[redacted]

[redacted]

March 23, 2018

[redacted]

Pediatrician (None Given)

[redacted]

RE: [redacted]

CENTRAL AUDITORY PROCESSING EVALUATION

HISTORY:

[redacted], a 12 year old female, was seen at [redacted] for Children Audiology Department on 03/16/2018 for a **diagnostic central auditory evaluation** that included peripheral audiological evaluation, 1.25 hours of auditory processing testing and interpretation, and electrophysiological evaluation using the Cortical Auditory Evoked Potential (CAEP). [redacted] mother, [redacted], accompanied her to today's evaluation and acted as the primary informant. [redacted] was referred for this evaluation by [redacted] given [redacted] overall difficulties associated with her history of Epilepsy and right functional hemispherectomy. A thorough case history questionnaire (APAD-Q) was completed by the mother and reviewed at the time of the appointment.

Pre and perinatal history was unremarkable as reported by [redacted]. [redacted] was born at 39 weeks gestation via vaginal delivery at [redacted], and she passed her newborn hearing screening in both ears. There has not been a known family history of hearing loss in childhood reported. Otologic history was unremarkable for middle ear

dysfunction and ear infections. Medical history was remarkable for complex seizure disorder quantified on a neuropsychological report as "varied and changed over time, which included bilateral myoclonic jerks, generalized tonic-clonic seizures, atonic seizures, and absence seizures.... Neuroimaging revealed malformation of cortical development (MCD) in the right frontal lobe." [redacted] underwent right functional hemispherectomy at the [redacted] in October 2012. There was not a noted history of developmental delays in gross motor skills, fine motor coordination, or speech language skills prior to hemispherectomy at age four; however, subsequent impact in all of these areas were noted post surgically. [redacted] mother reported that [redacted] is right-hand dominant. As a result of her hemispherectomy surgery, [redacted] has left hemiparesis and has worn ankle foot orthotics (AFO) to assist with walking. She has been taking Keppra, Lamictal, and Clonidine for her seizure management but has had an addition of Zoloft to manage more recent concerns of anxiety and depression. Prior to middle school, [redacted] was described as "friendly, kind hearted, and has an amazing personality." Because of her difficulties with transitions, she was scheduled for Orientation and Motility before starting middle school classes. Her para educator services were not provided for daily classroom transitions and she was considered "too high functioning" for continuation of these services in general, therefore, she was only given a helper for periods of transition. On her first day of school, her schedule was changed without the family's prior knowledge and, as a result, [redacted] had what her mother described as a "meltdown" at school. Over time, she began experiencing bullying from other students that escalated into instances of physicality from some students. Her mother noted that [redacted] also began exaggerating some of these events in a likely attempt to remove herself from the environment. At the school's requirement, she began psychiatric consultation in December 2017 due to her threats of self harm. At continued threats to do so, [redacted] was admitted to an inpatient facility for 10 days. Her mother noted today that she did not believe that [redacted] understood what she was threatening to do but more likely was using this as a way to escalate her need to be removed from the school environment. There have been no further threats to self harm or behavioral issues since her removal from the school environment.

[redacted] attends the sixth grade at [redacted] in [redacted] with a reported class size of approximately 30 students. Since December, however, she has had homebound instruction for approximately 1-2 hours daily. Her mother notes that the instruction has been intermittent due to teachers not being present daily. [redacted] parents rate her academic and reading performances as both "Below Average". There are not concerns for speech and language delays, and [redacted] has not had an updated speech and language evaluation. She has had a vision evaluation with neuro-ophthalmologist, [redacted], in October 2016. The findings at that time indicate "a dense, left homonymous hemianopsia, a complex mix of saccadic inaccuracies, possible left-sided visual hemi neglect, and central visual impairment. [redacted] is scheduled for a follow up consultation with developmental optometrist, [redacted], on 03/16/2018. A neuropsychological evaluation has been completed on 03/24/2017 by the neuropsychology team at the [redacted] in [redacted], which indicates that [redacted] "has a number of intact skills, including verbal reasoning, divided attention, contextual verbal memory, verbal fluency, abstract problem solving, and academic skills...auditory attention for digits, rote verbal learning and memory, and aspects of executive functioning. ...weaknesses were observed in the areas of nonverbal reasoning, sustained attention, contextual verbal memory, visual-motor integration, visual perception, and processing speed. ...she demonstrated substantial difficulty following rules on less structures tasks, which is likely multifactorial in nature and may have been due to deficits in self-monitoring, not fully understanding the rules at the beginning of the tasks, and/or feeling anxious when she perceived her strategy was unsuccessful." On the Wechsler Intelligence Scale for Children (WISC-V), [redacted] has a Full Scale IQ Score (FSIQ) of 80. Her component scores are as

follows: Verbal Comprehension Index (VCI) is Average at 92 (30th percentile), Visual Spatial Index (VSI) is Below Average at 72 (3rd percentile), Fluid Reasoning Index (FRI) is Below Average at 74 (4th percentile), Working Memory Index (WMI) is noted as "not calculated", and Processing Speed Index (PSI) is Low Average at 83 (13th percentile). There is a 20 point difference between the lowest and highest index scores. On the ChAMP, [redacted] visual memory index is significantly reduced (80, 9th percentile) as compared to her verbal memory index (109, 73rd percentile). [redacted] does have an Individualized Education Plan (IEP) through school (see scanned document for full list of accommodations). She does not receive tutoring in addition to school accommodations.

