Topics in Central Auditory Processing

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Start Off Each Day with a Smile

I tested the hearing of an elderly man. Seeing the audiometric results and the complaints of his family, I recommended hearing aids. His response was, "I believe that God lets me hear what God wants me to hear." I replied, "Let's see if God wants you to use hearing aids." Sure enough, God wanted him to use hearing aids.

An adult was being tested on the SSW. On item 37, when he heard again, "Are you ready?" He replied, "Would it matter."

** Submit one or two of your funny stories*

In This Issue

Managing APD in Blast-exposed Veterans

Wayne J. Wilson Ph.D.

Many service men and women return from conflict zones having experienced blast exposure (i.e., having been exposed to the forces of an explosive blast). While many of them will show peripheral hearing losses, they will also report problems such as difficulties understanding speech-in-noise and rapid speech, and difficulties following instructions and long conversations. As audiologists, we recognise these symptoms as indicating possible APD. Recently, Saunders and colleagues extended that recognition to conduct a randomized controlled trial of some APD rehabilitation strategies to see if this helped these veterans to hear better in difficult listening situations.

Saunders et al. randomly allocated 99 blast-exposed veterans to one of four interventions:

1) Compensatory Communication Strategies (CCS) education (a 10-to-15 minute one-on-one session) reviewing information from the National Center for Rehabilitative Auditory Research on auditory processing, communication strategies, and hearing conservation),

2) CCS, and a personal FM system for 8 weeks,

3) CCS, and an auditory training program conducted for 1 hour per day, 5 days per week, for 8 weeks. The program was the Brain Fitness Program of Posit Science, chosen for its exercises in temporal processing and auditory pattern recognition, and for research showing improved speech understanding in noise, memory, and attention following training with the program, and

4) the previous three interventions combined for 8 weeks.

While many measures were conducted, the two primary measures used by Saunders et al. were the Hearing in Noise Test (HINT) and the Psychosocial Impact of Assistive Devices Scale (PIADS, selected because all three interventions had the potential to positively impact PIADS scores).

While many results were obtained, Saunders et al. reported two primary findings. First, the CCS and personal FM system intervention benefitted speech understanding in noise and self-reported hearing in that participant group. Second, the combined CCS, personal FM system and auditory training intervention benefitted self-reported cognition in that participant group, but they also reported liking and using the FM, but generally poor adherence and high attrition for the auditory training.

Saunders et al. concluded that an FM system is an effective intervention for blast-exposed veterans with normal or near-normal hearing and functional hearing difficulties. As audiologists, we can take this conclusion as yet more evidence that there is much we can do to help persons with APD, including service men and women who have returned from conflict zones.

References

1. Saunders, G.H., Frederick, M.T., Arnold, M.L., Silverman, S.C., & Chisol, T.H. (2018). A randomized controlled trial to evaluate approaches to auditory rehabilitation for blast-exposed veterans with normal or near-normal hearing who report hearing problems in difficult listening situations. Journal of the American Academy of Audiology, 29, 44–62. DOI: 10.3766/jaaa.16143
2. Brain Fitness Program: https://www.brainhq.com/brain-training-products/brain-fitness-program
3. The Hearing in Noise Test
4. PIADS https://www.researchgate.net/publication/281495573_Psychosocial_Impact_of_Assistive_devices_Scale_PIADS

Diagnosis and Treatment of Spatial Processing Disorder Part II: Treatment, hearing loss, and inclusion in test batteries

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In Part I (previous issue of TiCAPS), we discussed the nature of spatial processing disorder (SPD), its most common cause (protracted otitis media in early childhood), and how it is diagnosed in a way that avoids the effects of poor attention, working memory or language (using the LiSN-S test). In this concluding part we show how SPD can be treated, the impact of hearing loss on measurement of spatial processing, and indicate when it is most appropriate to include the LiSN-S test within a clinical assessment battery.

How is it treated?

SPD is treated by giving the client lots of practice at listening to a frontal talker while suppressing talkers from the left and right sides. Because it takes tens of hours of practice for these skills to develop, it is highly desirable that training be done at home, via a computer-assisted training program. The program that has been created specifically to remediate SPD is LiSN & Learn,[1] and its more engaging successor, Sound Storm.[2] The computer generates quasi-random target sentences which are presented from an apparent frontal direction over headphones. Simultaneously, continuous discourse competing messages come from the left and the right. The child's task is to select an image that matches one of the words in the target sentence. The program constantly adapts the SNR to the ability of the child so that the child is always challenged, but always achieves some success. The recommended training is for 15 minutes per day, 5 days per week, for at least 10 weeks. This allows the child to play 100 games, which experience has shown is necessary to achieve and maintain normal spatial segregation ability. Figure 4 shows the SNR to which the training program progressively adapted in a study that examined whether LiSN & Learn works.[3] Evaluation of the children using LiSN-S three months after cessation of the training showed that the new spatial abilities were fully maintained for eight of the nine children in the study, and partially maintained for the remaining child.

