Topics in Central Auditory Processing

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This About That: Turnabout is Fair Play. Play 'Turnabout' with your patients so sometimes they are the teachers and you are the subject. It has many benefits for all and may bring more people into our profession. See the article on Turnabout in the winter issue of TiCAP.

In This Issue

Analyzing SIR for Integration Weakness

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This column is divided into two parts. The first part is an interesting case study and the second is a little research project it inspired.

I recently saw a patient- KS, who was referred by a Reading Specialist. KS was a very bright 7 year-old female. Speech-Language and psychoeducational scores were in the high-average range. The professionals had informed the mother for over 4 years that this child is 'typical,' and that the mother is overly anxious about her because she has been comparing her performance to that of her twin, who is more boisterous and outgoing.

Her mother indicated that she has had concerns about KS because she was not able to process and learn new information as efficiently as her twin. She has always been a quiet child, often reticent in school. She received private speech therapy for articulation weakness (/r/ and /th/) including a slight lisp at age 5, but she did not qualify for school-based services. She has never enjoyed reading and is very sensitive to challenges.

Neuropsychological evaluation indicated a full scale IQ of 112. All scores were in the average or high average range. Her attention and auditory working memory were in the 50th percentile in comparison to her visual working memory of 91st percentile. Immediate recall for short stories was in the 93rd percentile. However, following the presentation of a distractor list, her recall of original list was in the 7th percentile, and after a 20 minute delay her recall of the list was in the low average range. Receptive and Expressive Vocabulary were in the high average range. Speech and Language assessment indicated average to above-average scores for Phonological Blending; Number Forward/ Backward Repetitions; Word/ Sentence Memory on the Test of Auditory Processing Skills (TAPS-3).

Several red flags indicating possible Tolerance Fading Memory (TFM) or Decoding (DEC) deficits may have escaped notice or mention.

- anxiety in new learning situations
- very exhausted when she gets home
- no energy to do her homework
- significant processing and response delays
- had received speech therapy for some time to remediate w, l, r sounds
- Reading specialist noticed that she was dropping final sounds in words
- Phonics (despite speech and language therapy in the past)
- Oral reading accuracy

When I did the Buffalo Model testing the quantitative scores were within normal limits except the Standard Integration Ratio (SIR) on the SSW. KS had 12 LC errors and 3 RC yielding a SIR of 1.39 (significant difference is $\geq$1 SD for left ear). She also presented with weak right ear word recognition in quiet, however the left ear recognition which was normal in quiet was significantly poorer in noise, resulting in an inter-aural difference. Phoneme recognition in isolation was difficult and inconsistent. Difficulty with discriminating the voiced and voiceless /th/ sounds when asked to associate a word to the phoneme was noted.

She had many qualitative signs which seemed like Decoding (DEC) issues. KS was very slow in processing almost all tasks including pure tone thresholds. Extreme delays were present too. She presented with atypical pauses in her speech that affected her prosody. She had a flat affect while she was responding to test items. She seemed to be making an overt effort to stay focused to process the auditory information. She presented with some extreme delays in all of the tests including pure tone thresholds.

She had good endurance and stamina to stay on task. However, she grimaced and frowned when the task seemed to be challenging (SSW- dichotic listening). She indicated that the task was very hard for her. She also seemed to rely on context cues primarily for self-monitoring and self-correction, and appeared to be very confused when a response did not make sense but wasn't able to correct her response based on phonemic errors. She spoke with a slightly nasal tone and had unusual breaks in her speech voicing patterns. As we sometimes see in bright children who have had speech therapy or other training, she had good quantitative scores but her compensations showed up in the qualitative findings.