[redacted] denies hearing difficulties, especially in background noise. Her favorite subject is English with her least favorite being Math. [redacted] reportedly enjoys swinging. Her mother observes that [redacted] is not getting appropriate amounts of sleep (approximately 10 hours but "very restless sleep"), nutrition, and exercise at this time.

The following characteristics and behaviors of concern were noted on [redacted] Auditory Processing and Associated Diagnoses Questionnaire (APAD-Q):

0 = Does not exhibit
1 = Exhibits occasionally
2 = Exhibits regularly
3 = Interferes with everyday function

Daydreams/"zones out" frequently (0 - Does not exhibit)
Impulsive or hyperactive (1 - Exhibits occasionally)
Short attention span in most situations (1 - Exhibits occasionally)
Restless, cannot sit still (1 - Exhibits occasionally)
Forgetful in many situations (1 - Exhibits occasionally)
Does not complete assignments (1 - Exhibits occasionally)
Often fatigued (2 - Exhibits regularly)
Tires easily (2 - Exhibits regularly)
Temper tantrums more than once a week (2 - Exhibits regularly)
Seeks attention (2 - Exhibits regularly)
Irritable (2 - Exhibits regularly)
Lacks self-confidence (2 - Exhibits regularly)
Shy (0 - Does not exhibit)
Fakes illnesses (2 - Exhibits regularly)
Expresses dislike of or anxiety about school (3 - Interferes with everyday function)
Disobedient (1 - Exhibits occasionally)
Lacks motivation in regard to completion of tasks (1 - Exhibits occasionally)
Difficulty with phonics, spelling, or writing (1 - Exhibits occasionally)
Difficulty following written directions (1 - Exhibits occasionally)
Difficulty following television programs (2 - Exhibits regularly)
Difficulty with vision/visual stimuli (2 - Exhibits regularly)
Reverses written numbers or letters (1 - Exhibits occasionally)
Says "huh" or "what" frequently (1 - Exhibits occasionally)
Asks for repetition of verbal information often (1 - Exhibits occasionally)
Sensitivity to loud sounds (2 - Exhibits regularly)
Appears confused in noisy places (2 - Exhibits regularly)
Distracted by background sounds (2 - Exhibits regularly)
Inattentive to auditory stimuli (0 - Does not exhibit)

Difficulty following a verbal sequence (1 - Exhibits occasionally)
Difficulty following verbal directions (1 - Exhibits occasionally)
Difficulty following multi-step directions (1 - Exhibits occasionally)
Does opposite of what is requested (0 - Does not exhibit)
Easily upset by new situations (1 - Exhibits occasionally)
Displays anxiety/stress frequently (3 - Interferes with everyday function)
Prefers to play with younger children (1 - Exhibits occasionally)
Prefers to play with older children (1 - Exhibits occasionally)
Prefers solitary activities (0 - Does not exhibit)
Clumsy N/A due to the hemiparesis

Pain assessment was performed today with a 0 rating (nonpainful) using the 10 Point Scale.
No contraindications to testing were reported today.

Test Results of Peripheral Auditory Function:
Prior to assessment of auditory processing abilities, a peripheral hearing loss must be ruled out.

Otoscopic Examination:
Right- unobstructed.
Left - unobstructed.

Tympanometry:
Right - Type A, normal middle ear system compliance and pressure, normal ear canal volume.
Left - Type A, normal middle ear system compliance and pressure, normal ear canal volume.

Distortion Product Otoacoustic Emissions (DPOAE):
Right - Present at 2-5 kHz.
Left - Present at 2-5 kHz.

OAE testing is not a direct test of hearing. When OAEs are present, the responses support normal outer hair cell function within the cochlea for the frequency range tested. The absence of OAEs can correlate with cochlear hair cell loss and subsequent hearing loss as a result; however, this finding should be judged with caution as these emissions are also adversely affected by outer and middle ear obstructions such as ear wax, small ear canals, and middle ear fluid.

Middle Ear Muscle Reflexes (Acoustic Reflexes):
Ipsilateral and contralateral acoustic reflex thresholds were evaluated at 500 through 4000 Hz bilaterally. Reflex thresholds were as follows:

Ipsilateral Right (probe and stimulus in the right ear):
500 Hz: 85 dB; 1000 Hz: 85 dB; 2000 Hz: 80 dB; 4000 Hz: 80 dB

Contralateral Right (stimulus in the right ear and probe in the left ear):
500 Hz: 100 dB; 1000 Hz: 95 dB; 2000 Hz: 90 dB; 4000 Hz: 85 dB

Ipsilateral Left (probe and stimulus in the left ear):
500 Hz: 85 dB; 1000 Hz: 80 dB; 2000 Hz: 80 dB; 4000 Hz: 75 dB

Contralateral Left (stimulus in the left ear and probe in the right ear):

500 Hz: 95 dB; 1000 Hz: 90 dB; 2000 Hz: 90 dB; 4000 Hz: 85 dB

Please note: The reflex thresholds are recorded by the stimulus ear.

Normal middle ear muscle reflex thresholds indicate synchrony throughout the middle ear acoustic reflex arc. This response usually rules out the possibility of Auditory Neuropathy Spectrum Disorder (ANSD).

