CONCEPT VOCABULARY IN CHILDREN WITH HEARING LOSS

by

Lauren Harper

Submitted in partial fulfillment of the

requirements for Departmental Honors in

the Department of Communication Sciences & Disorders

Texas Christian University

Fort Worth, Texas

May 2, 2022

CONCEPT VOCABULARY IN CHILDREN WITH HEARING LOSS

Project Approved:

Supervising Professor: Emily Lund, Ph.D.

Department of Communication Sciences and Disorders

Jean Rivera-Perez, Ph.D.

Department of Communication Sciences and Disorders

Lynn Hampton, Ph.D.

Department of John V. Roach Honors

ABSTRACT

Children with hearing loss (CHL) often struggle with vocabulary knowledge more than their normal hearing peers (Convertino et al., 2014; Davidson et al., 2013; Hayes et al., 2009; Lund, 2015; Nott et al., 2009; Tomblin et al., 2015). However, most vocabulary studies on CHL focus only on overall vocabulary outcomes. It is important to know the specific vocabulary that CHL struggle with as certain words are particularly crucial for academic success and creating complex syntax. When analyzing vocabulary knowledge, research should focus both on *what* is known and *how* words are used. The purpose of this study was to explore concept vocabulary knowledge in CHL as compared to children with normal hearing (CNH) by analyzing their expressive concept vocabulary in single-word, standardized testing versus in spontaneous language samples.

Children with hearing loss tend to struggle with vocabulary knowledge more than their normal hearing peers (Convertino et al., 2014; Davidson et al., 2013; Hayes et al., 2009; Lund, 2015; Nott et al., 2009; Tomblin et al., 2015). However, there is a gap in modern research regarding the various types of vocabulary knowledge struggles exhibited in these children, because most vocabulary studies in children with hearing loss focus only on overall vocabulary outcomes, not types of words that present particular challenges. Knowing the types of vocabulary that children with hearing loss struggle with is important to note as certain types of words are particularly crucial for both academic success and creation of complex sentences. For example, concept words are highly important in helping a child conjoin clauses, understand directions, and more. When analyzing a child's vocabulary knowledge, research should focus both on *what* is known and *how* words are used. The purpose of this study is to explore concept vocabulary knowledge in children with hearing loss as compared to children with normal hearing by analyzing their expressive knowledge of concept vocabulary in single-word, standardized testing versus their use of concept vocabulary in spontaneous language samples.

Vocabulary in Children with Hearing Loss

Although children with hearing loss present varied audiological profiles relative to type, degree, or technological support for their hearing loss, a majority present with delays in vocabulary acquisition (Convertino et al., 2014; Lund, 2015; Nott, et al., 2009). Overall, children with hearing loss tend to perform lower on vocabulary related tasks than their normal hearing peers (Convertino et al., 2014; Davidson et al., 2013; Hayes et al., 2009; Lund, 2015; Nott et al., 2009). This finding holds true for various methods of assessing vocabulary knowledge, including diary-based vocabulary reporting (e.g., Nott et al., 2009), single-word norm-referenced vocabulary assessment (Davidson et al., 2013; Hayes et al., 2009), vocabulary identification through picture labeling (Convertino et al., 2014), fill-in-the-blank using definitions (Convertino et al., 2014), fill-in-the-blank with sample sentences (Convertino et al., 2014), and in studies using meta-analytic techniques (Lund, 2015). Because children with hearing loss cannot hear as well as their peers, it is understandable that they would have a difficult time accumulating vocabulary words at the same rate as their same-age peers without hearing loss. Furthermore, different factors such as severity and age of cochlear implantation have been shown to influence vocabulary outcomes (Geers et al., 2009; Hayes et al., 2009; Lockhurst et al., 2013; Moeller et al., 2007; Tomblin et al., 2015). Difficulties in understanding and use of vocabulary words increase as the severity of the hearing loss increases (Tomblin et al., 2015). It is clear that different degrees of hearing loss create barriers to vocabulary growth and that not every child with hearing loss will require the same amount of support to enhance their vocabulary skills.

Age at amplification, particularly if a child needs cochlear implants to access speech sounds, may contribute to a child's vocabulary outcomes. However, the research supporting this position as a leading cause of vocabulary struggles is disparate. Although some research shows that an earlier age of implant correlates with a larger range of vocabulary in children with hearing loss (Connor et al., 2006; Geers er al., 2009; Hayes et al., 2009; Luckhurst et al., 2013), other studies assert that age of implantation has no lasting effect on vocabulary outcomes for this population; but rather, a larger proportion of children with hearing loss will struggle with vocabulary regardless of age at amplification (Convertino et al., 2014; El-Hakim et al., 2001; Lund, 2016; Nott et al., 2009). It is clear then, that research must address not only whether children with hearing loss experience delays in quantity of vocabulary knowledge, but also whether they experience difficulties with certain types of vocabulary knowledge.

Conceptual Vocabulary Knowledge and Children with Hearing Loss

Concept words are a type of vocabulary knowledge that is difficult to acquire even for children without hearing loss (e.g., Schwanenflugel & Akin, 1994), but that influences academic and complex language performance. Concept words are vocabulary that essentially represent abstract ideas whose meaning changes based on a word referent (Boehm, 1991). For example, the word big changes relative to the context surrounding it: a phone is relatively big when compared to an ant, but a phone is small when compared to an elephant. Basic concepts act as a foundation of later language skills across many domains of language: they support use of complex syntax for example.

A small number of studies have considered the conceptual vocabulary knowledge of children with hearing loss. Moeller and colleagues (2007) found that the degree of loss may have a negative correlation with children’s understanding of conceptual categories. This finding would indicate that, as with general vocabulary performance, children with hearing loss exhibit lower performance on concept vocabulary as their degree of hearing loss increases. Children’s conceptual vocabulary knowledge may also be affected by the quantity of adult language that are exposed to. According to Rufsvold et al. (2018), the more adult input received by the deaf or hard of hearing child, the stronger that child’s knowledge of vocabulary and basic concepts. This study analyzed 41 children between 36 and 50 months of age, including children with hearing loss who use cochlear implants, hearing aids, and no technology. The study analyzed various demographics that could affect the children’s understanding of basic concepts, but these factors were secondary to the central variable of quantity. In another study, however, when gender, degree of hearing loss, aided pure tone average, paternal education, and income were controlled, no significant effect of adult language input on a child's understanding of basic concepts and vocabulary was found (Arora et al., 2020).