Study of SIR Integration Pattern

In this case the significant SIR finding and extreme delays suggest an Integration problem. However it was curious to note that the only other significant finding was the Speech in Noise score for left ear and Words in Quiet score for right ear. The purpose of this study was to see if SIR correlates with any other values on the Buffalo Test Battery including Phonemic Synthesis; Speech in Noise and Quiet; Type A and 2B3 (significant on if least 2 of 9 scores are at least 3 standard deviations poorer than mean). SIR was also compared to Dichotic Offset Measure (DOM), an additional Integration test. SSW and DOM are both tests of dichotic skills (In DOM, two different letters of the alphabet are presented to each ear at presentation offset times ranging from 0 milliseconds to 400 milliseconds. The offset time indicates the time gap between the centers of the competing words going into each ear). For both SSW and DOM tests the LC-RC absolute values were also considered for comparison since SIR depends on the LC and RC scores. The total SSW and DOM scores were also compared.

The subjects were 16 children between 6 and 11 years. Each child was identified having an auditory processing disorder based on the APD testing and referral information. Following evaluation the children were seen for appropriate therapies based on the auditory processing categories identified. Then DOM was administered and Dichotic Offset Training after completing the Phonemic Synthesis program (12-15 sessions later). Post-therapy findings were obtained for the same tests.

Statistical analyses were completed using the non-parametric Pearson rho correlations. In addition, all Type-A data employed the non-parametric Spearman rho correlation because the Type A does not have a numeric value (just two choices 1= positive and 0= negative).
A variety of scores were compared using the Buffalo Model Battery of tests to analyze the significance of SIR. The pre- and post-therapy results were compared and only the significant findings were reported. Of all the comparisons made, only the significant correlations related to SIR were reported for both pre- and post- therapy.

Strong Correlation Pre and Post Therapy Findings:
SIR vs. SSW-RC

SSW-SIR correlated significantly Pre & Post with the SSW-RC measure.

Table 1. Correlations (pre- and post- therapy) for SSW-SIR and SSW-RC measures

When tested	r	p
Pre	-.572	.003*
Post	-.459	.021*

*significant p<.05

The negative correlations indicate that the higher one score was, the lower the other was. The lower the RC score the easier to show SIR. While a good RC score makes it more likely that SIR will be positive, possibly the LC score does not correlate because the LC score is not as pure because it can be tainted by both TFM and Integration errors.

SIR vs. Type A

Table 2. Correlations (pre- and post- therapy) for SSW-SIR and Type A measures.

When tested	r	p
Pre	.395	.050**
Post	.420	.037*

Table 2 shows that SSW-SIR and Type A correlated with a trend pre-therapy and significantly post-therapy (p<.05). This finding is quite common pre-therapy when DEC + TFM signs may conceal the Type-A. After therapy SIR and Type-A were significant (p<.05).

Strong Correlations Pre-Therapy only: The correlations below were significant pre-therapy only. These findings suggest that the therapy likely changed the factors which may have contributed to the initial correlations.

SIR vs. SSW-Total
Table 3 shows negative correlations between the Total SSW error score and SIR. The correlations were significant only pre-therapy for these two measures (see below). It is interesting to note that the Pre-Therapy means were SSW-Total 30.6 and SIR 1.03.

The Post-Therapy means were 17.16 for SSW-Total and 1.14 for SIR. Clearly the big change following therapy was the great improvement in the Total SSW score with little change in the SIR RC and LC relationship.

Table 3. Correlations (pre- and post- therapy) for SSW-Total and SIR measures

when tested	r	p
Pre	-.418	.037*
Post	-.165	.431

Strong Correlations Post Therapy Only:
Some measures indicated no significant correlations pre-therapy, but significant correlations on post -therapy analyses. It might suggest that therapy reduced the influence of other factors.

SIR vs. SIN-RE

Table 4. Correlations (pre- and post- therapy) for SSW-SIR and SIN-RE measures.

When tested	r	p
Pre	-.148	.482
Post	.419	.037*

*significant p<.05

The previous SIR correlation with SSW-Total score was significant pre-therapy only; however, for the SIN-RE the opposite was true (Table 4). The correlations between SSW-SIR and the two SIN measures (RE and LE) revealed no significance pre-therapy for both ear measures but post-therapy, the SIN-RE was significantly correlated. The significant finding post therapy seems to be due to the improvement in the right ear in noise following therapy.

