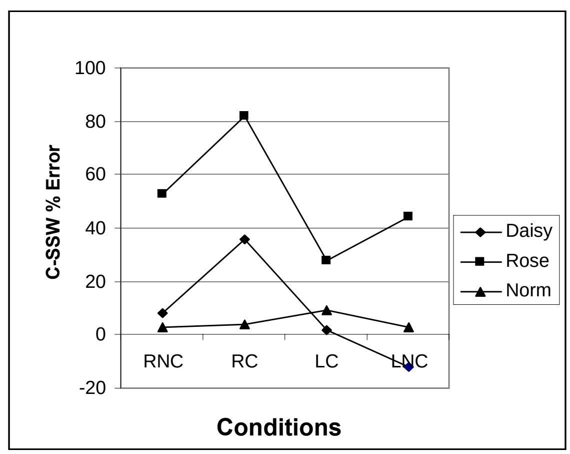

Figure 2. Corrected SSW (C-SSW) scores for the same two participants.

The Competing Environmental Sounds (CES) tests revealed significance in both left and right ears for Daisy and Rose (See Figure 4), but especially the right ear, contralateral to the damaged left temporal lobe. The Pitch Pattern Sequence test identified a significant outcome in all conditions using verbal responses for Daisy while Rose had one significant finding in the right ear correct category and all others falling within normal limits (See Figure 5). The Left and

Right correct scores are the number of items correct while the total scores includes the number of items correct plus the number of reversals. Reversals are included in the total since they are not considered to be entirely incorrect. The reversals may provide sequencing information. Due to the extremely low verbal response scores in the pitch pattern sequence test, Daisy was administered the test again with a hum response. Her scores improved; however, they were still outside normal limits.

Daisy had significant findings in both ears for the Dichotic Digits Test while Rose

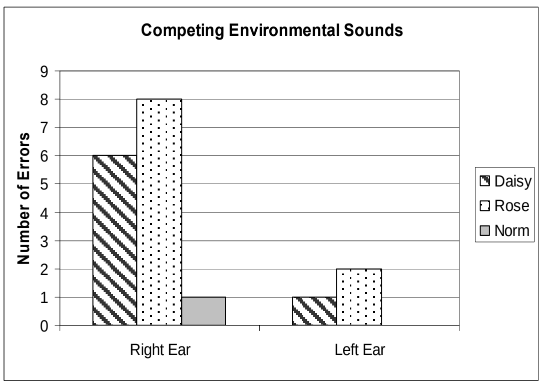

Figure 4. Competing Environmental Sounds (CES) test for both left hemisphere stroke cases.

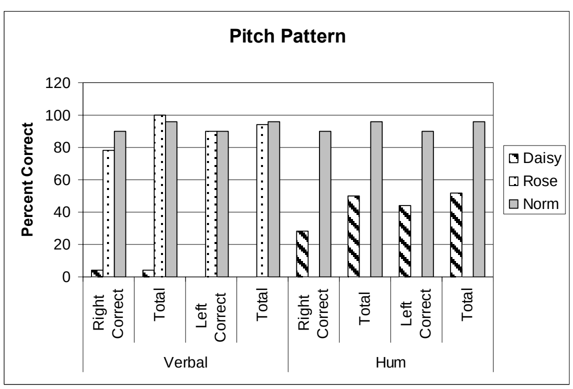

Figure 5. Pitch Pattern Score with a verbal response and hum response for the two left hemisphere posterior lesion participants. Rose was not evaluated using a hum response due to the high level of performance on the verbal response.

revealed a significant finding in the left ear and normal function the right ear (See Figure 6). The Binaural Fusion test revealed a significant score at the 30 dB SL level for right and left ears, and at the 40 dB SL level only a significant left ear score was identified for Rose (See Figure 7). Daisy showed a significant outcome in the left and right ears for both the 30 and 40 dB SL levels (See Figure 7).

