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EFFECTS OF ATTENTION AND MEMORY ON THE PROCESSING OF AUDITORY AND VISUAL INFORMATION

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ABSTRACT

There is much disagreement in the speech language hearing community on the diagnosis of auditory processing disorders. Most studies done on individuals' auditory processing abilities are strictly done in the auditory modality. Testing done strictly in the auditory modality makes it difficult to differentiate true deficits in auditory processing ability from deficits in other areas of higher order processing such as memory, language, and attention. It has been suggested throughout the literature that in order to obtain a true picture of an individual's auditory processing abilities, testing must also be done in additional modalities (i.e., visual). Therefore, this thesis examined adults' performance on both auditory and visual tasks that were designed to parallel each other. Increased attentional and memory demands were also put in place in attempt to differentiate between strict auditory and visual performance and the effects of attention and memory. Our results showed that performance on specific language tasks (i.e., nonword repetition tasks and backward digit span) might be a predictor of performance on auditory processing tasks. However, the effects attention and memory have on auditory processing abilities is still unclear.

TABLE OF CONTENTS

LIST OF TABLES

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Chapter 1

Literature Review

Auditory Processing Disorder Defined

Auditory processing disorder [APD] is defined as difficulty hearing and understanding speech in the absence of peripheral hearing loss or intellectual impairment (Maerlender, 2010). These deficits disrupt the auditory processing of acoustic, phonetic, and linguistic information, as well as affect a person's information processing from sound reception to discourse understanding (Jerger & Musiek, 2000). Under typical circumstances our central auditory processing system relays auditory information effectively and efficiently to our central nervous system (American Speech-Language-Hearing Association, 2005). Our central nervous system is then able to perform the following tasks: sound localization and lateralization; auditory discrimination; auditory pattern recognition; temporal aspects of audition, including temporal integration, temporal discrimination (e.g., temporal gap detection), temporal ordering, and temporal masking; auditory performance in competing acoustic signals (including dichotic listening); and auditory performance with degraded acoustic signals (American Speech-Language-Hearing Association, 2005). It is when there is a deficit in one or more of these skill areas of a properly functioning central nervous system, that we consider an individual to have an auditory processing disorder.

Prevalence of APD is an estimated 2%-3% of all children, with boys showing signs of this disorder twice as often as girls (Chermak & Musiek, 1997). Some of the behavioral correlates of APD include being easily distracted, having improved behavior and performance in quieter settings, demonstrating difficulty following directions and keeping up with conversations, frequently saying "huh"

or “what”, having difficulty listening and focusing when there is background noise present, and having poor auditory attention (Maerlender, 2010).

The Controversy Behind Auditory Processing Disorders

Although there has been much discussion and research throughout the speech-language-hearing community, researchers have consistently failed to come to a consensus on various topics in the area of auditory processing disorders (e.g. diagnosis and treatment techniques) (Cacace & McFarland, 2005). According to Cacace and McFarland (2005), this lack of consensus is due to the way APD is being researched. APD is strictly a disorder of auditory perceptual dysfunction, which is a modality specific dysfunction (Cacace & McFarland, 2005). In the past, researchers have failed to differentiate between deficits of processing acoustic information and deficits in phonological awareness, attention to auditory information, memory of auditory information, auditory synthesis, and comprehension and interpretation of presented auditory information (American Speech-Language-Hearing Association, 2005). According to the American Speech-Language-Hearing Association, these skill sets are considered higher order cognitive/communicative functions, and therefore are not included in the definition of APD. Here lies the issue that comes with properly diagnosing APD. How can researchers and clinicians be certain that they are in fact observing strict deficits in the central auditory processing system and not related cognitive/communicative systems?

Auditory Processing Disorder and Specific Language Impairment

Individuals who are thought to have an APD often experience deficiencies in reading, spelling, and expressive and receptive language (American Speech-Language-Hearing Association, 2005). These same deficits can be observed in individuals with specific language impairment [SLI] (Miller & Wagstaff,

2011). SLI can be defined as the impairment of comprehension of spoken language, production of spoken language, or both, in the absence of a physical hearing impairment, general developmental delay, or neurological dysfunction (Vandewalle, Boets, Ghesquiere, & Zink, 2012). However, the etiology of SLI is still a topic of great debate (Leonard, 2014).