To combat the overall decreased performance in concept understanding and use, studies have shown that direct instruction and intervention have been successful in creating significant improvements in the students' ability to recognize, produce, and comprehend these concept words and phrases (Dimling, 2010; Lund et al., 2020). In the study conducted by Dimling (2010), six students were analyzed, all being in the second grade in a Midwest school and possessing a bilateral sensorineural hearing loss. This study measured variables of recognition, production, and comprehension, conducted through recognition tests, word/phrase cards, and semantic mapping activities. In the study conducted by Lund and colleagues (2020), 27 children with hearing loss were compared to 37 children with normal hearing, analyzing them through the PWPA measure, the Print knowledge subtest of the Phonological Awareness Literacy Screening-PreK (PALS-PreK), and the print-knowledge questions for the TOPEL. The vocabulary used on the tests was cross-referenced with words from both the BBCS-3 and the Boehm Test of Basic Concepts. Although these children face a struggle with their conceptual vocabulary acquisition, these studies demonstrate that there is hope for them to make improvements. In the study conducted by Bowers and Schwarz (2013), four children from a deaf-centered preschool program were tested through the administration of the Wiig Assessment of Basic Concepts (WABC) and an experimental basic concept-curriculum based measure (BC-CBM). This study confirmed the findings of previous researchers that children who are deaf and hard of hearing have deficits in basic concept understanding as well as showed support for intervention to make improvements in this area and for the development of more broad-scale testing using BC-CBM. Through studies like these, it is apparent that children with hearing loss not only struggle with general vocabulary but concept vocabulary as well, and they can improve their skills despite this delay if given proper instruction and intervention.

Real-life Use of Concept Vocabulary

Knowing that children with hearing loss have a higher chance of difficulties with learning concept vocabulary, it is important to note the various uses of concept vocabulary in daily life. Concept words are crucial for understanding directions, succeeding in the classroom, developing early reading skills, and performing well on standardized tests (e.g., Bowers and Schwarz, 2012). Concept vocabulary is a critical aspect of a child's language as it is also the basis for various aspects of syntax, for understanding math concepts, and for understanding and using spoken language. For example, a child would need to know the concepts of *before* and *after* when creating specific subordinating clauses that include these vocabulary words. A child would need to understand concepts of addition and subtraction and related basic concepts like *together* or *a piece of* to have success in their math classes. They would need to understand words like *above, under, close, and open* to be able follow the directions of their teachers (Bracken and Crawford, 2010). In this study conducted by Bracken and Crawford (2010), various concepts and categories taught in the US education system were highlighted, describing the importance for the inclusion of these words and categories in the education of young children, including but not limited to colors, letters, numbers/counting, sizes/comparisons, and self-and social-awareness. All of these concept categories are integral to the success of children in their daily lives and schooling.

Throughout children's lives in school and outside of it, concept vocabulary is a guiding light for understanding the world around them.

Concept knowledge can also be important when analyzing a child's preparedness and success in their schoolwork. Piersel and McAndrews (1982), for example, found that there was a strong positive correlation in the relationship between student performance on the Boehm Test of Basic Concepts and children's kindergarten readiness skills and first grade achievement. In their study, they analyzed a group of 70 girls and 53 boys in kindergarten from the southwestern United States who were tested prior to and post-kindergarten using the Boehm Test of Basic Concepts. Tests from the McCarthy Scales of Children's Abilities and a criterion-referenced test created by the school district to assess basic skills related to the curriculum for that year. These results provide support and validation for using the Boehm Test of Basic Concepts as a predictor for current and future success in school as well as for the general idea that concepts are important to the general success of children academically. Another study indicated that there was a positive correlation between children's concept knowledge and their achievement outcomes in both math and literacy, as monitored through self-reports and teacher-reports (Magi et al., 2009). Both of these studies indicate that a strong understanding of concept knowledge helps children to make achievements in different aspects of their schoolwork.

Concept Vocabulary and Spoken Language Outcomes

Because vocabulary is a skill that underlies other language domains, it is important to think about how vocabulary delays may contribute to other skill delays. In the case of conceptual vocabulary, it is important to consider whether it is likely to contribute to delays in complex syntax development. Children with hearing loss have a documented deficit in syntax knowledge, both relative to language production and comprehension, regardless of culture or language (Mandal et al., 2016; Spencer, 2004). Knowing that children with hearing loss experience a general delay in syntax opens up opportunities to explore which aspects of syntax may be particularly troublesome and if any of those elements could be related to a delay in basic concept knowledge. A study conducted by Cannon and Kirby (2013) shows that many children with hearing loss struggle with using regular nouns in singular and plural forms and with using correct noun-verb agreement of the copular form of the verb "to be." These deficits are not necessarily predictable from struggles with complex syntax use.

In another study conducted by Werfel et al. (2021), researchers specifically analyzed the complex syntax production of a group of 72 four-year-old children with bilateral hearing loss in comparison to their normal hearing peers matched either by chronological age or by MLU. This study concluded that the children with hearing loss demonstrated delays in complex syntax acquisition relative to their peers in both areas of same-age and same-MLU, based on their use of this language in spontaneous speech.

Complex syntax deficits could more clearly be associated (and possibly predicted by) conceptual vocabulary knowledge deficits. To date, no research has considered whether conceptual vocabulary of children with hearing loss appears to contribute to complex syntax outcomes, particularly for those types of clauses that likely rely heavily on basic concepts.