Conclusion and Discussion

Our results showed that SIR was correlated negatively with the Right Competing (RC) SSW score. The negative correlation indicated that lower the RC score, the higher the SIR score, but interestingly not a positive correlation with the LC score. There were also significant correlations for the Pre-therapy scores of SIR and SSW-Total. Pre-therapy SIR was related significantly with Type A indicating possible similar factors, as well as differences, involved in these two measures. There was a significant correlation between Post-Therapy scores for SIR and SIN-RE. Based on these findings it appears that Buffalo Model Battery measures a variety of complex processes that make slightly different demands on auditory processing. Thus only a few measures in this study correlated significantly.

As for the original case that led to the present study, it is possible that the significant SIR findings may indicate a significantly stronger right ear compared to left ear ability in the presence of competing signals (both for dichotic and background noise). Weakness in the left ear results, seems to create a 'limp' resulting from a specific INT difficulty that was not detected by other measures. It is possible the Type A and SIR are measuring similar factors, whereas the SIR may be a more sensitive measure. The better the RC scores and Right ear Speech in Noise score, but not the Left ear, the higher the SIR scores.

'Ear Limp' reminds me of someone limping when one leg is weaker than the other. Although they have one strong leg the body still limps because the stronger leg can't do the job for both. So the bad leg makes it harder for the good leg. Similarly it is possible that the Ear Limp occurs when the function in the weaker ear makes it harder for the better ear. Further research is needed to develop an understanding of this proposed Ear Limp weakness. In the absence of strong DEC and TFM quantitative signs and a case history of extreme struggle in school, it may well suggest an integration issue due to the Ear Limp phenomenon that would be exacerbated by the DEC and TFM weakness.

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Billing, Codes, Reimbursement – OH MY!

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Often I am asked about billing and reimbursement information for the evaluation and treatment of a central auditory processing disorder (CAPD). Such questions are from professionals in the United States and from colleagues who desire to research the reimbursement process in the United States. This article will provide the current procedure codes, a history of the procedure codes, and reimbursement issues. After all, a business needs to maintain a positive flow of reimbursement, otherwise it is a hobby.

Current Procedural Terminology (CPT) Codes

CPT codes are developed and maintained by the American Medical Association (AMA) and are used by Centers for Medicare and Medicaid (CMS) for reimbursement to providers. Several years ago the CPT Codes changed for the evaluation for an auditory processing disorder (APD). These codes are 'Designation of time' codes. There are two designation time codes for the evaluation of APD:

92620 and 92621.

92620: The evaluation of central auditory function, with report, initial 60 minutes.

92621: The evaluation of central auditory function with report; each additional 15-minutes.

It is important to note that a timed code is billed if testing is at least 51% of the time designated in the code's descriptor. For CPT codes designated at 15 minutes, multiple coding represent minimum face-to-face treatment:

1 unit: 8 minutes to < 23 minutes

2 units: 23 minutes to < 38 minutes

3 units: 38 minutes to < 53 minutes

4 units: 53 minutes to < 68 minutes

5 units: 68 minutes to < 83 minutes

6 units: 83 minutes to < 98 minutes

So let's see how this works. An APD evaluation and report takes 90 minutes. Thus, the provider will bill for 92620 (60-minutes) and 92621 at 2 units. If the evaluation and report was completed in 2 hours, then the provider will bill for 92620 (60-minutes) and 92621 at 4 units.

Historically, the designated time codes are based on those used by anesthesiology, as an anesthesiologist performs in a time-increment manner. Further, designated time codes are 'at risk' codes for an audit from the reimbursement industry.