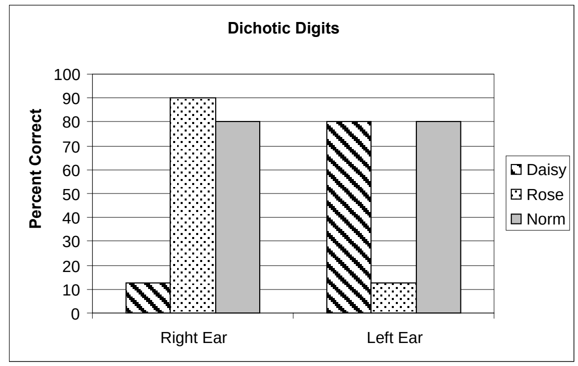

Figure 6. Dichotic Digits Score for the two left hemisphere posterior lesion participants.

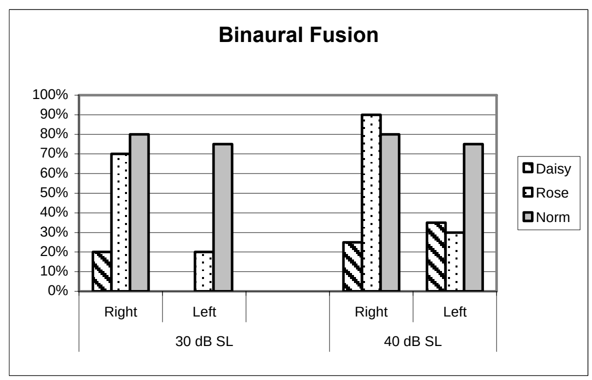

Figure 7. Willeford's Binaural Fusion Test Score for the two left hemisphere posterior lesion participants. Norm for 30 dB SL Left condition is 0.

The Language Assessment CAT profile is determined using T scores (M = 50; SD = 10) which permit comparison across modalities; a modality mean T score of 62.8 is strongly suggestive of an aphasic impairment. Daisy's performance revealed an auditory syntactic deficit as evidenced by a significant difference in T scores between auditory sentence comprehension and written sentence comprehension (See Figure 8 & 9). Daisy's test scores also revealed better performance in auditory comprehension of paragraph length information than sentence length information, an uncommon pattern based on traditional language assessment. Rose's CAT profile revealed a difference in comprehension of written and auditory information which was not statistically significant; she did not show a specific auditory syntactic deficit. Rose's comprehension scores declined as the stimulus length increased, a more typical observation which was not seen with Daisy.

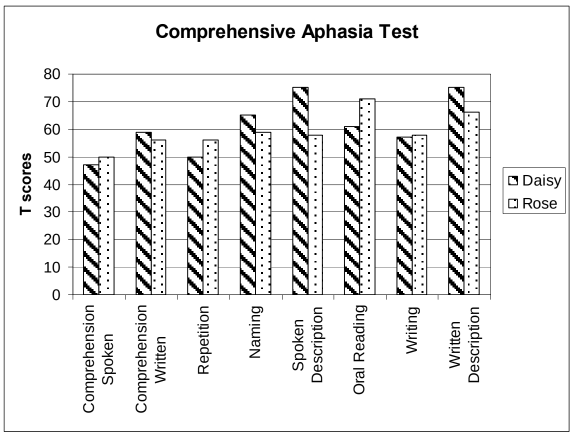

Figure 8. Comprehensive Aphasia Test Score for the two left hemisphere posterior lesion participants.

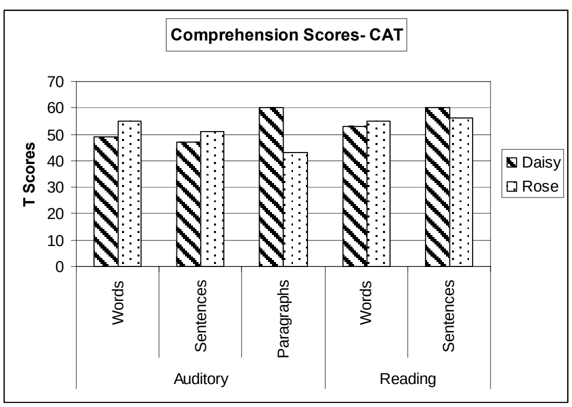

Figure 9. Comprehensive Aphasia Test (CAT) Comprehension Scores for the two left hemisphere posterior lesion participants. A T score of 62.8 is suggestive of an aphasic impairment.