<u>The Present Study</u>

To consider how vocabulary knowledge might contribute to spoken language outcomes, that knowledge must be considered in a structured, elicited context (e.g., an assessment that directly tests child knowledge of vocabulary) and in more spontaneous conversation. The purpose of this study is to consider how spoken language, conceptual vocabulary knowledge differs between children with and without hearing loss across single-word vocabulary knowledge assessments and standardized language samples. Understanding how vocabulary contributes to spoken language use will help interventionists to know if working on one skill (e.g., concept vocabulary) is likely to affect multiple domains of language knowledge (e.g., complex syntax) and could guide future intervention research. This study seeks to address the following research questions:

a) Do children with hearing loss (cochlear implants or hearing aids) perform lower on single-word measures of conceptual vocabulary knowledge than children with normal hearing matched for age?
b) Do children with hearing loss (cochlear implants or hearing aids) use fewer conceptual vocabulary words in language samples than children with normal hearing matched for age?
c) Between age four and age six, do children with hearing loss and children with normal hearing grow in their knowledge of concept vocabulary words?
d) For children with and without hearing loss, is there a correlation between their single-word knowledge of concept vocabulary and their use of concept vocabulary in language samples?
e) When they use concept vocabulary words, do children with hearing loss embed those words in complex syntax less often than children with normal hearing?

Method

Participants

This study analyzed data from elementary school participants from a larger longitudinal study: The Early Language and Literacy Acquisition in children who are Deaf or Hard of Hearing study (ELLA). The ELLA study focuses on tracking the acquisition of emergent literacy skills of children with and without hearing loss both throughout their preschool and elementary school years. After reviewing qualifying participants, the present analysis included 69 children total, including 32 children with normal hearing and 37 children with hearing loss (divided into 16 children with cochlear implants and 21 children with hearing aids). These children were from multiple states, spanning all regions (Northeast, Midwest, South, and West) across the continental United States.

Children were grouped according to their amplification status because (a) there tends to be a different age of identification and receipt of amplification in children who are eligible for cochlear amplification than those with hearing aids (e.g., Walker et al., 2017), and (b) because there are some slight differences in the auditory signal and the outcomes of consequent speech perception from cochlear implants than from a hearing aid (e.g., Goldsworthy & Markle, 2019). There were some participants who wear both a hearing aid and a cochlear implant but were part of the cochlear implant group classification due to their qualification for a cochlear implant being determined by their degree of loss. All of the participants used spoken language as their primary form of communication, because this is an inclusion criterion for the ELLA study. Children in the ELLA study were recruited through clinical connections and social media, such as groups for children with hearing loss. For this particular paper, children's performances were analyzed after completing their first time-point of testing the longitudinal study. Within the ELLA study sample, 34.04% of children with cochlear implants, 28.88% of children with hearing aids, and

28.79% of children with normal hearing are from areas classified as eligible for a rural health grant, whereas the rest live in suburban and urban areas.

Within the ELLA study, there is not significant variation amongst average caregiver (parent) education level by amplification type (F(2,146=1.01, p=.37), a finding that we expected results of this study to mirror.

English was spoken primarily by caregivers across all groups (at least 70% of the time as this was a benchmark for enrollment in the larger study). As in the overall ELLA study sample, we anticipated that some children would have experience with exposure to manual modes of communication (SEE/ASL).

Parents also reported on any co-morbidities. In the CI group, one child had a comorbid ADHD diagnoses and another child had agenesis of the corpus collosum as well as a history of learning disability. In the HA group, one child displayed comorbid fine motor delays, another child had cerebral palsy, and a third child had spina bifida (and these comorbidities did not affect their ability to complete assessments). There were no reports of additional diagnoses within either TH group.

Measures and Procedures

Descriptive Measures

In order to understand their mental, speech, and language abilities, participants completed several descriptive measures.

Nonverbal intelligence. To measure nonverbal intelligence, the Primary Test of Nonverbal Intelligence (Ehrler & McGhee, 2008) was used. Participants selected drawings that did not fit in from an arrangement of line drawings.

Speech sound production. To measure speech sound production, the Arizona Articulation Proficiency Scale-Third Edition or Fourth Edition (Fudala, 2000; Fudala & Stegall, 2017) was used. Participants were asked to name pictures after being shown an arrangement of line drawings.

Spoken language. To measure omnibus spoken language, the Test of Early Language Development-Third Edition or Fourth Edition (Hresko et al., 1999, 2018) was used. Expressive Language and Receptive Language subtests were included on both versions of the test.

To measure expressive vocabulary, the Expressive One-Word Picture Vocabulary Test-Fourth Edition (Brownell, 2011) was used. Participants were asked to name pictures from line drawings shown to them by the examiner.

To measure receptive vocabulary, the Peabody Picture Vocabulary Test-Fourth Edition or Fifth Edition (D. Dunn, 2018; L. Dunn & Dunn, 2007) was used. Participants were asked to point to a picture named by the examiner from an arrangement of four pictures.

Concept Vocabulary Measure

To measure receptive concept vocabulary understanding, children were assessed using the Bracken Basic Concept Scale – Third Edition (Bracken, 2006). The test was administered to children between ages 3 years, 0 months through 6 years, 11 months. There are 10 subtests, but this study only used the subtests in the following categories: Sizes/Comparisons, Direction/Position, Self-/Social Awareness, Quantity, and Time/Sequence. The Sizes/Comparisons subtest involves concepts used to describe things in one, two, or three dimensions as well as measures the child's ability to find similarities and differences between objects based on their characteristics. The Direction/Position subtest is made of relational terms that children use to describe object placement relative to other objects (e.g. under), an object's relative position to itself (e.g. open), or placement direction (e.g. center). The Self-/Social Awareness subtest measures concepts relating to the child's emotional state (e.g. angry) as well as vocabulary that helps them to express kinship, gender, relative ages, and social appropriateness (e.g. mother, young). The Quantity subtest measures vocabulary that is used to "describe the degree to which objects exist and the space that these objects occupy" (e.g. full) as well as measures the child's ability to understand that quantities can be manipulated (e.g. more than). The Time/Sequence subtest includes vocabulary to describe temporal or sequential occurrences and the degree of speed and/or order that those events occur in that temporal continuum (e.g. first). The examiner showed the child a set of pictures and ask them to show them which one represents a certain concept (e.g. "Which animal is big?"). This test was selected due its extensive list of concept vocabulary words.