There is mixed evidence on whether or not SLI is due to an underlying temporal auditory processing deficit (Vandewalle et al., 2012). In studies done by researchers such as Tallal (1999), it has been observed that children with SLI have problems processing rapidly presented auditory stimuli. However this observation is often refuted in studies such as Marshall, Ramus, & van der Lely's (2011) who observed no issues with auditory processing in children with SLI, as well as studies that suggest that if such auditory processing problems did exist they would not be present in the perception of non-speech stimuli (e.g., Bishop, Adams, Nation, & Rosen, 2005). To further complicate matters, other researchers conclude that auditory deficits are not causally related to SLI, but may occur in association with language disorders (Rosen, 2003). Overall, there is still much disagreement about APD and its relation to SLI within the field.

Auditory Processing Disorders and Attention

"Performance on any test can be influenced by a variety of factors including perception, memory, motivation, attention, linguistic abilities, and motor skills" (Cacace & McFarland, 1998, p. 356). In addition, individuals with APD have been characterized as being hyperactive, inattentive, and having short attention spans (Chermak & Musiek, 1992). It is suggested that individuals who are classified as having APD also have an attention deficit disorder [ADD] (Cacace & McFarland, 1998). Other researchers disagree with this statement and declare that the ADD label is a heterogeneous entity that has multiple underlying causes; it would be incorrect to state that there is a causal relationship between ADD and APD (Weinberg & Brumbeck, 1992).

There have been many different tests on ADD and behavior in regards to auditory processing that have yielded many different results. For example, in a study done by Ludlow, Cudahy, Bassich, and Brown (1983) researchers compared the auditory processing skills of several different groups of children with singular or combined impairments. They found that generally children with ADD/hyperactivity did more poorly on signal-detection tasks and temporal-order tasks than their non-attention disabled peers. However, other studies contradict this finding. Cacace and McFarland (1998) reported a study that found no difference in auditory processing abilities between groups of normal and ADD children on tasks requiring divided and focused attention for verbal material presented in a binaural, dichotic format.

The literature also examines the effects of noise distracters on auditory processing with individuals with ADD. In a study done by Geffner, Lucker, and Koch (1996) it was reported that children with ADD had more difficulty with monosyllabic word recognition than the control groups when noise distractors were presented both ipsilaterally (over headphones) and binaurally (in the sound field). However, other researchers claim that auditory distractors may actually improve performance on auditory processing in children with ADD (Abikoff, Courtney, Szeibel, & Koplewicz, 1996). This would suggest that distractibility and attention are task dependent.

Bendi, Halperin, and Sharma (1994) claim that distractibility is potentially modality-specific. Therefore, when evaluating the APD diagnosis in individuals with attentional problems, it is important to examine whether their inattentiveness is more pronounced with auditory stimuli versus stimuli presented in other sensory modalities (Cacace & McFarland, 1998). Therefore, researchers such as Shapiro and Herod (1994) suggest that in order to delineate APD from ADD during the diagnosis of APD one should include both auditory and visual tasks to improve the specificity of the diagnosis.

Auditory Processing Disorder and Memory

In addition to attention, other non-auditory abilities such as memory have been found to affect assessment of auditory processing (Cacace & McFarland, 2013). Studies done by Parkinson (1994) and colleagues suggest that short-term auditory memory and central auditory processing abilities are related based on the strong relationships between dichotic listening tasks and "digit memory" in college students. Other recent studies have yielded similar results. A correlation analysis done by Riccio, Cohen, Garrison, and Smith (2005) revealed a significant relationship between performance scores on the Staggered Spondaic Word [SSW] test and a memory for sentences test (Clinical Evaluation of Language Fundamentals, 3rd ed., Sentence Repetition {Semel, Wiig, & Secord, 1995}) in children. This led to the conclusion that the processing of auditory information does require the use of some elements of auditory memory.

Standardized Testing

Nonword Repetition

The nonword repetition test [NRT] is often used to measure phonological memory (Coady & Evans, 2008). According to Coady & Evans (2008), an individual's phonological memory is a contributor to their language abilities. Poor NRT scores have been strongly associated with SLI across numerous studies (Graf Estes, Evans, & Else-Quest, 2007). However, nonverbal working memory is not suspected to be depressed in individuals with APD (Miller & Wagstaff, 2011).