Audiogram Results:
Test Mode: insert earphones, standard behavioral response
Test reliability: good. [redacted] was cooperative for the evaluation.

The audiometric results revealed normal pure tone thresholds from 250 through 8000 Hz including mid-high frequency interoctaves. Speech recognition thresholds (SRT) were obtained at 5 dB HL in the right ear and at 10 dB HL in the left ear. Speech discrimination abilities in quiet were 100% in both ears. SRT did corroborate the pure tone average bilaterally.

Tests Of Central Auditory Processing Ability:
The Central Auditory Processing Battery is designed to measure auditory processing skills in a variety of areas including: binaural integration of information, binaural separation of information, auditory closure, auditory figure-ground (speech-in-babble), and temporal sequencing/pattern perception. Additionally, this battery assesses phonemic synthesis as a functional indicator of phonological awareness skills although it is not considered a diagnostic finding for central auditory processing ability.

The **SCAN-3 for Children** is made up of a series of subtests that assess a wide range of auditory processing abilities. The Auditory-Figure Ground subtest assesses a listener's ability to perceive speech stimuli in the presence of background noise. The Filtered Words subtest assesses the processing area of *auditory closure*. It requires [redacted] to listen to a degraded speech signal, and by "filling in the blanks" of the distorted message, identify individual words. The Competing Words subtest assesses *binaural integration* skills using individual words. [redacted] hears a different word in each ear simultaneously and is asked to repeat both words. The Gap Detection Screen Subtest screens for the ability to detect brief silent gaps of variable durations (ms) between tone pairs. Poor performance would suggest the need for further testing in the area of temporal processing.

	Raw Score	Scaled Score	Percentile Rank	Performance
Auditory Figure-Ground	36	7	16	normal
Competing Words	**20**	**2**	**0.4**	**significant**
Gap Detection Screen	passed	N/A	N/A	normal

Mean Standard Score = 10 / 50th percentile
Normal Range = 7-13
Borderline Range = 4-6
Disordered Range = 0-3

In comparison to other children [redacted] age, scores for auditory figure-ground are borderline, for binaural integration of information are significantly disordered, and for temporal processing are considered age appropriate at this time. The ear advantage (right) is considered atypical for the both the Auditory Figure-Ground and Competing Words subtests (2% prevalence).

The **Dichotic Digits Test (DDT)** is a test of *binaural integration* abilities. This test requires [redacted] to listen to a group of 2 numbers and then 4 numbers (2 numbers presented to each ear at the same time). She is asked to repeat all the numbers, regardless of the order. This test is not heavily language based, as [redacted] is only required to repeat back digits as opposed to complex language stimuli such as a sentence. Therefore, this test is able to assess dichotic listening abilities whether or not the child has language difficulties. This type of task may be challenging for children who have difficulty listening when more than one person is talking at the same time.

[redacted] Score (single pairs)		Normative Value	
Left Ear	**85%**	**90% or greater**	**significant**
Right Ear	100%	90% or greater	normal

[redacted] Score (double pairs)		Normative Value	
Left Ear	**84%**	**90% or greater**	**significant**
Right Ear	96%	90% or greater	normal

[redacted] performance for binaural integration/dichotic listening is significant in the left ear. The ear advantage (right ear) is considered atypical.

The **Frequency Pattern Test/Pitch Pattern Sequence Test (PPST)** assesses both *temporal sequencing* and *pattern perception abilities*. This test is made up of a series of pattern sequences of "high" and "low" pitched tone bursts. [redacted] is asked to verbally label the pattern she heard (i.e., "high-low-low" or "high-low-high" etc). Deficits in the area of temporal processing may present as difficulties with speech perception such as the inability to detect differences in stress or intonation within the spoken message or small linguistic cues in speech such as voicing. It may also have an effect on the perception of music.

	[redacted] Score for labeling	[redacted] Score for humming	Normative Value	
Binaural- Pitch Discrimination	**60% (90% with reversals)**	100%	80% or greater	**Significan c**
Binaural-Pitch Sequence	100%	100%	80% or greater	nc

[redacted] performance for temporal sequencing is normal. She has difficulty discriminating and labeling sounds when the sounds are the same with no refernce (i.e. No difference to delineate high vs. Low pitch) but is able to mimic pitch differences accurately by humming. When pitches are in a sequence of three, with a reference (difference between sounds), she is able to recognize the difference to accurately label

the sounds by high and low pitch labels.

The **Random Gap Detection Test (RGDT)** assesses *temporal awareness* by asking [redacted] to indicate the smallest interval gap between two tones presented to both ears. Inability to perceive a smaller gap interval may be an indication of deficit in *temporal processing* ability. [redacted] is asked to tell whether she hears one or two beeps for a variety of interval lengths and tonal/click stimuli. The smallest gap interval is then scored to check [redacted] ability to detect subtle changes in timing cues.

[redacted] lowest gap interval		Score Cut Off	Normative Result
500 Hz tone	10 msec.	20 msec.	normal
1000 Hz tone	5 msec.	20 msec.	normal
2000 Hz tone	5 msec.	20 msec.	normal
4000 Hz tone	10 msec.	20 msec.	normal

[redacted] performance for detection of temporal interval differences is normal.