Language Sample Elicitation

The study used the Hadley (1998) protocol due its use of expository and story retelling contexts for language samples which elicit more diverse utterances and a greater range of linguistic features in comparison to using play-based language samples (Evans & Craig, 1992; Masterson & Kahmi, 1991).

Each child's language sample consisted of three blocks and each were around 12 min long total (mean time = 12 min 52 s, *SD* = 45 s). The first 4-min block focused on personal narratives about a birthday party or recent holiday, as well as accounts about the participant's siblings or other family members. The second 4-min block focused on expository descriptions about taking care of a pet and playing a favorite game. The last 4-min block focused on retelling a story of the participant's favorite movies and/or books.

Language Sample Transcription

Language samples were transcribed by trained lab members or SALT Transcription Services, according to procedures described by Werfel (2018). Three passes were involved in the language sample transcription procedures. The first pass involved transcribing the dialogue. The second pass involved cleaning up the transcription. The final pass was an ultimate check of accuracy in transcription. Utterance division followed the standards described in Werfel and Douglas (2017).

Language Sample Coding

After finalizing the transcription process, the language sample was coded for concept words and complex syntax within utterances containing concept words.

Concept Vocabulary. Language samples were searched for use of words from the Bracken Basic Concept Scale – Third Edition (Bracken, 2006), specifically for words used in the following subtests: Sizes/Comparisons (e.g. different, similar, alike), Direction/Position (e.g. open, around, following), Self-/Social Awareness (e.g. angry, wrong, difficult), Quantity (e.g. many, both, neither), and Time/Sequence (e.g. beginning, twice, before). These words were highlighted throughout the sample, marked in brackets, and counted.

Complex Syntax. Sentences containing concept vocabulary words were pulled from the sample and were coded as having complex syntax or not. Complex syntax was coded according to the procedures outlined in Schuele (2009). Percent of utterances with concept words in them that also contained complex syntax was calculated for each child.

Analysis

To answer the first, second and third research questions, BBCS scores (question one) and number of conceptual vocabulary words in the language sample (question two) for all children was entered into an analysis of variance (ANOVA) as dependent variables, with group (cochlear implant, hearing aid, or normal hearing) as the between-subjects independent variable and time (age four or age six) as the within-subjects independent variable. The main effect of group determined the answers for question one and two, and the main effect of time and interaction effects answered the third question. Follow-up linear contrasts were used with a Bonferroni correction for multiple comparisons.

To answer the fourth question, Pearson correlations were run for each group comparing scores on the BBCS and number of concept words in language sample. To answer the fifth research question, percent of sentences with concept words that also contain complex syntax was calculated for each child and entered into a one-way ANOVA calculation with group as the between-subjects independent variable.

Reliability

Lab members were trained to score the Bracken Basic Concept Scale (BBCS). These members then re-scored at least one third of the BBCS forms from the ELLA study to ensure scoring accuracy. Lab members were also trained prior to the start of language sample coding responsibilities. SALT Transcription Services will analyze language sample transcriptions, the accuracy of which has been verified in other ELLA studies (see Werfel et al., 2021). Within the language samples, lab members were taught to identify concept words from a pre-set list (described above) in utterances across the sample. For one-third of the language samples, lab members independently verified that (a) all concept words were appropriately identified in the sample and (b) that all instances of complex syntax were identified and appropriately coded.

Results

The first research question of this study asked if children with hearing loss (hearing aids or cochlear implants) perform lower on single-word measures of conceptual vocabulary knowledge than children with normal hearing matched for age. The second research question asked if children with hearing loss (hearing aids or cochlear implants) use fewer conceptual vocabulary words in language samples than children with normal hearing matched for age. The third research question asked if children with hearing loss (hearing aids or cochlear implants) and children with normal hearing grow in their knowledge of concept vocabulary words between age four and age six. In regard to questions 1 and 3, data from participants' performance on the Bracken measure was entered into a repeated-measures analysis of variance with raw score on the individual Bracken subtests as the dependent variable, group (NH, HA, CI) as the between-subjects independent variable and time (Time 1 or Time 5) as the within-subjects independent variable. For question 2, the dependent variable was the number of concept words from the individual language samples.

For the Sizes/Comparisons subtest of the BBCS, the analysis yielded a significant main effect of time ($F(1,64) = 27.40$, $p < .01$) and of group ($F(2,64) = 3.95$, $p = .024$) but not an interaction effect of time and group ($F(2,64) = .948$, $p = .40$). For significant group differences, a post-hoc, Bonferroni-corrected analysis was completed. The NH group had a significantly higher performance than the CI group ($p = .032$) but not than the group with HA ($p = .194$). The CI and HA groups did not significantly differ ($p = 1.00$). Thus, children grew in their knowledge of size/comparison vocabulary, and children with cochlear implants knew fewer words than children in the NH group at both Time 1 and Time 5.

For the Direction/Position subtest of the BBCS, the analysis yielded a significant main effect of time (F(1,65) = 110.486, p < .01) and of group (F(2,65) = 5.463, p = .006) but not an interaction effect of time and group (F(2,65) = 11.207, p = .423). For significant group differences, a post-hoc, Bonferroni-corrected analysis was completed. The NH group had a significantly higher performance than the CI group (p = .006) but not than the group with HA (p = .250). The CI and HA groups did not significantly differ (p = .872). Again, children with CI had lower knowledge of direction/ position words than children in the NH group at both Time 1 and Time, but all groups grew in their vocabulary knowledge.