Digit Span

Digit span memory performance has a long history of being used in both experimental and clinical psychological research (Maerlender, 2010). Forward digit span tasks appear to activate the frontal cortex of the brain, specifically Broca's area (articulatory function), as well as the inferior parietal structures (Maerlender, 2010). A study by Gerton and colleagues showed that the left inferior parietal lobe is involved in short-term phonological storage (e.g., phoneme encoding, storage, & assembly) (Gerton, Brown, Meyer-Lindenberg, Kohn, Holt, & Olsen, 2004). Backward digit span tasks demonstrate more executive or frontal involvement. According to Maerlender (2010), there is a high correlation between digit span tests and audiometric tests used for diagnosing APD. Coupled with data from previous studies, Maerlender (2010) suggests that auditory short-term memory is a ubiquitous deficit in individuals with APD.

Frequency Pattern Test

The frequency pattern test [FPT] assesses an individual's ability to discriminate between frequencies, as well as their temporal sequencing abilities (Bellis, 2003). FPT's typically consist of one "high" and one "low" tone presented in a triplet where one tone differs from the other two tones in varying sequences (Miller & Wagstaff, 2011). For example, one triplet may be "high low low" and another "high low high". Presentation of an FPT may allow us a glimpse into an individual's auditory processing abilities.

A visual analog that parallels the FPT can be used to ensure that deficits found are specific to the auditory modality. This is important when assessing APD since it is a disorder of strict auditory dysfunction. In this study, the visual analog consist of one "light" grey rectangle and one "dark" gray rectangle presented in a triplet where one rectangle color differs from the other two rectangle colors in varying sequences. For example, one triple may be "dark light dark" and another may be "dark dark

light". Presentation of a visual analog may help to confirm that deficits lie only in the perception of auditory information, and not other areas of language or cognitive function.

Purpose of Study

As previously stated, current tests and diagnosis of APD lack a clear theoretical construct (Cacace & McFarland, 2013). Previous research also suggests that APD is a modality specific disorder, therefore testing needs to be done in multiple modalities. Using multi-modal testing methods will assist in distinguishing APD from cognitive, language based, and/or supramodal attentional and memory problems (Cacace & McFarland, 2005). The overarching purpose of this study is to investigate the roles attention and memory play in auditory tasks, as well as whether or not it is possible to distinguish auditory processing from attention and memory deficits. The end goal of this study is find answers to the following questions:

1.) How is a typical adult's performance on specific language tasks related to their performance on auditory processing tasks?

2.) Does the modality a discrimination task stimulus is presented in (auditory vs. visual) affect a typical adult's performance?

3.) Does presentation of a distractor affect the performance of a typical adult on a frequency pattern test and/or a visual analog task; and if so, what modality is most affected?

4.) Does a delayed response time, which increases the demand on one's working memory, affect the performance of a typical adult on a frequency pattern test and/or visual analog task; and if so, what modality is most affected?

Chapter 2

Methods

Research Design

The methodology that was implemented in this study included a battery of tests that required participants to come into the research lab. This design was chosen so that participant's auditory processing abilities could be directly measured.

Participants

This study required the use of human subjects. Participants were recruited via email that was sent out to special interest groups (e.g., The National Student Speech Language Hearing Association), as well as via flyers that were posted throughout Penn State's campus. After interest was expressed, participants were asked to fill out a screening questionnaire to ensure that they met the following criteria: (a) over the age of 18, (b) native, monolingual English speaker, (c) have not experienced a head injury or concussion in the past five to 10 years, (d) have never been told they have a neurological impairment, (f) have never been told they possess an auditory processing disorder nor have they been formally diagnosed with an auditory processing disorder, (g) have never been told that they may have or have been formally diagnosed with autism or a language impairment. Those who met the inclusionary criteria then received an explanation of what would happen throughout the study, and were required to sign a consent form before the testing took place.

Materials

Nonword Repetition Task

Dollaghan & Campbell's (1998) NRT was used to measure nonverbal working memory. The NRT consisted of 16 nonsense words (4 one-syllable items, 4 two-syllable items, 4 three-syllable items, and 4 four-syllable items). Stimuli were presented via an audio recording and participants were asked to repeat the nonsense word that was presented to them. For the purposes of this study, scoring was done by marking each individual NRT stimuli as correct or incorrect. In order to count as a correct response the participant had to produce every phoneme correctly. However, it is important to note that the task can also be scored on a phoneme-by-phoneme basis (Miller & Wagstaff, 2011).

Backward Digit Span

Semel's, Wiig's, and Secord's (2003) Clinical Evaluation of Language Fundamental's (4^{th} edition) was used to measure short-term memory. Participants were asked to repeat digit sequences of increasing length in the reverse order that they were presented to them. Each item had two subtests (*a* and *b*). The test was scored by awarding 1 point for each correct backward repeated digit sequence or 0 points for each incorrect backward repeated digit sequence. Participants reached a ceiling when they answered both subtests *a* and *b* incorrectly in the item, and the test was discontinued.