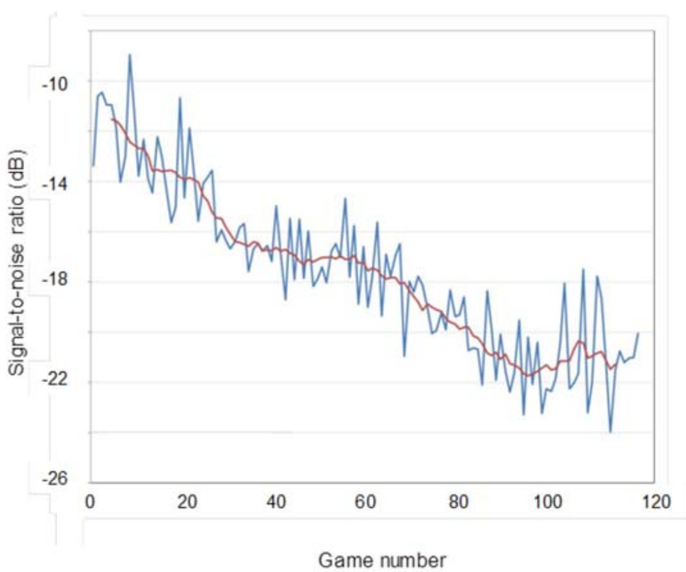

Figure 4: Signal-to-noise ratio to which LiSN & Learn adapted versus the number of games played, averaged across the nine child participants (jagged blue line) in Cameron and Dillon (2011). The smoother red line shows the same data averaged across 10 sequential games, which typically takes 5 days of training to achieve.

LiSN& Learn was further evaluated in a blinded, randomised-controlled study in which ten children with SPD were randomly allocated to either train using LiSN & Learn or train using Earobics.[4] Earobics trains on a variety of auditory tasks, including listening in noise, but does not include spatial training, so was not expected to help these children because their specific deficit was reduced spatial segregation ability. Results were as hypothesised: all five children in the LiSN & Learn group achieved essentially normal scores on the LiSN-S test after training, whereas scores for all five children in the Earobics group were essentially unchanged. Although the study was small, such results could be achieved by chance less than one in a thousand times. Real life benefit reported by the children, their teachers, and their parents was greater for the LiSN & Learn group than for the Earobics group. It was significantly so for the parents. An analysis of LiSN & Learn training results with 33 children diagnosed as having SPD by the Australian Hearing APD service also showed significant real-life benefit, as reported by the children's parents.

Whereas the original LiSN & Learn was played on computer, its replacement, Sound Storm, is played on an iPad, and provides a much more engaging game experience that keeps children motivated to use it longer. Both versions use identical auditory stimuli and training rules. The effectiveness of Sound Storm for children with SPD, and the sustainability of the benefit has also been shown in a study with 16 children by Graydon et al [21].

Where in the brain does it occur?

The one thing about SPD that we don't yet know is what parts of the brain are involved in emphasising sounds coming from a particular direction and suppressing sounds coming from other directions. All we know is that these auditory processes are under attentional control, since we can direct our attention to any direction we choose. Attempts to answer this question with electrophysiological testing have so far not given definite answers, though we can see that the amplitude of cortical responses evoked by sounds coming from directly in front of the listener increases when the competing sounds are moved from the front to each side. Of course, a stronger response would occur in the cortex even if the binaural enhancement happened in the brainstem.

Further research

It would be desirable for future research to identify, possibly through electrophysiological testing, the locus within the brain of spatial selectivity. More immediately, creation of a new test, the Listening in Spatialized Noise – Universal (or LiSN-U) is well advanced. This test uses as target stimuli and competing sounds nonsense syllables constructed from phonemes that are used in nearly every language in the world. Consequently, the test should be useable for people who speak any language. Normative data already collected show that the test produces a very large spatial advantage, presumably because there are very few other differences between the target and competing sounds. This should make the test very sensitive to SPD.

Even without any further research, we consider that SPD is unique within the field of APD, because we know:

- Its major cause (repeated or protracted otitis media during the first five years of life);
- How to diagnose it, without the diagnosis being affected by comorbid attention, memory or language deficits (differential testing, specifically LiSN-S);

- How to remediate it (auditory training using Sound Storm that has been designed to develop the specific ability for which there is a deficit); and
- That the remediation generalises to real-life benefit, as shown in various studies, including a blinded randomised trial.

We don't believe that all of these can be said, yet, about any other types of auditory processing disorder.

Can we measure spatial release from masking in people with hearing loss?

Yes, and no. LiSN-S includes an individually prescribed pre-amplifier to offset the effects of hearing loss. If the patient's audiogram is entered, the NAL-RP prescription will automatically be applied to amplify all test stimuli. Despite this amplification, measurements on a large number of people with hearing loss showed that they all appear to have a spatial processing disorder, in that they needed a better SNR than normal hearing people, and experienced a smaller spatial advantage.[6] Subsequent research, however, showed that the primary cause was that reduced audibility of the high-frequency parts of speech prevented access to the cues made possible by the head shadow effect.[7] Despite the amplification (which never fully restores hearing), people simply could not hear the softer high-frequency sounds that mostly facilitate better-ear glimpsing (see part I). Consequently, although the symptoms are the same as occur in people with SPD who have normal hearing thresholds, the cause is different and so is the treatment. We hypothesised that spatial training would not help people with sensorineural loss (because training cannot make audible sounds that are below threshold), and this proved to be the case.[8] It is possible that people with hearing loss could have a loss of hearing in noise due to both inaudibility of high-frequency sounds, and SPD arising from a binaural processing deficit, but separating out these components is not straightforward.