For the Self-/Social Awareness subtest of the BBCS, the analysis yielded a significant main effect of time (F(1,65) = 100.718, p < .01) and of group (F(2,65) = 6.253, p = .003) but not an interaction effect of time and group (F(2,65) = .958, p = .389). For significant group differences, a post-hoc, Bonferroni-corrected analysis was completed. The NH group had a significantly higher performance than the CI group (p = .003) but not than the group with HA (p = .137). The CI and HA groups did not significantly differ (p = 1.00). This pattern of performance again indicated that, over time, the CI group had less knowledge of self and social awareness vocabulary than children with NH, and all groups grew in knowledge between Times 1 and 5.

For the Quantity subtest of the BBCS, the analysis yielded a significant main effect of time (F(1,65) = 152.238, p < .01), of group (F (2,65) = 15.233, p < .01), and an interaction effect of time and group (F(2,65) = 12.339, p < .01). For significant group differences, a post-hoc, Bonferroni-corrected analysis was completed. The NH group had a significantly higher performance than both the CI group (p < .01) and the HA group (p = .016). The CI and HA groups did not significantly differ (p = .217). Additionally, the NH group grew more quickly from Time 1 to Time 5 than did the groups with hearing loss, as demonstrated in Figure 3.

For the Time/Sequence section of the BBCS, the analysis yielded a significant main effect of time ($F(1,65) = 167.978$, $p < .01$) and of group ($F(2,65) = 9.718$, $p < .01$) but not an interaction effect of time and group ($F(2,65) = 1.135$, $p = .327$). For significant group differences, a post-hoc, Bonferroni-corrected analysis was completed. The NH group had a significantly higher performance than both the CI group ($p < .01$) and the HA group ($p = .049$). The CI and HA groups did not significantly differ ($p = .612$). Again, all groups grew in knowledge between Time 1 and Time 5.

In regard to question 2, data from the participants' performance on the language samples measure was entered into a univariate analysis of variance with number of concept words as the dependent variable and group (NH, HA, CI) as the between-subjects independent variable. The analysis did not yield a significant main effect of group ($F(2,84) = 1.650$, $p = .198$). Therefore, there was not a significant difference in use of concept vocabulary in language samples between children with and without hearing loss.

Recall that question 4 asked whether or not there exists a correlation between single-word knowledge of concept vocabulary and use of concept vocabulary in language samples for children with and without hearing loss. A Pearson Correlation was calculated comparing total number concept words used in the language sample and performance on each subtest of the BCBS. Language sample use of concept words was significantly correlated with all subtests except the Quantity subtest. Table XX shows individual correlation values. Language sample use of concept words was also significantly correlated with the overall total raw scores from the BBCS ($R = .483$, $p <.01$).

Subtest	Correlation with Language Sample Concepts
Sizes/Comparisons	*R* = .350, *p* = .002
Direction/Position	*R* = .386, *p* = .001
Self-Social Awareness	*R* = .495, *p* < .01
Quantity	*R* = .405, *p* = .171
Time/Sequence	*R* = .455, *p* = .015

Recall that question 5 of this study asked if children with hearing loss embed concept vocabulary in complex syntax less often than children with normal hearing. For this question, data from the participants' performance on the language samples measure was entered into a univariate analysis of variance with percent of complex syntax in sentences with concept words as the dependent variable and group (NH, HA, CI) as the between-subjects independent variable. The analysis did not yield a significant main effect of group ($F(2,82) = .324$, $p = .724$).

Discussion

Recall the purpose of this study is to explore concept vocabulary knowledge in children with hearing loss in comparison to their normal hearing peers through an analysis of their expressive knowledge of concept vocabulary in a single-word measure and use in a spontaneous language sample.

The first question of this study asked if children with hearing loss perform lower on single-word measures of conceptual vocabulary knowledge than children with normal hearing matched for age. As seen in Figure 1, children with hearing loss tend to perform lower on single-word measures of conceptual vocabulary than their normal hearing peers. Due to this lower concept vocabulary knowledge amongst the children with hearing loss, it can be expected that they would be put at a disadvantage in concepts used often in their schoolwork and learning. This set of graphs also shows that children amongst all groups have the strongest knowledge of Direction/Position words. The graphs also illustrate that all of the groups have room to grow as each one progressed over time.

The second question of this study asked if children with hearing loss use fewer conceptual vocabulary words in language samples than children with hearing matched for age. Based on the results, the use of concept vocabulary in the language samples did not prove to have a significant difference between any of the groups of children with and without hearing loss. However, it should be noted and can be seen on Figure 3 that there is a numerical and visual difference between the levels of concept vocabulary in the language samples and BBCS scores.

The third question of this study asked if children with hearing loss and children with normal hearing grow in their knowledge of concept vocabulary words between ages four and six. For all of the subtests on the BBCS, children across all groups grew in their knowledge of concept vocabulary between Time 1 and Time 5, as shown in Figure 1. Though this positive growth rate amongst all groups demonstrates an ability to grow and enhance their vocabulary, it is still concerning that the children with hearing loss stay behind their normal hearing peers. These children are their peers and classmates, so this delay could present disadvantages in the classroom for the children with hearing loss. It is also important to note that the children with normal hearing grew at a significantly quicker rate than the children with hearing loss during this time, as shown in Figure 3. This difference could likely be related to the children’s math skills, as many of the vocabulary words on the Quantity section of the BBCS are used often for math. If this were true, this data could also indicate a deficit in math skills from the children with hearing loss. Once again, this data shows that children with hearing loss may be at risk for disadvantages in the classroom.

The fourth question of this study asked if a correlation exists between single-word knowledge and use of concept vocabulary from children with and without hearing loss. A significant correlation was proven between total raw scores on the single-word measure and number of concept vocabulary words in the language sample. A significant correlation was also found between each subtest, with the exception of Quantity, and overall language sample use of concept vocabulary. This data demonstrates that between children with and without hearing loss, they were not using the concept vocabulary that they knew on the BBCS as often in conversation. The range of performances for their concept vocabulary knowledge was wide at Time 1 (age 4) between language samples and BBCS scores, likely because these children were not using words that they didn't know with confidence in their conversations.