Frequency Pattern Test

A FPT (Musiek, 1994) was used to collect information on auditory processing abilities including frequency discrimination and temporal sequencing. Participants were presented with an audio recording of "high" (1122 Hz) and "low" (880 Hz) frequency tones, produced by Audiology Illustrated,

which included 30 groups of stimuli with subsets of three. In each stimulus group there were two frequency tones that were the same and one frequency tone that was different. After presentation of a stimulus item, participants were prompted to verbalize the sequence of the frequency tones in the triplet. Scoring was done on an all or nothing basis. If the participant correctly identified the order of the sequence they received 1 point. They did not receive a point for incorrect answers.

Visual Analog

As discussed earlier, multi-modal testing should be implemented in assessing auditory processing abilities. A visual analog to the FPT was designed by the author in attempts to differentiate auditory processing abilities from higher order cognitive/communicative skills. The visual analog was designed to visually correspond to the FPT. In order to do this, a PowerPoint presentation was created that consisted of "light" and "dark" colored grey rectangles to correspond to the "high" and "low" frequency tones of the FPT. Like the FPT, two rectangles were the same, and one was different. The presentation timing of the visual analog was matched as closely as possible to the presentation timing of the FPT. After presentation of a stimulus item, participants were prompted to verbalize the sequence of the colored rectangles in the triplet. Scoring was done on an all or nothing basis. If the participant correctly identified the order of the sequence they received 1 point. They did not receive a point for incorrect answers.

Manipulations

Other testing materials included various manipulations of the FPT and its visual analog. These manipulations included attention distractors and an increased demand on working memory in order to examine the effects of attention and memory on one's auditory processing abilities. The manipulations for attention included distractors that were inserted into both the FPT and its visual analog. The FPT

attention distractor consisted of a white PowerPoint slide that would randomly appear throughout the FPT[1]. A total of 10 attention distractors appeared randomly throughout the set of 30 stimuli. The attention distractor for the visual analog consisted of a buzzing sound. Again, there were a total of 10 attention distractors that appeared randomly throughout the groups of 30 stimuli. When these distractors were presented in both modalities, participants were asked to mark a tally on a piece of paper in attempts to ensure that the distractors were not ignored.

In order to manipulate the demand on participant's working memory, a delay in response time was utilized in both the auditory and visual modalities. Typically, participants were prompted to respond immediately after the stimuli were presented. This allowed for approximately a seven second response time. In attempts to increase the demands of working memory while completing these tasks, there was a delay in response time. After the groups of stimuli were presented there was a 2.5 second delay before participants were prompted to respond, leaving them with approximately 4.5 seconds to formulate a response. Scoring was done on an all or nothing basis. If the participant correctly identified the order of the sequence they received 1 point. They did not receive a point for incorrect answers.

Procedure

After consent was obtained formal testing could begin. Testing took place in a quiet room to avoid additional noise distractors. A digital audio recorder was used to record the session. All participants were first given the NRT followed by the backward digit span [BDS]. Presentation of the FPT and its visual analog was counterbalanced, meaning half of the participants were presented with the visual modality and its respective manipulations first while the other half of participants were presented with the

[1] It is important to note that the FPT was presented to participants via PowerPoint. Typically, a black screen was shown throughout the auditory testing. However, a white slide was implemented when manipulating attention.

auditory modality and its respective manipulations first. The non-manipulated test was always presented first in each respective modality, followed by varied orders of the two manipulated tasks.

Scoring Reliability

Testing was initially conducted and scored by the author. In order to ensure reliability an audio recorder recorded each testing session. A trained, undergraduate student in communication sciences and disorders also scored 50% of the tests to check for reliability. Tests that were scored a second time for reliability were selected randomly. Scoring reliability was 100%.

Chapter 3

Results

The Spearman's Rho correlation in conjunction with Cohen's (1988) guidelines for effect size of Pearson correlations was utilized to examine the relationships of the eight participants' performance on measures of NRT, BDS, FPT tasks, and visual analogs of the FPT tasks. In regards to the first research question (how is a typical adult's performance on specific language tasks related to their performance on auditory processing tasks?), we see that there is some correlation between a typical adult's performance on specific language tasks (i.e., NRT and BDS) and performance on auditory processing tasks. The only statistically significant correlation was between performance on the backward digit span and performance on the FPT, suggesting that working memory plays a role in the processing of auditory information; particularly frequency discrimination and temporal sequencing. For purposes of this study, the

significance level was set at $p < .025$. A more stringent p-level was set than conventional ($p < .05$) due to the large number of correlations. The statistical results can be found in Table 1.