When should we test for spatial processing disorder?

If a child is reported to have abnormal difficulty understanding speech when there is background noise, and had repeated or protracted otitis media during the first five years of life, then there is a reasonable chance the child has spatial processing disorder. Currently, the only available test to diagnose it is the LiSN-S test, so without use of that test (or LiSN-U when it becomes available), the disorder is likely to remain undiagnosed. The condition can be fully remediated by using the Sound Storm auditory training software. Provided the child completes the recommended 100 games with this software, there is a very high chance that the disorder will be fully remediated, and that improved functioning in noisy places will be observed by the child, parents, and teachers.

A national service for APD operated by Australian Hearing included the LiSN-S test for diagnosing SPD. A review after the first nine months of operation examined the results for 666 children. Of these, 20% were diagnosed with SPD.[5] One should not, however, expect that every clinical sample will have the same proportion of children with SPD. The Australian Hearing APD service was advertised as intended for children who had difficulty understanding speech in noisy places (despite having normal hearing thresholds). Some APD clinics, by contrast, seem to attract children with predominantly cognitive problems,[9] so the proportion of children with SPD, and presumably other types of auditory processing, will be smaller.

Disclosure: The National Acoustic Laboratories (but not the authors) derives some income from sale of LiSN-S (via its distributor, Phonak) and of Sound Storm (via the Apple App store).

References

1. Cameron S, Dillon H. LiSN & Learn Auditory Trainng Software. 3.0.0 ed. Sydney, Australia: National Acoustic Laboratories; 2012.
2. Cameron S, Dillon H. Sound Storm Auditory Training Software. 1.2 ed. Sydney, Australia: National Acoustic Laboratories; 2017.
3. Cameron S, Dillon H. Development and evaluation of the LiSN & learn auditory training software for deficit-specific remediation of binaural processing deficits in children: preliminary findings. J Am Acad Audiol 2011; 22(10): 678-96.
4. Cameron S, Glyde H, Dillon H. Efficacy of the LiSN & Learn auditory training software: randomized blinded controlled study. Audiol Res 2012; 2(1): e15.
5. Cameron S, Glyde H, Dillon H, King A, Gillies K. Results from a National Central Auditory Processing Disorder Service: A Real-World Assessment of Diagnostic Practices and Remediation for Central Auditory Processing Disorder. Semin Hear 2015; 36(4): 216-36.
6. Glyde H, Cameron S, Dillon H, Hickson L, Seeto M. The effects of hearing impairment and aging on spatial processing. Ear Hear 2013; 34(1): 15-28.
7. Glyde H, Buchholz JM, Nielsen L, et al. Effect of audibility on spatial release from speech-on-speech masking. J Acoust Soc Am 2015; 138(5): 3311-9.
8. Glyde H, Cameron S, Dillon H, Hickson L. Remediation of spatial processing deficits in hearing-impaired children and adults. J Am Acad Audiol 2014; 25(6): 549-61.
9. Tomlin D, Dillon H, Sharma M, Rance G. The Impact of Auditory Processing and Cognitive Abilities in Children. Ear Hear 2015; 36(5): 527-42.

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At What Age Should We Test for Auditory Processing Disorders? Results of Professional and Parent Surveys

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You may remember the IGAPS email discussions we held regarding the age factor in evaluating and diagnosing young children having auditory processing disorders (APD). Many of us reported that audiologists (Auds) and speech-language pathologists (SLPs) often tell parents you cannot test a child under 7 years of age. This eventually led to a letter submitted to The ASHA Leader which identified the research that shows there is no age limit to test children for APD. One result of that submission to The ASHA Leader was that the editor refused to consider the article because it assumed that Auds and SLPs were making such statements to parents without evidence.

The concern about whether professionals feel there is, or should be an age limit (i.e., youngest age to test) for evaluating and diagnosing children with APD led Dr. Lucker to discuss with his doctoral (PhD) students his concern. Under Dr. Lucker's mentorship, the students developed three questionnaires targeting different groups. These questionnaires were distributed via the internet and were shared on the IGAPS group's
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discussion forum. When the results were studied, the students found only about a dozen professionals who were not Auds or SLPs responded to the “Other Professionals Questionnaire.” Thus, only the Aud/SLP Questionnaire and the Parent Questionnaire provided sufficient input to report. The following is a discussion of the outcomes from these two questionnaires. Although the responses were low, especially for the Parent Questionnaire, results provide insights into what these professionals and parents feel about the age at which we should evaluate and diagnose children for APD. Thus, consider this an initial study regarding the age fac-tor. Additionally, the discussion includes how this information can be used and shared with people who say you cannot test a child below the age of 7 years.