The **Bamford-Kowal-Bench Speech In Noise (BKB-SIN)** test attempts to identify difficulties in the perception of speech in the presence of background noise that more closely mimics noise in the classroom setting. [redacted] is asked to listen to and repeat two sets of ten sentences in each ear that are presented in background multi-talker babble, which increases in loudness until sentence ten is reached. *Although not specifically a test of auditory processing ability, this test helps identify whether a better signal-to-noise ratio (SNR) is needed for a child to successfully listen in the classroom.*

Ears	[redacted] average SNR-50	Correction Value	[redacted] SNR Loss	Criterion Range	Performance
Right	1.0 dB	-0.9	1.9 dB	0 - 3.0	Normal
Left	**6.5 dB**	**-0.9**	**7.4 dB**	**7.1 - 15.0**	**Moderate signal-to-noise ratio (SNR) loss**
Binaural	-0.5 dB	-0.9	0.4 dB	0 - 3.0	Normal

[redacted] performance for understanding speech in the presence of multi-talker babble is normal for the individual right ear and binaural (i.e. Both ears) listening conditions. Testing shows a moderate SNR loss in the left individual ear listening condition.

Cortical Auditory Evoked Potential Testing:
Cortical Auditory Evoked Potentials (CAEP) were obtained while [redacted] was awake and in a state of calm repose while watching a silenced video screen. A 4-electrode, dual channel montage was used with insert earphones to present a short speech stimulus /consonant-vowel/ in quiet and various noise paradigms. This evaluates [redacted] higher auditory pathways at the level of the brain (i.e. Auditory Cortex) for the efficiency of that pathway to detect speech. CAEP results reflect processes of pathways with decussation (i.e. Crossovers) occurring within the brainstem and before the auditory cortex. Crossover pathway function at the level of the corpus callosum cannot be determined by today's testing; therefore, dichotic listening skills

cannot be evaluated with this test and must be evaluated via the behavioral CAP evaluation.

Quiet Test Condition:
This condition presents the speech segment /da/ repeatedly to each individual ear in a quiet setting. ***Present P1/P2 complex and N2 responses were observed essentially within normal latencies in both ears using adult and site-specific norms. By the third repeated run, however, a significant reduction in amplitude and morphology of the response was observed that persisted with all subsequent runs. This occurred in both ears and may be an indication of fatigue within the transmission of the auditory pathway.***

Ipsilateral Noise Test Condition:
The speech stimulus /da/ was presented with ipsilateral (i.e. same ear) background noise at a +5 dB signal-to-noise ratio to investigate [redacted] cortical auditory pathway speech detection abilities in the presence of a challenging background noise setting. ***Present P1/P2 complex and N2 responses were observed essentially within normal latencies in both ears using adult and site-specific norms. By the third repeated run, however, a significant reduction in amplitude and morphology of the response was observed that persisted with all subsequent runs. This occurred in both ears and may be an indication of fatigue within the transmission of the auditory pathway.***

Binaural Noise Test Condition:
The speech stimulus /da/ was then presented with binaural (i.e. both ears) background noise at a +5 dB signal-to-noise ratio to investigate [redacted] cortical auditory pathway speech detection abilities in the presence of the most challenging background noise setting. ***Present P1/P2 complex and N2 responses were observed essentially within normal latencies in both ears using adult and site-specific norms. Following the initial run, however, all subsequent runs showed a significant reduction in amplitude and morphology as testing continued. This occurred in both ears and may be an indication of fatigue within the transmission of the auditory pathway.***

Minimal electrical/myogenic interference was observed in all conditions. This was deemed to not have an adverse effect on this test condition's reliability and morphology. Morphology and repeatability were considered good for all conditions. No significant asymmetry in latencies was observed consistently throughout testing.

Behavioral Observations:
[redacted] was cooperative, willingly participated in all of the auditory processing tests, and appeared to give her best effort with consistent reinforcement. Today's testing was judged with good reliability. Behavioral observations observed today did not appear to negatively affect testing reliability, diagnosis, or interpretation of results.

Impressions:
A **central auditory processing disorder (CAPD)** is diagnosed based on a pattern of repeatable deficit in one or more of the five auditory processing areas (i.e. Auditory figure-ground, auditory closure, binaural separation, binaural integration, and temporal processing). CAP deficits are a consistent abnormal finding in 2 or more tests for the *same* auditory processing area and must be present for formal CAPD diagnosis. A **central auditory processing weakness** is an abnormal finding that is not consistently observed in more than one test or that is borderline throughout the testing. CAP weakness may be an indication of

neurological immaturity within the auditory processing system, and although a formal CAPD diagnosis cannot be made based on weakness alone, management recommendations are similar to those for formal disorder.

Today's results demonstrate that [redacted] does have a diagnosis of Central Auditory Processing Disorder (CAPD) at this time in dichotic listening tasks, specifically in tasks of binaural integration. Additionally, she shows weaknesses in the area of auditory figure-ground, with consistent left sided weakness evident in all tests of this skill. [redacted] responses on the Cortical Auditory Evoked Potential (CAEP) show essentially normal latencies(i.e. Timing of the response) for all test conditions; however, the morphology (i.e. Size and shape of the response) reduces significantly over time and the responses fatigue very quickly with typical repitition of the presentation of speech stimuli.