Table 1: Spearman's Rho Correlations[2]

		FPT - ATT	FPT - MEM	FPT	VA – ATT	VA – MEM	VA	NRT	BDS
NRT	**rho**	-0.92	.136	.304	.118	-.103	.176	1.000	.242
	p	.828	.749	.456	.781	.809	.677		.564
BDS	**rho**	.522	.206	.806	.155	-.014	-.595	.242	1.000
	p	.184	.624	.016	.715	.937	.119	.564	

In regards to the second research question (does the modality a discrimination task stimulus is present in [auditory vs. visual] affect a typical adult's performance?), the answer is unclear. The effect the presentation modality (auditory vs. visual) of a discrimination task has on typical adult's performance was not able to be determined statistically. Data for the non-manipulated visual analog task was deemed uninterpretable because participants' scores were at ceiling.

The third research question that was posed considered how the presentation of a distractor would affect the performance of a typical adult on a FPT and/or a visual analog task. According to paired sample t-tests, there is no significant difference between performance on non-manipulated FPT tasks and attention manipulated FPT tasks [$t(7) = -1.72$, $p = .13$]. Statistical results can be seen in Tables 2 and 3. According to mean visual analog scores, participants scored the same with both the non-manipulated visual analog and the attention manipulated visual analog. The mean score for both tasks was 29.3 correct

[2] For all Tables: VA = Visual Analog, ATT = Attention, MEM = Memory

responses. Statistical results can be found in Tables 2 and 3. It is important to keep in mind that the validity of the visual analog data is in question.

Lastly, this experimental research aimed to examine the relationship between memory demands and auditory processing abilities. According to mean FPT scores, there was no significant difference on tasks where there was an increased demand on short-term memory [t(7) = -0.27, p = .79].Non-manipulated presentation of the FPT yielded a mean score of 27.3 correct responses with a standard deviation of 3.1. The manipulated presentation of the FPT (delayed response time) yielded a mean score of 27.5 correct responses with a standard deviation of 2.7. Statistical results can be found in Table 2 and 3. In visual analog performance, no difference between the non-manipulated and memory manipulated conditions was found [t(7) = 0.87, p = .41]. Statistical results can be found in Tables 2 and 3. However, remember to keep in mind that the validity of the visual analog scores is in question.

Table 2: Paired Sample Statistics: Mean and Std. Deviation

	Mean	*N*	*Std. Deviation*
FPT	27.2500	8	2.91548
FPT - ATT	28.6250	8	1.30247
FPT	27.2500	8	2.91548
FPT - MEM	27.5000	8	2.72554
VA	29.2500	8	2.12132
VA - ATT	29.2500	8	.70711
VA	29.2500	8	2.12132
VA - MEM	28.5000	8	.75593

Table 3: Paired Samples Test: t-test

Comparison	*t*	*df*	*p*
FPT vs. FPT - ATT	-1.718	7	.130
FPT vs. FPT - MEM	-.271	7	.794
VA vs. VA - ATT	.000	7	1.000
VA vs. VA - MEM	.871	7	.413

Chapter 4

Discussion

The initial hypothesis of this research experiment was that manipulations of both attention and memory in both modalities (auditory and visual) would yield a poorer performance by participants than the presentation of non-manipulated tasks. It was also suspected that that there should be no significant difference in performance in the auditory and visual modalities in individuals with normal auditory processing abilities.

In regards to the first research question (how is a typical adult's performance on specific language tasks related to their performance on auditory processing tasks?), we found that a typical adult's performance on specific language tasks (i.e., backward digit span) have large correlations with some auditory processing tasks. These statistical results can be seen in Table 1. According to the literature, specific language tasks and tasks of auditory processing should have no effect on each other because they are measuring two different areas of language. Specific language tasks examine higher order cognitive and communicative function while auditory processing tasks examine how auditory information is

processed in the brain without the influence of other language functions. However, it makes sense that there are some significant correlations, especially when considering the specific language tasks that were used. The tasks that were used to measure specific language functioning were the NRT and backward digit span. The NRT measures nonverbal working memory while the backward digit span measures short-term memory. The tasks used to examine auditory processing abilities were the FPT and the visual analog, both of which require some element of memory.