Results from the Aud and SLP Questionnaire

One hundred and nineteen surveys were completed by 37 Auds (30%), 63 SLPs (59%), and 19 Dually Certified Professionals (11%). The professionals work in a variety of settings: 56% Private Practice; 30% Public Schools; 11% Universities (including clinics). The remaining work in other settings, such as hospitals, clinics and group practices. All professionals (except for 3) were from the U.S. The 3 non-US professionals includ-ed two from New Zealand and one from Europe. These non-US professionals were not included in the re-ported results and, thus, are not part of the 117 surveys from which the data were collected.

In response to the question, “At what age do you do you evaluate children for APD?” (see Figure 1), 56% said they do not evaluate, likely because of the large number of SLPs. Of the remaining 44%, 100% evaluate at age 7 years and older. However, 80% evaluate at age 6, 64% at age 5, 46% at age 4, and 25% at age 3. Thus, a high percent (above 45%) evaluate at age 4 and older. For those who do not evaluate, the question asked was “At what age do you refer children for APD evaluations?” It was surprising that 100% did not state at age 7 or older. Responses for these age groups ranged from 90% at age 7 to over 90% at 8 years and older. However, 72% refer at age 6, 60% at age 5, 30% at age 4, and 18% at age 3. Thus, many professionals refer children for APD testing below age 7 years. (see Figure 2).

The next question related to the age for SCREENING children for APD with 51% reporting they do screen for APD. Of these professionals, 78 to 81% who screen do so at age 7 and older. However, 75% screen at age 6 or older, 72% at age 5 or older, 56% at age 4 or older, and 34% at age 3 or older. Thus, more than 50% of respondent’s screen children for APD from ages 4 years and older. (see Figure 3).

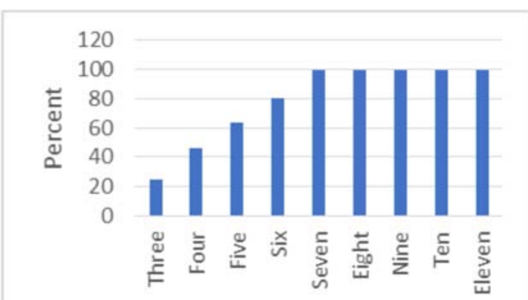

Figure 1: Age at which evaluate for APD

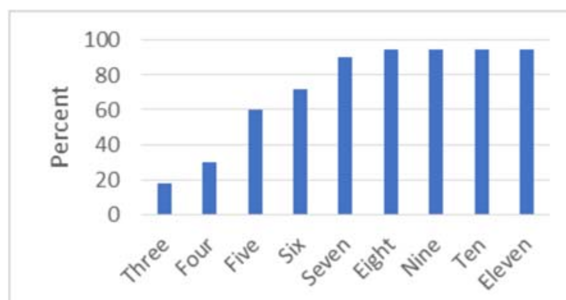

Figure 2: Age at which refer for APD evals

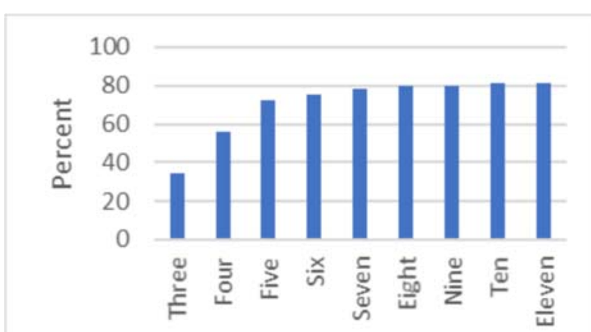

Figure 3. Age at which SCREEN for APD

The bottom line question was what do they believe is the appropriate age to evaluate children for APD, whether they do the evaluations or not. Of this sample, 93% to 100% said that ages 7 years and older is appropriate. But, for younger ages, the percent supporting appropriate ages for evaluating APD were: 6 years = 80%, 5 years = 73%, 4 years = 47%, and 3 years = 33%. Thus, more than 45% of respondents feel it is appropriate to evaluate children aged 4 years and older for APD. (see Figure 4).

Regarding responses provided, professionals were asked to fill in why they feel it is not appropriate to evaluate children for APD below 7 years of age. Qualitative responses were grouped as follows. No normative data below 7 years, research says under 7 years is too soon, SLPs responded they were advised not to have a child under 7 years evaluated for APD, too many developmental factors, testing below 7 years does not provide appropriate information, young children cannot attend to the test stimuli, and other similar responses. What is most interesting is that the evidence provided in the original article written, identified in many publications and provided as references for the letter reveal that for years professionals (Auds and SLPs) have been testing or referring children for testing well below the age of 7 years. What the responses to the survey reveal is that there is much misinformation regarding evaluating young children for APD and a great deal of support by Auds and SLPs that we can and should evaluate children below 7 years.