The fifth and final question of this study asked if children with hearing loss embed concept vocabulary words in complex syntax less often that children with normal hearing when they use concept vocabulary. For this question, there was not a significant difference between the amount of complex syntax used with embedded concept vocabulary in children with and without hearing loss. Again, because this data was taken at age 4, these children may not have had enough time yet to develop strong complex syntax as a whole, thus affecting their ability to use concept vocabulary in complex syntax.

Children with hearing loss have been documented to have difficulties with complex syntax, but there is little research about the potential connection between concept vocabulary knowledge and complex syntax use. As demonstrated in this study, the children with hearing loss displayed a similar use of complex syntax with embedded concept vocabulary to their normal hearing peers. However, more research into this area would likely help to show how this relationship might change as children get older and their ability to create complex syntax expands. At a later date, children with hearing loss might fall further behind their normal hearing peers due to their already proven struggle with complex syntax.

Concept vocabulary is essential for children's success in various aspects of academic life and overall language abilities. Since children need complex syntax to find success in many of their daily tasks and school-related challenges, the information provided in this study is vital as it shows that children with hearing loss may be at a higher risk for not achieving academic success due to their significantly lower ability to understand and use concept vocabulary. Because children with hearing loss do not have the same strong foundations for concept vocabulary as their normal hearing peers, it is evident that they may fall behind in certain key areas in their schoolwork.

Concept words are difficult for all children, regardless of hearing capability, and the few studies that have related concept vocabulary and children with hearing loss have shown that there may be some hope for improvement with intervention. As demonstrated in this study, children with hearing loss have more difficulty understanding and using concept vocabulary than their normal hearing peers. Thus, children with hearing loss may be more likely to need intervention methods to be able to approach the abilities of their normal hearing peers in an area of language that is already difficult for all children.

Children with hearing loss tend to have more difficulties with vocabulary than their normal hearing peers. While this study focused solely on one specific area of vocabulary, the data presented adds to the current pool of research that analyzes the higher level of difficulties with vocabulary shown in children with hearing loss.

Limitations/Future Directions:

Limitations of this study provide opportunities for future research. One limitation of this study is that the participants were only analyzed at two time periods early in their development of language. Even though significant differences were not seen in the subtests, excluding Quantity, there were still numerical differences between the rates of the groups. This small time frame may also hinder the ability to see how much the children's ability to produce complex syntax may grow or change over a longer span of time. A future study should expand this timeline to include children who are further along their educational journey to see if these differences in concept vocabulary and in related complex syntax between the children with and without hearing loss grow over more time.

Another limitation of this study is that the participants' concept vocabulary and complex syntax in the language sample measure was not analyzed at Time 5 and rather solely at Time 1. A future study should not only compare participant's scores on the single-word measure over time but also should compare their use of concept vocabulary and embedded complex syntax in the language sample measure at each time. This would allow for a more holistic comparison of each group's growth in concept vocabulary knowledge and use as well as demonstrate any possible changes/growth in complex syntax with embedded concept vocabulary during this timeline.

Furthermore, this study did not sort the concept vocabulary used in the language samples into the BBCS categories. A future study should analyze the language samples in more depth to give stronger comparisons of the differences, strengths, and weaknesses of each category of words that the children were presented on the BBCS. This could potentially help validate the results seen across each BBCS subtest and give interventionists a clearer path for goal setting when working on concept vocabulary with children with hearing loss.