Prior to the development of the 92620 and 92621 codes, the practice was to use individual test codes such as 92571 (Filtered Speech Test), 92572 (Staggered Spondaic Word Test), and 92576

provided rather than the use of 92620/92621 (a battery of tests). CMS indicates that 92620/92621 "captures the time spent on the evaluation and other test of CAP function often are used to determine the presence of APD." . Therefore use of 92620/92621 avoids suggestions that the three individual CAP tests (92751, 92572, 92576) are required as part of the test battery, allowing the audiologist to determine what tests should be administered.

In 2005, CMS approved the 92620/92621 codes after two years of advocacy from the American Speech-Language-Hearing Association (ASHA). Clinicians advocated to include the other separate test codes, but CMS denied such a request as a test battery is represented in the 92620/92621 codes.

What services are not covered in 92620?

CMS stresses that activities such as counseling, establishment of interventional goals, or evaluating potential for remediation are not included as diagnostic tests, and that the time spent on these activities should not be included in the billing of the 92620/92621 codes.

APD Therapy Codes

The CPT code 92507 is dedicated to treatment of APD. Interestingly, CMS indicates that 92507 used by a speech-language pathologist covers for treatment of speech, language, voice, communication and/or auditory processing disorder (individual treatment). Whereas, this code used by an audiologist does not offer reimbursement for intervention services for Medicare patients as "Medicare coverage is limited to diagnostic testing" for audiology. (Coverage for most audiology intervention services-including 92507- is included for Tricare patients and for many private insurance plans.)

Reimbursement Appeal

Professionals need to be aware of the reimbursement policies from all third-party payers. In appealing a denial, it is important to provide the information and documentation that supports how this service addresses the patient's specific medical needs. When deciding whether to submit an appeal on a client's behalf, consider the importance of taking this step because it may be the client's only opportunity to obtain coverage for this service.

Before drafting the appeal it is recommended to review the insurance company's denial to understand why coverage for this service was denied. If you do not understand it, then obtain more information from the third-party reimburse and request the criteria that were used. Review the client's records to ensure there is supporting information and documentation for the services you are recommending.

New Times Bring New Issues

While we diligently work to receive reimbursement for our services there will always be new issues in receiving payment for our professional services. At present, there are many families with a high-deductible insurance plan (~ $1000-5000 per family member). In such a case, many physicians and professional specialists require the client to pay for the services at the time of the service. This requires the provider to inquire of the third-party payer (in advance of the appointment) as to the client's current deductible allocation and to communicate the amount owed at the time of service.

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School and Home-Based Interventions for APD

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In a recent randomised controlled trial of interventions (RCT) conducted in Nigeria, Ayo Osisanya and Abiodun Adewunmi compared the use of direct interventions, compensatory strategies, and a combination of the two to treat school-age children with auditory processing disorder (APD) (Osisanya & Adewunmi, 2017).

Osisanya & Adewunmi randomly recruited 80 students (aged 7 to 11 years) who had a single profile of APD based on their failing at least two tests of auditory processing (AP), at least one of which used speech stimuli, by ≥ 2 SDs in at least one ear. The auditory processing test battery had consisted of the Tests for Auditory Processing in Children (SCAN-3:C) and the Random-Gap Detection Test (RGDT). The students had also passed screening assessments of intelligence, verbal intelligence, non-verbal intelligence, reading and attention.

The students were randomly allocated to one of four groups. Group 1 received a “bottom-up” therapy approach consisting of three direct intervention training packages: binaural integration and separation training, speech-in-noise training, and sound localisation training. In some of these exercises, the participants wore earplugs to mask their “better” ear. Group 2 received a “top-down” therapy approach consisting of three compensatory strategy training packages: improving auditory attention, improving auditory working memory, and shared reading. This training included whole-body listening techniques, story explanation, word replacement, listening in noise, and listening to and reading stories with and without intonation. Group 3 received a combined therapy approach consisting of various combinations of the “bottom-up” and “top-down” therapy approaches given to Groups 1 and 2. All the training sessions were completed in three 45 minute sessions per week over 10 weeks in both home and school environments. These session were all completed in the free field and involved varying uses of CD players, tablets, mobile phones, speakers, book chapters recorded to CD, movies, local radio station broadcasts, verbal presentations and exercises, and even metal items dropped onto hard floors. Group 4 served as the control group and were not exposed to any of the direct interventions or compensatory strategy training received by the other groups.