Results from the PARENT Questionnaire

In addition to getting feedback from Auds and SLPs, 47 parents completed the PARENT questionnaire. The parents came from all over the U.S. The two parent questionnaires that came from outside the U.S. were not included in the analyses.

Most parents (66%) indicated that their children go to public school. Parents identifying their children go to private school were 26% of the sample. The small remaining sample (9%) identified that their children go to Public Charter Schools or Parochial/religious schools.

Not surprisingly, 83% of the parents identified that their children were diagnosed with APD by an audiologist. However, 45% identified their children were identified by an SLP. About 20% of those parents indicated that their children‟s SLPs identified the APD problems and referred the children to the Aud for the formal APD testing and diagnosis. But, close to 25% identified that only an SLP diagnosed their child with APD. This is in violation to the ASHA practice standards and, thus, would be considered unethical if that is really what occurred.

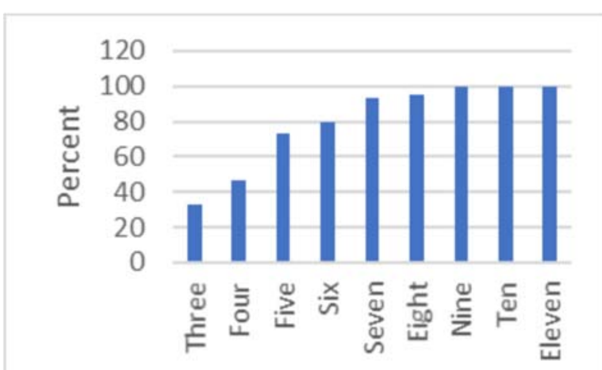

Figure 4. Age appropriate to evaluate for APD

For ages below 7 years, the responses were from 6% of parents trying when their child was 6 years, 15% at 5 years, 11% at 4 years, and 19% at 3 years. Thus, 51% of the parent respondents tried to get their child evaluated for APD problems below the age of 7 years while 49% did wait until age 7. Thus, a large percent of parents wanted to have their child identify below the age of 7. (see Figure 5)

Figure 6. Impact of waiting for age 7 to evaluate

When the 49% were asked why they did not try until their child was 7, 71% said they were told to wait until age 7 years or older. The remaining percent of parents identified they were told to wait until the child was 6 years (6%) or 5 years (9%). The remaining 16% were told to wait, but said they were not given a specific age before their child should be tested. Thus, parents are being told a lot of confusing information. Not surprisingly, for the parents told to wait until the child was 7 years, 41% said it was told to them by an Aud. while 11% were told this by an SLP. Interestingly, 11% of the parents said they did not wait but searched for someone who would test their child at the age the child was when the child was below 7 years. The remaining percent of parents were divided as being told by teachers, medical doctors, psychologists, or via searches on the internet. Internet searches led 7% of the parents to believe they had to wait until age 7. When asked why they were told they had to wait, from all respondents who were so told, 69% reported they were just told their child was too young, and 27% were told that development problems required them to wait until that age level. The remaining percent were told the research says you must wait.

The major concern of parents was the impact on the child for waiting until an older age. For both parents who waited and parents who felt it was not appropriate to wait, 31% felt that waiting would negatively impact the child educationally (Edu). Additionally, 33% felt there were multiple factors (Multi) including educational problems, emotional frustrations, and speech-language problems. Interestingly 25% of the parents responded, they did not care what people said, they did Not Wait but searched for and found someone to evaluate their child before the age of 7. (see Figure 6)

As with the Aud and SLP survey, parents could write their feelings about the age factor. In general, parents identified concerns that waiting would hurt their children educationally, developmentally, emotionally, and that the child needed treatment as early as possible (i.e., early intervention). Parents also identify that their own frustrations were increased when told to wait because they did not know what was going on with their children and what to do to help them. This is likely why many did not wait and searched for someone to test their child below age 7.