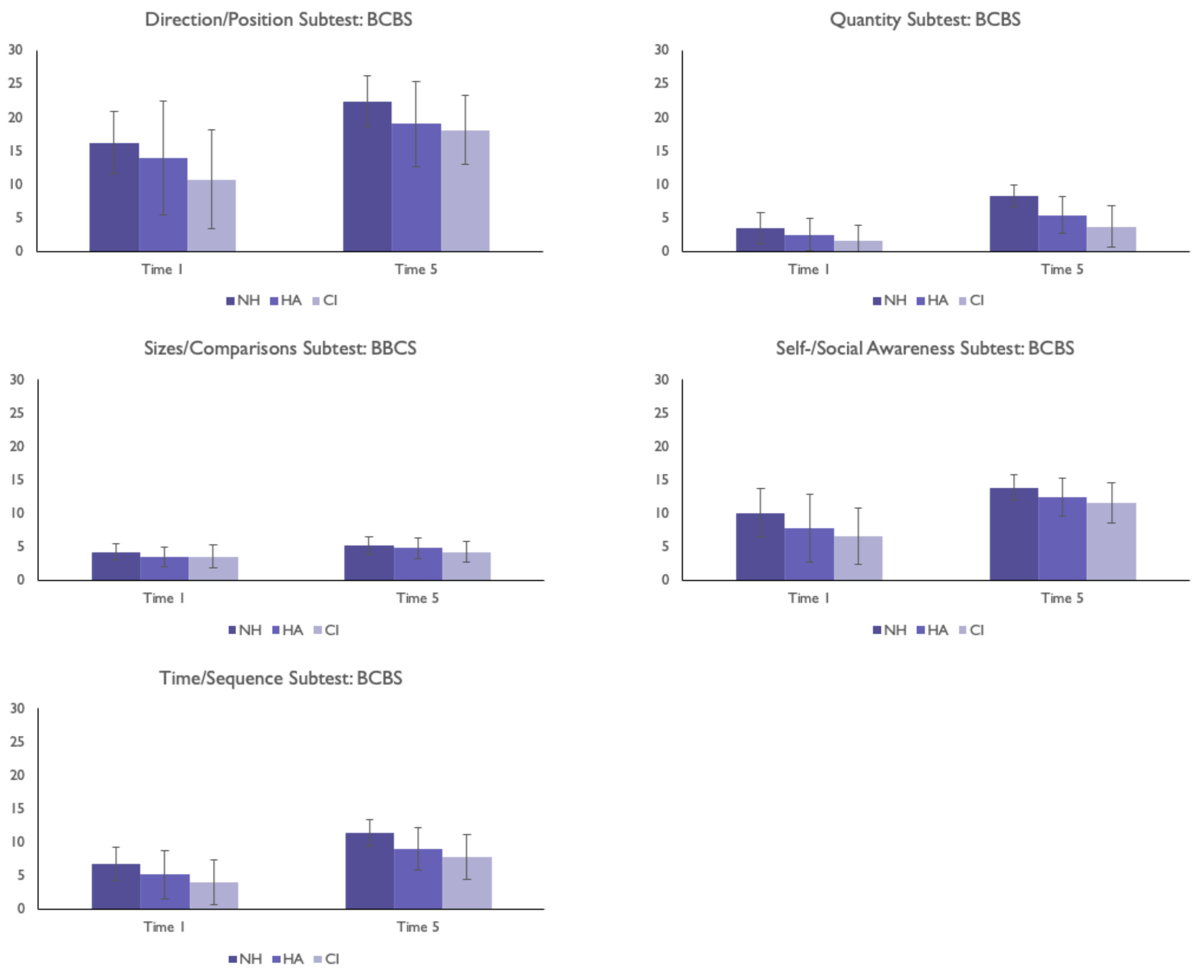

Figure 1. Concept Words on Bracken Subtests

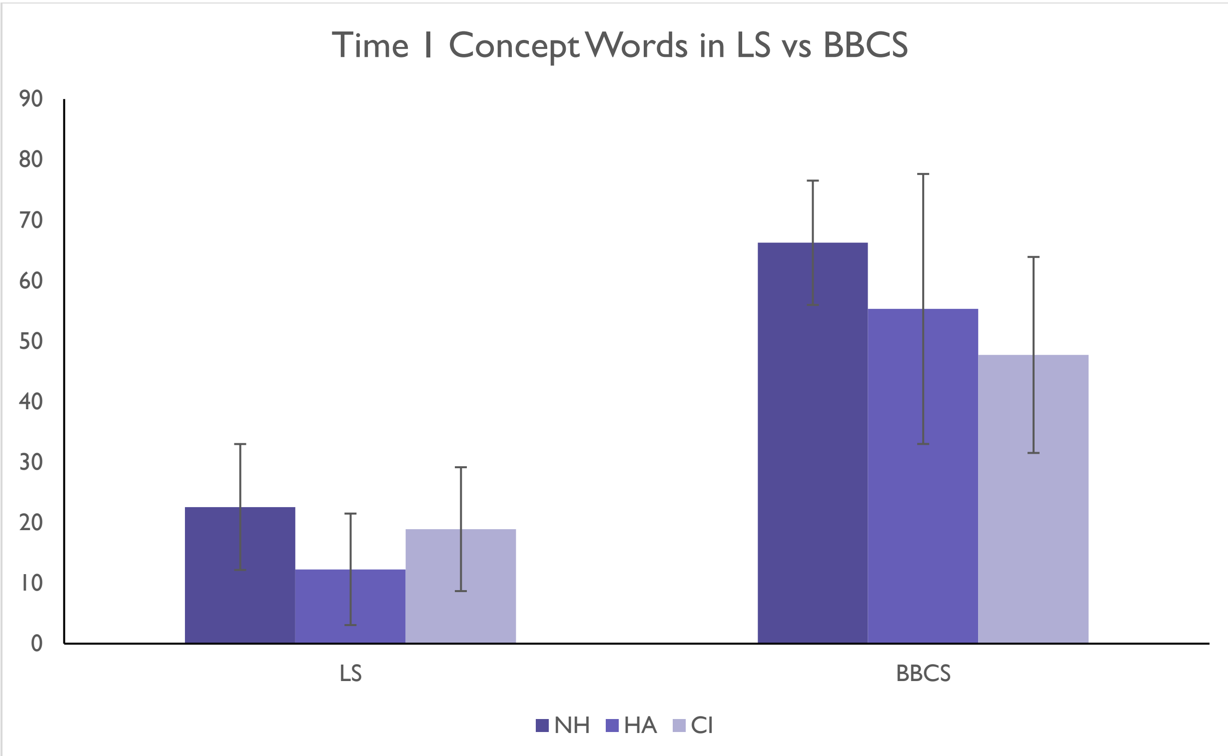

Figure 2. Concept Words in LS vs BBCS Overall Scores at Time 1

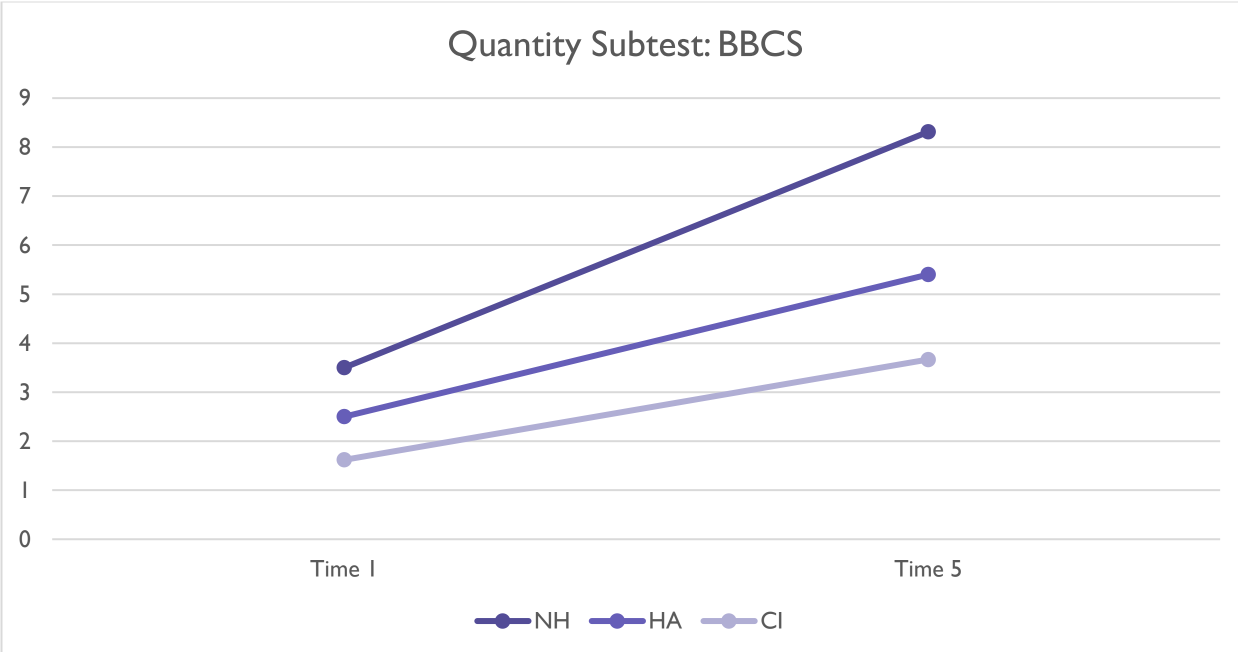

Figure 3. Change between Time 1 and Time 5 on Quantity Subtest

Works Cited

Arora, S., Smolen, E. R., Wang, Y., Hartman, M., Howerton-Fox, A., & Rufsvold, R. (2020). Language environments and spoken language development of children with hearing loss. *The Journal of Deaf Studies and Deaf Education*, *25*(4), 457–468. https://doi.org/10.1093/deafed/enaa018

Boehm, A. E.(1991). Assessment of basic relational concepts. InB. A. Bracken (Ed.),The psychoeducational assessment of pre-school children(2nd ed., pp. 241–258). Allyn & Bacon.

Bowers, L. M., & Schwarz, I. (2013). Assessing response to basic concept instruction. *Communication Disorders Quarterly*, *34*(4), 221–231. https://doi.org/10.1177/1525740112469662

Bracken, B. A., & Crawford, E. (2009). Basic concepts in early childhood educational standards: A 50-state review. *Early Childhood Education Journal*, *37*(5), 421–430. https://doi.org/10.1007/s10643-009-0363-7

Cannon, J. E., & Kirby, S. (2013). Grammar structures and deaf and hard of hearing students: A review of past performance and a report of new findings. *American Annals of the Deaf*, *158*(3), 292–310. https://doi.org/10.1353/aad.2013.0027

Connor, C. M. D., Craig, H. K., Raudenbush, S. W., Heavner, K., & Zwolan, T. A. (2006). The age at which young deaf children receive cochlear implants and their vocabulary and speech-production growth: Is there an added value for early implantation? *Ear and Hearing*, *27*(6), 628–644. https://doi.org/10.1097/01.aud.0000240640.59205.42

Convertino, C., Borgna, G., Marschark, M., & Durkin, A. (2014). Word and world knowledge among deaf learners with and without cochlear implants. *Journal of Deaf Studies and Deaf Education*, *19*(4), 471–483. https://doi.org/10.1093/deafed/enu024

Davidson, L. S., Geers, A. E., & Nicholas, J. G. (2013). The effects of audibility and novel word learning ability on vocabulary level in children with cochlear implants. *Cochlear Implants International*, *15*(4), 211–221. https://doi.org/10.1179/1754762813y.0000000051

Dimling, L. M. (2010). Conceptually based vocabulary intervention: Second graders' development of vocabulary words. *American Annals of the Deaf*, *155*(4), 425–448. https://doi.org/10.1353/aad.2010.0040