As previously mentioned, research results were not able to determine if the modality a discrimination task is presented in (auditory vs. visual) affects a typical adult's performance. This is because participants performed at ceiling on the non-manipulated visual analog tasks, making the results invalid. The hypothesized reason as to why participants performed so well is because the visual analog was not evenly matched in difficulty to the FPT. A direction for future research would be to design a task in the visual modality that exactly matches the difficulty of the FPT. Exactly matching the presentation of timing of the stimulus could potentially increase the difficulty to match that of the FPT's. In this research experiment the visual analog that was designed was just approximated in difficulty and timing, and was not exactly matched.

The hypothesized answer to the third research question (does the presentation of a distractor affect the performance of a typical adult on a FPT and/or visual analog task: and if so, what modality is most affected?) was that presentation of a distractor in both modalities would worsen the performance of a typical adult on those tasks. However, this was not the case. According to research results, presentation of a distractor either improved performance or had no affect on performance. These unexpected results may be contributed to weaknesses and limitations in the research study. First, the sample size that was tested was very small (8 participants) making it difficult to obtain a true picture of the effects of attention on auditory processing abilities. Second, the results of the visual analog tests have been deemed invalid. Lastly, this experimental research only looked at the attentional effects in the opposite modality of what was being tested. For example, the FPT attention distractor was presented in the visual modality and not

the auditory modality. This research did not consider the effects of inattention in the same modality. Suggestions for future research include obtaining a larger sample size, making sure the attention manipulation has been proven to be distracting, and manipulating attention in both the visual and auditory modalities for both the FPT and the visual analog.

As the research suggests, the processing of auditory information does require some element of memory. Therefore, it was hypothesized that a delayed response time, which increases the demand on one's working memory, would worsen participant's scores on both the FPT and the visual analog. The results show that this was true for the visual analog task, but not true for the FPT. . Similar to the weaknesses and limitations that were discussed with the presentation of an attention distractor this experimental research included a small sample size. A suggestion for future research would be to obtain a larger sample size as well as obtaining statistical evidence that delaying response time increases the demand on one's working memory. If this is not the case, future researchers will have to find other tasks that are known to affect one's working memory.

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ACADEMIC VITA

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Education

The Pennsylvania State University – University Park

- Bachelor of Science in Communication Sciences and Disorders| *Spring 2015*
- Minor: Special Education
- Schreyer Honors College

Academic Experience & Research

Honors Thesis

- Title: Effects of Attention and Memory on the Processing or Auditory and Visual Information
- Thesis Supervisor: Dr. Carol Miller

Aural Rehabilitation Honors Project

- Explored case studies with other honors students to further our knowledge and gain a deeper understanding or aural rehabilitation

Childhood Language Development Honors Project

- Researched information on cause, prevalence, characteristics, diagnosis, and treatment of childhood stuttering
- Presented research findings to communication sciences and disorders faculty and students

Deaf Culture Honors Project

- Researched and complied information on communication and education options for deaf children (ages 0-3) to present to parents at onset of their child's hearing loss

Honors and Awards

- 2014 Allegheny County Alumni Association Scholarship Recipient
- Dean's list 7/7 semesters

Leadership Experience

Undergraduate Teaching Assistant – Effective Speech

- Helped instruct 22 undergraduate students on the fundamentals of public speaking
- Created and graded quizzes
- Communicated effectively with professor and students

Chairman – Alpha Sigma Alpha Sorority, Epsilon Theta Chapter

- Planned social events with other university organizations; communicated effectively with other Greek chapters to plan Greek Week activities on campus; designed and ordered apparel from outside vendors

Association Memberships/Activities

National Student Speech Language Hearing Association – Member

- Volunteer with various community service projects (e.g., nursing home visits, operation smile, childhood literacy events)

Alpha Sigma Alpha Sorority, Epsilon Theta Chapter – Member

- Participate in a number of philanthropic events (e.g., Adopt-A-Highway, S. June Smith Center, Girls on the Run, Special Olympics)

Professional/Work Experience

Childcare Provider| *Present*

- Provide care for a 5 month old baby

America Reads – Our Lady of Victory Preschool| *Present*

- Conduct activities that build upon children's cognitive and reading abilities

Extended Day Services| *June 2013 – August 2014*

- Reviewed math and reading exercises with children adapting to the skill level of each individual child (grades K-7)
- Lead various summer camp activities

Penn State Behrend Early Learning Center| *December 2012 – May 2013*

- Provided a safe learning environment for children ages 6 weeks to 6 years in age