Discussion

The Auditory Processing Assessment for Daisy showed a left ear preference for all auditory processing tasks. This suggests a "reassignment" or "reallocation" of central auditory function from the left hemisphere to the right hemisphere. Generally, the right ear is the dominant ear for right handed individuals. The dominant ear for Daisy is currently the left ear. It is difficult to state that the right ear was the dominant ear prior to the cerebral vascular accident without prior testing. However, the history provides a high degree of certainty that Daisy's right ear and left temporal lobe was her dominant pathway way for speech, language, or hearing. Rose showed a different pattern in the auditory processing battery. The results indicate a right ear preference for Dichotic Digits and Binaural Fusion and left ear preference for the SSW, CES, and Pitch Pattern Sequence. Rose appeared to reassign a portion of the auditory processing function to the lobe contralateral to the lesion.

Overall, Daisy, who showed auditory function reassignment, had greater difficulty with the auditory processing tasks. A thorough review of the data seems to indicate that she performed particularly poorly on tasks that involved lesser degrees of lexical access and/or utilization of contextual information (pitch pattern, competing environmental sounds and dichotic digits). Daisy performed better on tests that provided more structure and content of language (SSW & CID W-22 in quiet), despite significant deficits in decoding. That is, Daisy relied on a more "top-down" approach to assist in processing incoming auditory information.

Rose, who showed "incomplete reassignment," also exhibited deficits in decoding. She did not show heightened auditory processing performance with more complex linguistic stimuli. Actually, her performance fell with increasing linguistic information. Rose had greater difficulty integrating higher representations of language to assist in auditory processing and used a more "bottom-up" auditory processing approach.

The results on the SSW and CES provide the greatest support for hemispheric reassignment. Both Daisy and Rose had their major peak of errors on the right side for the RC Condition as expected for someone with a lesion in the left posterior temporal region. The CES results tend to confirm the auditory reception nature of the disorder because it too was primarily in the right ear. This suggests that the pathway to the left temporal region was damaged so that both speech and environmental sounds were adversely affected.

Summary

The outcomes of this study revealed that two subjects with similar sites of lesion due to a cerebral vascular accident and similar pure tone averages showed different patterns of auditory comprehension and auditory processing as measured on language tests and auditory processing assessments. The differences in performance seemed, at least in part, related to selective patterns in reassignment of auditory processing skills from the lesioned lobe to the contralateral non-disordered side. The patient who demonstrated more complete reassignment displayed better utilization of linguistic content (semantics) when processing complex information ("top down" processing), but did not show better isolated syntactic skills ("bottom up" processing).

Results suggest that the auditory processing and linguistic systems involve components that are interrelated in functional language processing, but may be selectively impaired following a cerebral vascular accident. Identification of a patient's selective impairment may be useful to the clinician in designing stimuli for use in the rehabilitative process. Impaired and spared abilities should be identified in a therapeutic setting, whether in a model of retraining the impaired skills or making use of the spared skills in compensatory treatment. These issues should be explored further in future clinical research.

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Have you thought about working with people with CIs as if they had APD—Lately?

Jack Katz

Over the years I believe that I have shared with you my excitement and satisfaction of working with those who have cochlear implants as if they had APD. After all they have a mismatch between what is stored in the brain and what the CI delivers. While the cause of the mismatch is quite different from those we typically see who have APD, those with CIs "do not quickly and accurately digest speech". In that sense they behave like those with Decoding AP problems.

When I retired from UB I thought that I would move to Kansas City and for fun would work with some people who had CIs and some who were mentally challenged. Although the past 5 years have been loaded with clinical services I have not had even a nibble when it comes to CIs or MC.