The CAEP test is an objective measure of the neuromaturation of the higher auditory pathway and its ability to detect speech stimuli in quiet and a varying noise conditions. While this test cannot give a diagnosis of central auditory processing disorder, it does diagnose whether the "ipsilateral" central auditory nervous system (CANS) is functioning appropriately. Present CAEP recordings indicate that while [redacted] does have neural function of the ipsilateral (i.e. Same side) peripheral and cortical auditory pathways bilaterally, she shows responses similar to those of a younger child as well as auditory pathway fatigue with repeated presentations of speech. These findings suggest an inefficient neurotransmossion mechanism within the higher auditory pathway and the possibility of early fatigue to speech information with a slow recovery of the neural innervation of the system. These results further support the behavioral results that [redacted] has difficulty listening to speech in quiet and noise due to the intermittent responsiveness of the system, with binaural noise showing the greatest deficit. CAEP testing, however, does not evaluate the higher auditory pathway that crosses over the corpus callosum, which is responsible for the interhemispheric transfer of all sensory and higher executive function information. Major central auditory processing skill areas that are known to be adversely affected as a result of damage to this pathway are Dichotic Listening skills. Dichotic Listening skills are those skills utilized when meaningful auditory information is presented to the two ears at the same time. These skills are dependent on the ability of the two hemispheres of the brain to communicate with one another when information is presented to the two ears. This is done by the signal crossing over a band of neural fibers that connects the two brain hemispheres, called the corpus callosum. Behavioral testing of [redacted] dichotic listening skills are able to be performed (with modifications to reduce the impact of potential language deficits), and [redacted] shows a deficit in binaural integration. Dichotic Listening skills are documented to be adversely impacted when the corpus callosum is either absent, irreparably damaged, or surgically resected, and her behavioral testing results today further support this expectation.

As a result of her Right functional hemispherectomy and the resection of the corpus callosum, [redacted] is expected to have an atypical Right Ear Advantage when meaningful information is presented to both ears at the same time. Her CAP evaluation testing confirms this atypical Right Ear Advantage, which means that [redacted] has an easier time perceiving linguistic information presented to the Right ear than to the Left ear on dichotic listening tasks. "A general right ear-advantage (REA) for verbal information and a left ear advantage (LEA) for non-linguistic stimuli have been demonstrated in healthy individuals...The ear advantage is attributed to the dominance of the contralateral cerebral hemisphere for processing the stimuli (deBode et al., 2007)." A general right ear advantage is typical and most notable in younger children given that certain connections in the corpus callosum in the brain are still developing through early adolescence. The typical listening pathway to engage verbal language areas is dependent upon which ear receives the signal. In the majority of the population, the areas of the

brain responsible for receiving and comprehending language are located in the left hemisphere. When listening to a speech signal in the right ear, the signal travels through the peripheral auditory pathway, crosses over to the opposite side through the brainstem, and arrives at the left hemispheric language center for immediate processing. If the speech signal begins in the left ear, the signal travels in the same way but crosses the brainstem to the right side. The signal must go one extra step further and cross the corpus callosum to the left hemisphere for processing of language. In younger children, this pathway is less developed and, therefore, is slower and less efficient. This produces a lagtime effect, in which the child does not perceive as readily the speech signal presented simultaneously to the left side. It is only when the corpus callosum is fully developed in early adolescence that the speech signal can cross to the language center with almost the same timing regardless of the ear presentation. If the corpus callosum has been irreparably damaged or, as in the case with [redacted], has been completely severed, there is no ability for this neuromaturation to occur and there is a breakdown in this "linguistic neural bridge". This creates a permanent atypical right ear advantage (in other words left ear deficit), which extremely limits [redacted] ability to accurately detect and coordinate competing, meaningful messages. Also, factoring in slow processing speed, attentional concerns as well as language and memory deficits, and [redacted] ability to efficiently access linguistic information becomes greatly taxed.

[redacted] normal peripheral hearing may be deceiving in that she may seem as though she "hears" everything that is being verbally presented; however, her central auditory system shows major areas of deficit in its ability to efficiently "make sense" of the linguistic information. Given her auditory deficits in conjunction with other areas adversely impacted by her history of Epilepsy and brain surgery, [redacted] needs a small instructional setting for optimal processing of auditory and visual information. High noise levels can affect the ability to understand speech, decrease attention, affect reading ability, reduce on-task behavior, decrease achievement, and affect psychosocial behaviors (Crandell &Smaldino, 2000). Additionally, children with extensive cerebral involvement present with executive functioning deficits, which adversely impact their ability to plan, organize, and self-monitor. Behavioral treatment and appropriate academic supports and accommodations are essential. These include accommodations to greatly improve the instructional listening environment. Based on the recommendations indicated in the Educational Audiology Handbook (2012), "There are five acoustical factors most likely to affect speech perception in a dynamic classroom: (1) background noise, (2) signal or speech-to-noise ratio (SNR), (3) reverberation time, (4) talker-listener distance and directionality, and (5) interaction among these variables.... Variables that affect the listening process in the classroom include acoustical signals, potential barriers in the listening environment, and listener constraints (Bellis, 2005; Crandell & Smaldino, 2000b; Lasky, 1983; Nelson & Soli, 2000)." Given [redacted] history and current educational placement in a classroom of 30 students, all three of the variables that can adversely affect the listening process are a significant consideration for her. Although there is no single research study that defines plainly what is considered a small instructional environment, research studies of Tennessee's Program STAR and Wisconsin's SAGE strongly indicate a student-teacher ratio of approximately 13-17:1 be considered a small instructional environment. This is with the consideration that these are younger students with no diagnosed impediments to learning. However, the National Education Association states in their 2008 policy brief that the NEA "has taken a strong position in the class size debate. NEA supports a class size of 15 students in the earliest grades of regular school programs ***and even smaller classes in programs for students with exceptional needs.***"