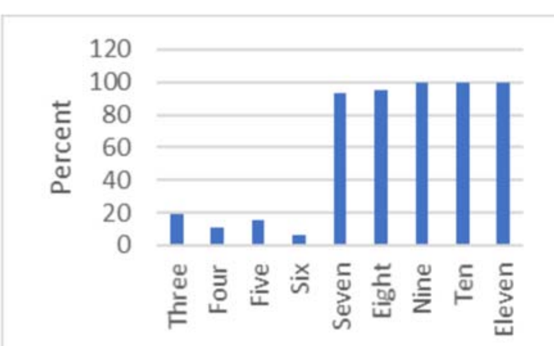

Figure 5. Age tried to get child evaluated for APD

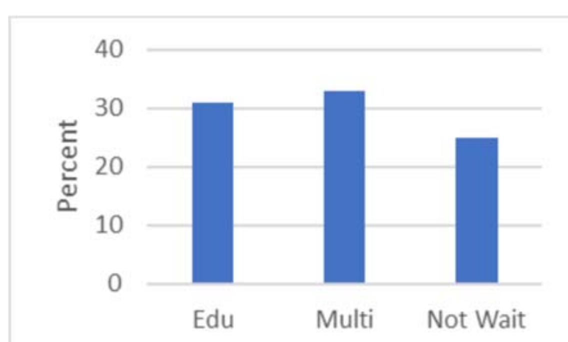

Figure 6. Impact of waiting for age 7 to evaluate

Conclusions

Results of these preliminary survey findings reveal that overwhelmingly Auds and SLPs are not waiting until age 7 years to evaluate children for APD, even if only with screening. Parents want to better understand their children"s problems and what to do to help their children overcome these problems. Early intervention seems to be the desire of most professionals and parents. Importantly, there is a great deal of misinformation provided, mostly by audiologists, regarding their rationale for waiting until the child is 7 years old. As noted in numerous publications, there is no evidence to support the need to wait before you can evaluate and diag-nose the child for APD. Professional associations, ASHA, AAA, EAA, do not state that one must wait until a child is a specific age (such as 7 years old).

If you are interested in what the research reveals about this age factor, contact Dr. Lucker at apddrj@gmail.com. He will be happy to send to you his list of references providing evidence regarding testing young children for APD. His information includes references of standardized, published tests that have norms for children below 7 years.

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Unique Characteristics of SSW

Kavita Kaul, M.S.,Au.D., CCC-SLP/ A

The Staggered Spondaic Word (SSW) test has been around for more than 50 years,[1] and those who use it appropriately get so much benefit from its findings. The SSW is a unique dichotic test. Actually, it is also a unique APD test, and among audiology tests.[2] A great advantage of the SSW is that it was developed as a site-of-lesion test and that its complexity permitted different disorders to produce specific error patterns.[3-6] Its design and recording challenges revealed auditory processing weaknesses, associated with all four of its categories of the Buffalo Model.[4,7,8] The SSW has been in continuous use since the early 1960s with numerous clinical populations[9] and reported in countless publications. Here is a summary of the challenges and factors that make the SSW unique and so valuable.

Recording Procedures:

1. The dichotic challenge of the SSW is powerful because the competing words are P-centered (perceptually centered).[10] There is no arbitrary method that makes competing words sound, 'maximally competing' (e.g., lining up onset times, offset times or even lining up midpoints will not do it). Each of the two competing words is complex in its length, intensity of the specific sounds, etc. P-centering insures that when you listen to the competing words (e.g., through a single loudspeaker), they sound maximally overlapped. This is done by manually shifting the words by milliseconds based on listener perception.
2. The carrier phrase "Are you ready?" that is given before each test item, must be suppressed, while the words that follow it must be repeated. Many people with APD cannot suppress repeating the carrier phrase, which is counted against them, and suggests a tolerance-fading memory (TFM) issue.[11]
3. Test items begin alternately in the right and left ears. This makes it harder to learn a systematic approach to compensate for difficulties.
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4. Guessing correctly is reduced because a third compound word (combining word #1 and word #4) enables a person to miss a competing word and fill it in (incorrectly) with the "available word."[12]
5. The task is made more challenging for those with APD by having a low level of background noise. Sometimes, those we test comment or complain, "There's noise in here." Normal listeners are unaware of the noise. The SSW's weaker resolution of the recorded speech makes it more difficult for decoding.
6. The two words of each spondee are separated by a brief pause. According to audiologist, Ray Hull, the average adult speaks at a rate of almost 170 words per minute.[13 14] But the average 5- to 7- year-old processes speech at a rate of only 120 words per minute. He says that to keep a child's attention it is best to speak like Mr. Rogers in from the old television show, *Mr. Roger's Neighborhood*. The words in the SSW are presented at about 2 words per second.
7. The pauses between the compound words makes it a bit easier for those with decoding problems, but harder for those with memory difficulty.[15,16]

Multidimensional Scoring

1. It is the only APD test that uses multi-dimensional scoring (which is used in Aphasia testing[18] and other fields), that enables us to look at various aspects of auditory processing at the same time.
2. Within a 10-minute test administration time, it provides more than 20 APD indicators related to the Buffalo Model categories.[18]
3. Other Quantitative scores that were not anticipated became obvious in working with patients with neurological disorders. For example, items beginning in the right ear often produced different results than ones starting in the left ear.[19,20] The Type-A pattern was an important find, because it gives us a specific measure that is associated with the efficiency of getting both hemispheres to work together effectively. This pattern tells us about the most severe type of APD (e.g., associated with dyslexia).[21-23] Also, sequencing[24-26] is rarely considered in other APD tests, and yet, it has importance in understanding and improving APD.
4. What is even more unique, is that the SSW benefits greatly from Qualitative signs. These can be noted on correct responses and incorrect ones. When a person takes the test and promptly responds, as they typically do, we assume that was normal performance. However, when a person "hems and haws" and then comes up with the correct answer, we score that as correct but, also indicate a delayed response. If the person has a significant number of delays, that suggests they needed more time, on items that were eventually correct. In this way, someone who has significant APD (e.g., DEC) could have no errors on a test because they are smart, worked longer or had prior training. Hence without the 12 qualitative measures, we would miss or be unsure of some people who need help.