Recently when I was at a doctor's office I was introduced to a man who has a CI. 'RF' is a 68 year old artisan who suddenly lost all of his hearing in the LE 13 years ago and 2 years ago lost almost all of his hearing in the RE. His CI in his LE was activated 2 years ago and he wears a powerful hearing aid in the RE.

RF immediately experienced great benefit from his implant; however, his audiologist indicates that he has not made progress since then; despite many changes to his map. RF was interested in seeing me when I told him that my CI patients have all been successful in using the telephone as this is his greatest auditory frustration.

Test Battery

Those with CIs have such poor decoding for speech sounds that we cannot use our regular test battery. In fact, in the past I just used 3 tests (preferably recorded and given auditory-only): Speech in Quiet and Phonemic Recognition Test (PRT) (both using Central Test Battery-CD) and the CID Everyday Sentences given live voice. Because this was for research, I also gave RF the recorded Speech in Noise and Phonemic Synthesis (PS) tests as well as a LV telephone test using a half list of W-22s. In addition to testing with the CI alone, RF was tested using both his CI and hearing aid.

Results

Table 1 shows the test results for RF and means for 6 post-lingually deaf adults CI patients.

	HA & CI	CI Only	Mean 6 CI
WRS-Quiet, CD	68%	36%	35%
WRS-Noise, CD	44%	20%	--
PRT, CD	71%	35%	40%
CID-EDS, LV	50%	42%	69%
PS (# correct), CD	2	--	--
WRS-Telephone LV	--	36%	--

Table 1 Performance of RF with both HA & CI or with CI alone. The tests are mentioned in the text.

For the words in quiet and noise as well as PRT the combination of HA and CI had doubled the percent correct of the CI alone. For sentences however performance was quite similar, suggesting that RF's use of cognitive skills enabled him to maximize his CI score. When compared to 6 patients with CIs prior to therapy RF was pretty much in the middle of the group.

On the PS test RF got a score of 2 correct out of 25. But it should be noted that prior to each response he repeated the sounds he heard (QR) and then tried to put them together. Thus, the Qualitative score would be zero. A Phonemic Error Analysis (PEA) was carried out on the 3 initial tests and 135 errors were noted compared to 55 for the average of the children I have seen before beginning therapy.

Plan

My first dilemma is whether to do therapy with or without the hearing aid. In days gone by therapy was recommended for just the CI, but my thinking is that RF will be using both (in an effective combination as we have seen), so we should try at first to work with both to maximize performance. Later on if we see that the CI alone is not improving then we can train with just the CI. I suspect that the HA has limited capacity to improve because it is limited to the low frequencies while the CI has a much greater range that can provide important speech information.

The plan is to begin therapy as we would anyone with APD. That is the Phonemic Training Program (PTP) to teach RF the sounds of English individually, 4 new ones each session until all 35 for which difficulty was noted are mastered. At that time some other sounds might be addressed as well. During the early sessions it would be well to administer two other tests: lipreading (which I suspect is quite good, but some training could be given if it is not too sharp) and localization of sound that RF indicates is quite poor. It is hoped that gradually we could work the PTP into a Phonemic Synthesis program as this will bring him up a level or two in decoding.

After about 3 sessions it would be well to start the telephone training. In this work we start very slowly because it is such a frustrating issue for RF. We want to be sure that it is successful. This will be done by setting up a routine that we will follow and practice before trying it on the telephone so by the time we use the phone it will be easy. From this point we use 4 or 5 topic sentences that will tell RF what the topic is (e.g., family, work, community).

Later on we can work on localization of sound and/or lipreading. In the past we have worked with post-lingually deaf patients in therapy for an average of 5 months. Some of those patients have continued to come for therapy after I left so the number is greater now. For pre-lingually deaf the mean therapy period was 13 months.

Although CI patients have a more severe type of DEC APD than our typical patients, they do improve fairly quickly and it has a major effect on their ability to get along in life. Audiologists can contribute both in the evaluation and therapy for those with cochlear implants. * * * * *