Recommendations:

The following recommendations are offered to assist [redacted] at home and at school. Due to the diagnosis of a Central Auditory Processing Disorder (CAPD) and cortical auditory impairment, the recommendations listed for the classroom environment should be discussed with [redacted] educational audiologist and proactively incorporated into an IEP or 504 plan to aid in [redacted] academic success.

1. Per verbal consultation with Nemours Psychology Department, [redacted] may benefit from Cognitive-Behavioral Therapy (CBT) for treatment of her symptoms. CBT is a form of therapy that teaches thinking and behavioral strategies to reduce distressing emotions and improve behavior. Treatment may also involve instruction in the use of relaxation techniques to provide [redacted] with coping skills when she gets anxious and/or upset. High-quality treatment should involve establishing concrete treatment goals, measuring progress over time, and hypothesized mechanisms of change. Given [redacted] history of medical and neurological complexities, she would likely benefit most from working with a licensed clinical psychologist who specializes in children with medical conditions. Further discussion of this with her managing medical and psychology practitioners is advised.

2. Given [redacted] neurologically complex history, [redacted] is strongly recommended to have a complete language evaluation by a certified speech-language pathologist. The primary goals for this evaluation should be to baseline [redacted] speech and language skills (including pragmatics), to identify areas of strength, and to address any areas of weakness that could add further obstacles to learning. This can be requested through the school's speech pathologist, an independent speech-language pathologist in private practice, or through the Therapeutic and Rehabilitation Services Department at this facility at 302-651-6010 (option 2). Please indicate that [redacted] has been seen recently through the Audiology Department. Upon completion of the evaluation at this facility, the therapist will determine if speech language therapy and/or a specific listening therapy is/are recommended at this time based on candidacy criteria. **If you are scheduling a "speech-language evaluation" through Nemours, please note that a prescription or order from your pediatrician is required prior to making the appointment.**

3. Some games that [redacted] family can use to assist her in further development of overall language and vocabulary are: Scattergories, Taboo, Apples to Apples, Brain Quest, Password, Jeopardy, Knock Know Jokes, Rags to Riches, Mad Libs.

4. Due to her complex vision impairment and unique needs for modifications and accommodations, reading accommodations should be put into place based on specific visual accommodations noted on the neuropsychological report from [redacted] as well as the updated considerations noted by the current managing vision specialist.

5. Some games and activities that [redacted] family can use to assist in her in improving reading and spelling skills are: Hangman, crossword puzzles, word search, Scrabble, and Up words.

6. Because of the link between listening and literacy, reading aloud daily for 40 minutes, with special emphasis on animation, serves not only to increase reading aptitude but also to reinforce the use of rhythm, stress, and intonation in expressive language. This also helps strengthen overall comprehension as well as increases auditory memory skills. For younger children, the parent is encouraged to read at least 4-6 books daily to the child. To perform this exercise for a school age child, the child should read aloud a book at her current reading level to the parent for approximately 20 minutes. Then the parent should read to the child for an additional 20 minutes from a chapter book that is one or two grade levels above the child's current reading level. The child should be asked brief questions to ensure that she

comprehends the reading subject. Additionally, a journal is suggested be kept during the reading to jot down key words or unfamiliar vocabulary.

7. Listening to an audiobook to augment any visual reading assignments is recommended to further increase [redacted] reading comprehension but to also exercise her listening skills and auditory memory. This task may be challenging for [redacted]; however, the key to this exercise is consistent daily practice. A family member should be directly involved with this task in order to have [redacted] answer basic questions about the excerpt and summarize the chapter. Learningally.com and Bookshare.org are educational websites that are designed to provide educational reading materials in both the written and verbal language modalities. Other audiobook resources are attached at the end of this report for further reference.

8. Some games and activities that [redacted] family can use to assist her in improving auditory closure and discrimination skills are: Wheel of Fortune, Rhyme in Time, Simon, Catch Phrase.

9. Due to [redacted] sensitivity to louder sounds, she may benefit from incorporating noise/sound desensitization exercises as well as utilizing therapeutic listening exercises on CD (e.g. Sound Eaze, Vital Sounds) in any therapy regimen and at home. The desensitization exercises have been included at the end of this report and should be discussed further with an evaluating occupational therapist as appropriate. Sound Eaze is available for private purchase through online stores such as Amazon.com. Vital Sounds resources are available through vitalsounds.com and should be utilized in conjunction with a planned occupational or vestibular therapy program through a licensed therapist.