Outdated Spondees and Repetition of Words

1. Despite the overwhelming number of unique benefits that the SSW provides, there is a concern that some of the spondees are no longer in common use, and this affects the integrity of the test. Roughly a dozen spondees/compound words, of the total of 80, can be considered 'outdated'. We hope to have a report of a study in progress regarding this topic in the next issue.
2. Almost all the monosyllabic words from each spondee are at a primary level. Language difficulty, per se, should be not an important factor. A significant correlation between SSW results and language is much more likely to reflect the decoding and memory influences on language development than the influence of language on them.
3. Some words are used more than once, but with a total of 160 words, there should not be a concern that the repetition affects the test's integrity.

Analysis and Interpretation

1. An important concern is whether we should use 1 or 2 SD norms. We will have more information on this topic also in the future issues of TiCAP. For adults and children ages 12 years and older, the scores for 1 SD and 2 SD are almost identical. For younger children, the 1 SD norms enable us to identify children with APD but who may be "sophisticated listeners" due to having early intervention and communicatively-rich environments.
2. In the Buffalo Model we are most fortunate to have independent information that has aided us in double checking our findings. On the SSW we compare and contrast the qualitative and quantitative results against the parent and/or teacher concerns. The Buffalo Model Questionnaire is used to make sure that we do not over- or under-state the severity and characteristics of a person's auditory processing.[26-28] Thus, it is easy to validate the results when the interpretation corroborates well with the concerns.

Other Unique Factors

1. In 2011, Emanuel et al.,[30] reported on a large survey dealing with APD. They found the SSW to be the most widely used test by audiologists to assess auditory processing.
2. It is based on decades of research with CNS neurology patients and found to apply to the evaluation of those with APD and other difficulties.
3. The auditory problems identified by the SSW can be improved with effective therapies.[31,32]
4. In addition to numerous SSW articles and chapters dealing with APD and neurological problems,[1,3,4,6,19,33,34] the SSW has been studied in those with developmental disorders such as intellectual disability[35], aging[36-39,] autism[40], hearing disorders,[41-43] stuttering,[44] etc. It has also been used to assess auditory skills in second language learners[45].

Finally, the SSW when used in conjunction with the Buffalo Model battery has small and large benefits. It provides sensitive data to interpret results of real-life abilities based on both qualitative and quantitative results. The findings allow for specific therapy recommendations to help those with auditory processing difficulties. The battery can also show the need for help with short-term memory; organization; speech-in-noise and other difficulties e.g., related to dyslexia. Other tests may provide information about various auditory processing skills; however, not many have the eclectic approach to provide a comprehensive remediation plan.

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References

1. Katz, J (1962). The Use of Staggered Spondaic Words for Assessing the Integrity of the Central Auditory Nervous System, Journal of Auditory Research, Vol. 2, pp. 327-337.
2. Katz, J (1984). The SSW Test-. Introduction," in H. Kaplan, V. Gladstone and J. Katz (Eds.), Site-of-Lesion Testing, University Park Press.
3. Katz, J (1970) Audiologic Differential Diagnosis: Cochlea to Cortex," Menorah Medical Journal, Vol. 1, 25-38.
4. Katz, J and Smith, P (1991). A Ten Minute Look at the CNS Through the Ears: Using the SSW Test, In Zappulla, R., LeFever, F, Jaeger, J and Bildern, R. Windows on the Brain: Neuropsychology's Technical Frontiers. Annals New York Academy of Sciences, 620, 233-252.
5. Balas, R (1971). Staggered Spondaic Word test. Ann Otol Rhinol Laryngol, 80, 1, 32-34.
6. Jerger, J and Jerger, S (1975). Clinical validity of central auditory tests. Scand Audiol, 4, 147-163.
7. Jutras B, Loubert M, Dupuis J, Marcoux C, Dumont V, and Baril M, (2007). Applicability of Central Auditory Processing Disorder Models. Am J Audiol, 16, 100-106.
8. Katz, J (2007). APD evaluation to therapy: The Buffalo Model. doi: 10 1044/1059-0889
9. Arnst D and Katz J (Eds) The SSW Test: Development and Clinical Use, San Diego: College Hill Press, 1982
10. Morton J, Marcus S and Frankish C (1976). Perceptual Centers (P-centers) www.personal.rdg.ac.uk/~llsroach/phon2/pcent-xtrax.htm
11. Katz, J (1987). Do you qualify? SSW Reports, 9: 1-6.
12. Katz, J (1984) The Available Word. SSW Reports, 6, 7-10.
13. Hull, R and Stovall, J (2016). The Art of communication. Shippensburg, PA., Sound Wisdom
14. Hull, R (2016). Inadvertent central auditory impairments in young children. The Hearing Journal. 69, 12, 28-30.
15. Rudman, F and Katz, J (1982). Dichotic onset and offset parameters on the SSW test. In D Arnst and J Katz, The SSW Test: Development and Use. San Diego, CA., College Hill Press.
16. Katz, J, Harder, B and Lohnes, P (1982). Lead/lag analysis of the SSW test items. In D. Arnst and J Katz, The SSW Test: Development and Use. San Diego, CA., College Hill Press.
17. Porch, B, and Callaghan, S (1981). Making predictions about recovery: Is there HOAP? In R Brookshire (Ed.), Clinical Aphasiology Conference proceedings. Minneapolis, MN: BRK.
18. Katz, J (2009, August). Scoring the Staggered Spondaic Word (SSW) Test: Using all the elements. *AudiologyOnline*, Recorded Course #14166. Retrieved from www.audiologyonline.com
19. Berlin, C, Chase, R, Dill, A and Hagepanos, T (1965). Auditory findings in patients with temporal lobectomies. Asha, 7, 360
20. Lucker, J (1979). Diagnostic significance of Type-A pattern. SSW Reports. 1,5: 20-22.
21. Katz, J and Lawrence-Dederich, S (1986). Central Nervous System, Cerebral Dominance and Dyslexia, in P. Skov, S. Momme and P. Kjeldsen (Eds.) Dyslexia: Proceedings, Second Annual Conference on Dyslexia: Psychologic and Neurologic, Paedgogisk Psykologisk Radgiving, (Aalborg, Denmark), 7-24.
22. Young, M (2005). Out-Law-In-Side: Dyslexia in the Booth. SSW Reports, 27, 2: 7-13.
23. Katz, J, **(**1992**)** Classification of Auditory Processing Disorders, "Katz, J, Stecker, N and Henderson, D (Eds.) Central Auditory Processing: A Transdisciplinary View, Chicago: Mosby Yearbook, 81-92.
24. Katz, J (1982). The National Sample Looks at Reversals. SSW Reports, 28, 2: 14.
25. Rudmin, F (1982). Are SSW Reversals Related to Deficits in Self Ordering? SSW Reports, 28, 2: 15-16.
26. Katz J & Feinberg S (1989). Verresslas (Reversed Reversals). SSW Reports, 11, 3: 13.
27. Katz, J (2010). Of course I may be wrong (BMW-R). Educational Audiology Review, Winter, 6-8.