To measure the listening abilities of the students, Osisanya and Adewunmi state that they used "verbal information/response of each participant after each intervention plan, and the results summed up and averaged where there were more than one question asked". This analysis resulted in two post-treatment scores for each student: a listening with background noise score (which was called the cocktail party effect score) and a sound localisation ability score.

The study's results showed all three treatment groups showed better listening with background noise and sound localisation ability scores compared to the control group. The best scores were observed in group 3 who received the combined therapy approach consisting of various combinations of the "bottom-up" and "top-down" therapy approaches given to Groups 1 and 2.

Whilst this study has several, very significant limitations, its findings do suggest that we can help at least some students with APD using materials and protocols that are readily available and easily implemented in both school and home environments.

Reference

Osisanya, A. & Adewunmi, A. (2017): Evidence-based interventions of dichotic listening training, compensatory strategies and combined therapies in managing pupils with auditory processing disorders. International Journal of Audiology. DOI: 10.1080/14992027.2017.1386331

The Next Challenge

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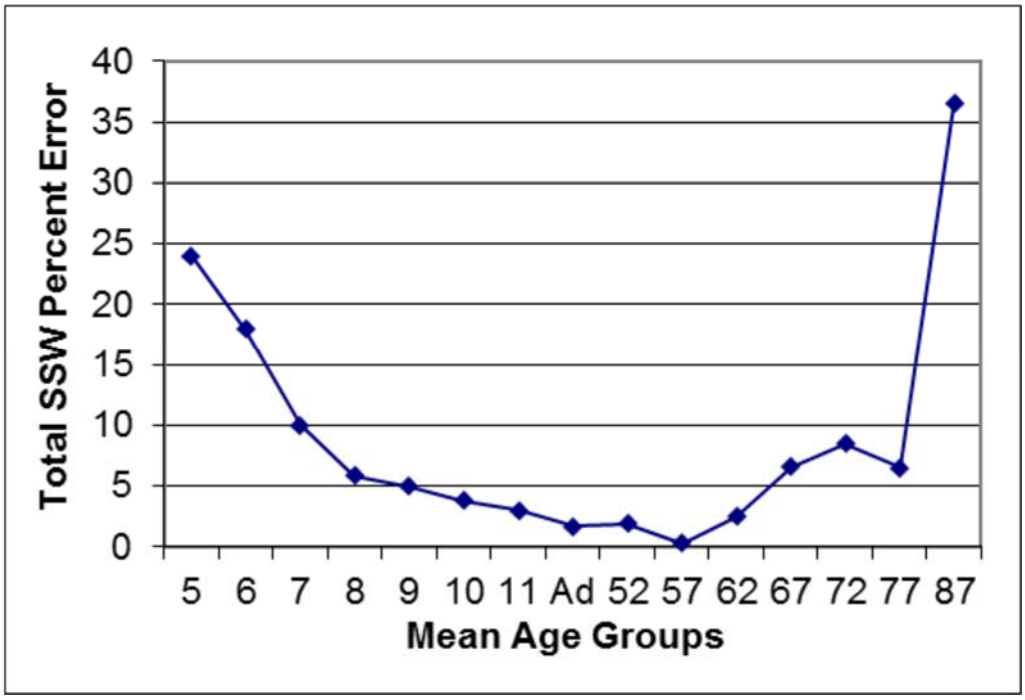
By far, most people that we see and treat for APD are children. How great to work with those beautiful little people (and even the bigger ones). But I'm focusing more and more on the other end of the spectrum. First let's consider what CAP looks like across the ages. Figure 1 shows the performance of typical-functioning individuals across the age spectrum in various studies using the SSW test.