10. Due to her issues with dichotic listening deficits and increased difficulty understanding complex speech in noise, [redacted] is considered a strong candidate for assistive listening technology to improve the signal-to-noise ratio within the classroom. This can be provided for the child through one of several options including classroom soundfield amplification or a personal remote microphone worn at the ear level in left ear . A remote microphone (previously "FM system") allows the child to hear direct sound from a microphone transmitter worn by a parent or teacher. The receiver is worn on the child's ears. Assistive listening technology allows the child to discriminate important speech information clearly while reducing competing speech and distracting background noise (also known as improving the signal-to-noise ratio). Either an IEP or Section 504 of the Rehabilitation Act of 1973 should be implemented so that [redacted] is provided with this technology. *Based on the current research literature and evidence-based practice, amplification in the form of assistive listening devices may be recommended if a diagnosis of Central Auditory Processing Disorder (CAPD) is given. Based on limited success rate, Nemours Audiology Department policy will no longer include fitting traditional hearing aids for amplification on children who have normal peripheral hearing with a diagnosis of Central Auditory Processing Disorder (CAPD), cortical auditory impairment, or central hearing loss. If families are interested in this management methodology, they are encouraged to pursue this option with a qualified audiologist in this specialty at an outside facility.*

11. Due to [redacted] issues with CAPD, potential for heightened auditory distractibility, and poor speech understanding in the presence of noise, reduction of classroom ambient reverberation and visual distractions is advised at the parents' discretion. This can be done through physical modifications in the classroom environment such as carpet on the floor, latex-free stoppers on chair legs, curtains on windows, corkboard bulletin boards on walls. Also, a self-contained classroom setting (i.e. permanent wall structures that reach to the ceiling, closing doors) is strongly recommended instead of an open, unstructured learning

environment, which may increase ambient noise and unwanted visual distractions. An example of this open classroom environment would be classrooms that are held in a larger community room with multiple grades present and teaching simultaneously. Additionally, it may be beneficial for [redacted] to do seat work in a quiet area, such as a study carrel, during independent work sessions and study halls.

12. Strategic/preferential seating is strongly advised to reduce auditory and visual distractions. This also assists with increasing meaningful visual (such as visual aids, models, assignments on the chalkboard, etc.) to augment the more meaningful auditory signals (e.g. Teacher's speech) as well as auditory memory and organization. [redacted] **most beneficial seating arrangement may be in the front center of the classroom or with her better ear (right) toward the teacher in the front of the classroom. Careful consideration will need to be given to the fact that [redacted] right ear and right visual field are the stronger side; therefore, position should be adjusted to further maximize visual cues to augment verbal ones.** This recommendation assumes that the teacher's placement is also at the front of the classroom and should be adjusted for the

13. Because of the total impact that the hemispherectomy has had on [redacted] processing of visual and auditory information as well as executive functioning deficits, small instructional setting is strongly advised ***in addition*** to all other classroom modifications. Small instructional setting for children with no diagnosed impediments to learning is considered to have a 15:1 student teacher ratio; however, because [redacted] has multiple obstacles to learning, this ratio should be far more stringent and a 6-10:1 ratio is strongly advised.teacher's position accordingly.

14. [redacted] would benefit from "pre-teaching" of new information, particularly new subject vocabulary, as she would be able to familiarize to new words. An example of this is providing [redacted] with a list of homework assignments/new vocabulary and a written study guide (when possible) for the week. This would increase her recognition of sounds and words in a noisier classroom environment.

15. Multimodality presentation of instructions and new subject matter is advised, i.e. written directions and/or visual examples to augment the verbal information. Complement new concepts and information with visual aids, including projection overheads, computers, and smartboard/blackboard examples. Explain verbally while showing visually, e.g. give directions both speaking and in written form. If these are directions for chores, track on a written chore schedule at home.

16. Attempts to obtain [redacted] attention (cuing) prior to giving directions is advised for both school and home settings. This can be accomplished by saying [redacted] name while obtaining eye contact, using an assigned visual cue, or gently touching her shoulder to gain her attention just prior to the initiation of the instruction. Additionally, maximize visual cues and gestures to provide extra contextual information. Examples of this would be moving closer for face-to-face communication, keeping the mouth unblocked during speaking for lipreading clues, and speaking in a well lit area.

17. Instruction should be short, simple, and repeated as necessary. The understanding of verbal information for the average child is approximately 124 words a minute. Given that the average adult speaks using over 200 words a minute, a child often needs a slower rate of speech, with deliberate pauses, and a clear voice. If a child has hearing loss, language delays, or is listening as a non-native speaker, speech may need even further adjustments to allow the

child time to access the speech information. Reducing the instructional information to smaller units and presenting with a slower rate of speech will increase [redacted] ability to effectively listen to and follow verbal instruction. Instructors and therapists should be made aware that faster rates speech may cause more difficulty for [redacted] to accurately follow new instructions and unfamiliar topics. Speakers should allow for "thinking" time, which allows [redacted] ample time to respond.

18. Extra time for oral testing and in participating in activities with verbal instructions is strongly suggested.

19. As [redacted] begins to attend more lecture-based types of classes, she would benefit from recording of classes. This allows her to later review information that was missed due to auditory memory deficits or due to poorer listening environments.

20. Modeling and allowing practice attempts are important accommodations for children who may have weaknesses in areas of higher executive functions. [redacted] showed improvement in overall performance and within subtests themselves when the task was modeled and she was given an opportunity to practice and ask for clarification.