28. Pavlick, M, Zalewski, T, Gonzalez, J, and Duncan, M (2010). A (C)APD Screening Instrument for The Buffalo Model Diagnostic Test Battery. Journal of Educational Audiology, 16: 49-58.
29. Katz, J (2012). When the Buffalo Model don't agree. SSW Reports, 34: 11-12.
30. Emanuel, D, Ficca, K and Korczak, P (2011). Survey of the diagnosis and management of APD. Am J Aud, 20, 48-60.
31. Kaul, K and Lucker, J (2016). Auditory processing training with children diagnosed with Auditory Processing Disorders: Therapy based on the Buffalo Model. TiCAP, 1, 1: 5,
32. Reeves, C and Lucker, J (2017). Analysis of changes in Auditory Processing after therapy. TiCAP 2, 3: 6-9.
33. Katz, J and Smith, P (1991). A 10-minute look into the CNS through the ears: Using the SSW test.Annals New York Academy of Sciences, 620,233-252.
34. Katz, J and Pack, G (1975). New developments in differential diagnosis using the SSW test. In M Sullivan (Ed.), Central Auditory processing Disorders. Omaha: University of Nebraska Press.
35. Katz, J, (1969, 1975). Differential diagnosis of auditory Impairments, In R Fulton and L Lloyd (Eds.), Assessment of the Retarded and Other Difficult-to-Test Persons, Baltimore: Williams & Wilkins.
36. Balas, R (1962). Results of the Staggered Spondaic Word test with an old age population. M.A. Thesis, Northern Illinois University.
37. Amerman, J and Parnell, M. (1980). The Staggered Spondaic Word test: A normative investigation of older adults. Ear and Hearing, 1: 42-45.
38. Rudmin, F and Forbes, B (1986). Cognitive Perceptual Strategies and Loneliness in Old Age. SSW Reports, 8, 4: 19-20.
39. Katz, J (1987). Young vs. old LD subjects. SSW Reports, 8, 11-13.
40. Wetherby, A, Koegel, R and Mendel, M (1981). Central auditory nervous system dysfunction in Echolalic Autistic individuals. J Speech Hear Research, 24: 420-429.
41. Smith, J (1962) The Effect of Peripheral Auditory Impairments on the Staggered Spondaic Word
42. Test. M.A. Thesis, Northern Illinois University, DeKalb.
43. Cafarelli, D, Nodar, R, Collard, M and Larkins, D (1977). SSW test results by patients with Meniere's Disease. ASHA Convention, Chicago, Ill.
44. Arnst, D (1980). SSW test with peripheral hearing loss. ASHA Convention, Detroit, MI.
45. Rentschler, G and Liebetrau, R (1982). Dichotic listening and Neuropsychologic performance of Stuttering children. SSW Reports, 4, 2: 7-9.
46. Rawiszer S (1979). Performance of non-native English speakers on the Staggered Spondaic Word test. M.A. Thesis, California State University, Fresno.