Starting with 5-year olds, you can see that performance on the SSW is quite poor. FYI: the errors were about equal for both competing conditions. The scores continue to improve until about 12 years old (see age group "Ad"), particularly in the right competing (RC) condition. The normative data remain about the same until the late 50s, including a small right-ear-advantage. Then in the 60s, the errors start to go the other way, usually greater in the left ear. We tried to develop norms for typical listeners in their 70s and 80s, but there was nothing normal or consistent about the data. Some were fairly good; looking something like the younger groups, but the vast majority differed in both pattern and severity. Hearing changes in one or both ears added to the confusion. For those reasons we have norms up to 69 years, but not beyond.

It seems clear that we age in different ways, depending (I believe) on how proficiently we developed various skills over the years, but especially in childhood etc. What we learn first, we tend to retain longest (a plug for early intervention).



It seems clear what we practice most effectively is built into our systems most powerfully. If you remember or practice them occasionally over the years, they are probably easier to access again when we are older. If we have visual reminders or stories that go along with the information, so much the better. For me, despite my poor short-term memory I remember songs and poems from childhood. A word or two of a song may give me a little piece of the melody, which provides additional words. Rhyming provides additional help, even if the meaning doesn't give enough information. Thirty-five years ago I saw a professor from another department and asked him his name. As he gracefully flipped his long, colorful tie in the air, he simultaneously said, "Ty". I never saw him again but I don't think I will ever forget his name.

What Does the Above Have to do with Anything?

1. It's wonderful to see the children absorb the little gems we give them and see their skills grow along with them.
2. When most people reach the plateau period they are usually quick to absorb APD training and are likely to hold onto it for decades to come, much like the kids (but we must be vigilant about middle ear issues).
3. In the older age groups, it may take longer to regain skills that were lost, and much longer if they had not been mastered before. They generally do great, or at least well, in therapy (depending on hearing and severity of APD). But as they age further it is likely that these regained/new skills will be more vulnerable. So there is a tendency to need additional maintenance help after therapy that we don't usually see with the other two age groups.

My Own Experience with an Aging Brain

I had a history of recurrent middle ear fluid until age three when my tonsils and adenoids were removed. After that, my ears were largely clear except for occasional episodes of otitis media. I had no therapy (there was none), but at about age 21 I got some exposure to a little "ear training." The next semester I had a great class in phonetics that was a big help with CAPD-- a disorder that I did not know I had and didn't know existed. Fortunately, CAPD just happened to catch my interest and has probably given me much training over the years and constant refreshers.

has probably given me much training over the years and constant refreshers.

Nevertheless, when I was about 72 I noticed, on the Speech-in-Noise test, when giving the word 'end' it sounded like 'him'! That was the same response as the youngster with whom I was working! It is not only a goofy error that we frequently get, but it can be explained by early otitis media. (Shriberg & Smith, 1983; Katz, Zalewski & Brenner, 2018). One-by-one I started losing words until finally realizing that I was regressing. Could find no one to give me therapy so I took a brain training program, "Posit Science," over the internet that helped me a lot overall. I believe that reawakened my whole brain and improved my auditory processing too. About 6 years later my speech-in-noise skills began to weaken, as before. Eventually, I realized that I'd have to figure out a way to improve my own auditory processing. The result was a modification of the WINT program.

The table below shows what happened when I gave myself WINT. Don't say, "That's not fair!" No one knows more than me my need for therapy so I would not voluntarily raise my score. I'm not sure of all the test words and their competitors and certainly not what word comes next. To be sure that I got a word right I had to be able to identify each of its phonemes.