21. Due to expressed concerns regarding [redacted] difficulty following written, verbal, and/or multi-step instructions as well as issues with abstract thinking about future actions, [redacted] is encouraged to actively participate in games that develop the ability to think several steps ahead, which facilitates improved organization, memory, abstract thinking, and problem-solving skills. Examples of these games include chess, backgammon, checkers,and blokus.

22. Metacognitive techniques designed to strengthen memory and aid in item recall may be useful during classroom instruction and specialized therapy. Suggested tasks may include verbal rehearsal, chunking (breaking sentences in two or three parts with pauses in between the phrases), tag words (e.g. "first we start with", "second step is", "before you do", "next we", "after you"), and organizational aids.

23. Incorporating checklists and schedules in daily tasks are suggested to assist [redacted] working with organization and memory skills.

24. Develop and maintain routines and use consistent vocabulary and formats. This will also assist with organization as well as memory skills.

25. Due to the reported concerns for [redacted] elf esteem and anxiety, art therapy or music therapy may be an option for [redacted] in order to build confidence and focus attention. A board-certified art therapist can be found through the American Art Therapy Association website at www.arttherapy.org. Board-certified music therapists are available through the Certification Board for Music Therapists at their website www.cbmt.org.

26. Hearing protection in loud noise (greater than or equal to 85 dBA). Noise protection devices (earmuffs or foam earplugs) can be purchased at local hardware stores and pharmacies. The Noise Reduction Rating (NRR) on the hearing protection package is recommended to be equal to or greater than 25 dBA for effective hearing protection. Those participating in impact noise activities such as hammering devices should wear double hearing protection.

27. Conservative volume use for personal listening devices (i.e. IPODs, MP3 players). Volume

levels should be between minimum volume and the halfway point to maximum. To exceed these levels may cause permanent damage to the sensory hearing organs.

28. Due to the immature responses on the CAEP, a repeat of the hearing test and CAEP should be performed in 1-2 years. [redacted] parents can call audiology scheduling at 302-651-6043 in order to schedule this appointment.

Test results and recommendations were discussed with [redacted] mother and understanding was indicated. If there are further questions or concerns, please contact the clinic at 302-651-6043.

[redacted] Au.D. CCC-A
Pediatric Audiologist

Copy to:
Parent(s)
Pediatrician
[redacted]

Behavioral Desensitisation of Anxiety about Sound Exposure

"1. When the child becomes distressed by exposure to sound, move the child away from the sound source if possible and then comfort and reassure him/her.

2. Try to explain the source of the sound to the child.

3. The child's fear reaction will often diminish if s/he can exercise some control over the sounds. So encourage the child to clap his own hands, to play with noisemakers or to start and stop the vacuum cleaner at home.

4. Repeated gentle exposure to the noise may help the child to reduce anxiety and desensitise the auditory aspect of the sensitivity. You could tape-record one or more of the problem sounds (e.g. Laughter, clapping, thunder, sirens, machine-noise) and help him to switch the tape recorder to a very low volume. Gradually over a period of days or weeks the volume can be increased. **(See also the "Selective Listening Exercises" below to be incorporated with this step.)** Practice with the sounds under play conditions that the child can control, to help break the association of that sound with fear. This is not the same as unexpected exposure to the same sound, as people with hyperacusis do say that they can cope better if they are warned that a sound is about to occur, but it is helpful.

5. Children should not be forced to stay in a situation that is causing them obvious distress (for example during singing in assembly). This may compound their apprehension and make them associate that situation (e.g. The assembly hall) with pain. If fear of a specific situation has become established, it is important to gradually desensitise the child, with time and care...

The use of ear plugs, muffs or defenders should be avoided except in extreme or short-term, unavoidable situations (e.g. During a journey). ***Exposure to normal and tolerable sound is crucial if the ear and brain are to establish normal sensitivity.***"

Josephine Marriage, Ph.D. "Management Approaches to Hyperacusis in Children: Framework of Symptom Management". www.hyperacusis.net.

General directions for Selective Listening Exercises/Noise Desensitization

Materials:
Recording of background sounds containing approximately 3 minutes of each of the following kinds of sounds:

Level I – Nonverbal constant noise (ex. Fan, dishwasher, vacuum cleaner, hair dryer)
Level II – Nonverbal variable noises (ex. Washing dishes, crowd noise, recess)
Level III – Nonverbal music (ex. Classical, jazz)
Level IV – Verbal music (ex. Folk songs)
Level V- Verbal, nonmeaningful conversation (ex. Foreign language, philosophical readings)

Directions:
Place the sound source so that the sounds reach [redacted] ears equally. The volume should not be louder than a speaking voice.

Complete simple exercises first. [redacted] should be able to complete each task with at least 80% accuracy without the background noise. Once she can complete the tasks the volume of the sounds should be increased.

As she masters the simple exercises move into harder tasks at the same sound level, but beginning at the lowest volume.

Once [redacted] has mastered exercises with Level I sounds, it is appropriate to proceed to the level II sounds. Repeat exercises.

It is important to remember that this is slow process. [redacted] may or may not be able to fully focus when there are verbal stimuli present. It is also very important to listen and let her tell you if she believes that she is ready to proceed.

Hall, J.W. & Mueller, H.G. (1997). *Audiologist's Desk Reference Volume I.* Singular Publishing, San Diego, pp.558-559.