Round	Age	# Sess	Thera-py	Levels	Errors	Error	Comment
			months	*from/to*	err/items	%	
Posit Sci.	72 - 73	36-1hr	---	---	---	---	No records
R-1 begin	79			0 – **54**dB	9/40	22	Took 8 sessions to
end	80	38-½hr	10	0 – 62	4/70	**6**	reach 62dB noise
R-2 begin	81			0 – 62	5/70	7	
end	81	8	2	0 – 62	4/70	**6**	
R-3 begin	82			0 – 62	12/70	17	
end	82	6	1	0 – 62	3/70	**4**	
R-4 begin	82			0 – 62	5/70	7	
end	82	4	2	0 – 62	2/70	**3**	
R-5 begin	83			0 – 62	14/70	20	Waited too long!
end							

Table 1. Showing age at beginning and end of each therapy round (starting with the Posit Science program over the internet), then the number of session and length of each session and number of months. The speech presentation level of WINT was 62dB. The next column shows the dB noise level range with 10 words at each noise level. The following column shows the number of items and the number of errors. Finally, is the percent error and comments.

It took me 38 half-hour sessions to get through the WINT program in the first therapy round (R-1). Training started with no noise and just the 3 easiest noise levels (for a total of 40 words). There were 9 errors words (with noise as high as +8 dB SNR) and 3 months later I had 4 errors for 70 words going up to 0 dB SNR. After that the table shows that when I noted my noise skills dropping at work I gave myself another round. I was not so smart before starting R-5. This time I knew I was having trouble and not getting 'end' and other words, but in addition I had trouble understanding what Irma and others were saying, especially on TV. Unfortunately, I was so busy with work and so tired at the end of the day that I kept putting it off. When I finally started R-5 last week I had 14 errors, that's 80% correct in noise.

I learned a great deal from giving myself the therapy that I have given to patients since then. But look at red data in the table. It took so many sessions to improve my skills in noise in order to reach a good level. For example, initially it took 8 sessions just to get to 62dB of noise (0dB SNR). Then it took 30 more sessions until I felt I was processing smoothly.

Even though there were 4 more rounds, the 22 errors for session #1 were the poorest. And that was just for the least challenging noise levels. Imagine if I had gone to 70 words at 62dB! It would surely have produced more than double the errors. So now that provides some perspective for the rest of the table. It took less time for each of the successive rounds, so that intensive initial training appears to have been very important. It's interesting that improved final scores were shown for 4 of the rounds of therapy.

Maintenance Program for Older Adults

When I began to write this column I had no intension of discussing my own situation, but it was the only data that I had. And fortunately, it supports the notion of a maintenance program for older adults.

Because of the direction of change in older brains; it seems logical that the fine results in therapy will be undone much more quickly than in the kids. The problems of the past and even after successful therapy unfortunately may not hold fast for older adults. A significant percentage of the adults, with whom I work, lose ground between rounds, when the break duration is longer. At the end of the next round they may have stronger performance than at the end of the previous round. So, hopefully it will serve them even longer.

I wonder if I had occasionally kept up with my skills between rounds whether that would have sustained the progress that I made. I think so! I started planning a maintenance program in 2013 when I realized that a patient with a progressive neurological disorder would need help for years to come.

Current Plan for Auditory Maintenance Program

1. Maintenance is not therapy! It is necessary that they have successful therapy first (maintenance should be started as soon as possible after completing therapy).
2. It is most practical that maintenance be in a group setting, preferably 3-5 people.
3. I think one time per month for a meeting would be good, but some people may need more and they can have assignments to do at home as well.
4. A one-hour session should be enough without overloading most people. Unlike therapy in which all of the attention is focused on one person, here it is divided.
5. It will also require more explanations when everyone may not have familiarity/remember some information.
6. Hearing what other people will say is a good teaching device when we don't know the sound or answer to a question.
7. The therapist and program members should be sitting around a table in close proximity.
8. All should be able to see and hear the therapist.
9. The program could start with procedures similar to what we do in therapy and as the group gets accustomed they can be varied.
10. One of the variations could be to have others take over parts as the therapist. That will be good for me so I can get some therapy too. Teaching is a great way to learn.
11. Here are some of the procedures I would like to use: Phonemic Training Program, Phonemic Synthesis (live voice), Speech-in-Noise, Memory, and Localization.
12. I haven't figured out how to give Dichotic Listening training.

Hopefully we will get started in a few months.