El-Hakim, H., Levasseur, J., Papsin, B. C., Panesar, J., Mount, R. J., Stevens, D., & Harrison, R. V. (2001). Assessment of vocabulary development in children after cochlear implantation. *Archives of Otolaryngology–Head & Neck Surgery*, *127*(9), 1053. https://doi.org/10.1001/archotol.127.9.1053

Evans, J., & Craig, H.(1992). Language sample collection andanalysis: Interview compared to free play assessment contexts.Journal of Speech and Hearing Research, 35(2), 343–353. https://doi.org/10.1044/jshr.3502.343

Geers, A. E., Moog, J. S., Biedenstein, J., Brenner, C., & Hayes, H. (2009). Spoken language scores of children using cochlear implants compared to hearing age-mates at school entry. *Journal of Deaf Studies and Deaf Education*, *14*(3), 371–385. https://doi.org/10.1093/deafed/enn046

Hadley, P.(1998). Language sampling protocols for eliciting text-level discourse.Language, Speech, and Hearing Services inSchools, 29(3), 132–147. https://doi.org/10.1044/0161-1461.2903.132

Hayes, H., Geers, A. E., Treiman, R., & Moog, J. S. (2009). Receptive vocabulary development in deaf children with cochlear implants: Achievement in an intensive auditory-oral educational setting. *Ear & Hearing*, *30*(1), 128–135. https://doi.org/10.1097/aud.0b013e3181926524

Luckhurst, J. A., Lauback, C. W., & Unterstein VanSkiver, A. P. (2013). Differences in spoken lexical skills: Preschool children with cochlear implants and children with typical hearing. *The Volta Review*, *113*(1), 29–42. https://doi.org/10.17955/tvr.113.1.729

Lund, E. (2015). Vocabulary knowledge of children with cochlear implants: A meta-analysis. *Journal of Deaf Studies and Deaf Education*, *21*(2), 107–121. https://doi.org/10.1093/deafed/env060

Lund, E., Miller, C., Douglas, W. M., & Werfel, K. (2020). Teaching vocabulary to improve print knowledge in preschool children with hearing loss. *Perspectives of the ASHA Special Interest Groups*, *5*(6), 1366–1379. https://doi.org/10.1044/2020_persp-20-00023

Mandal, J. C., Kumar, S., & Roy, S. (2016). Comparison of auditory comprehension skills in children with cochlear implant and typically developing children. *International Journal of Pediatric Otorhinolaryngology*, *91*, 113–120. https://doi.org/10.1016/j.ijporl.2016.10.009

Masterson, J., & Kamhi, A.(1991). The effects of sampling conditionson sentence production in normal, reading-disabled, and language-learning disabled children.Journal of Speech and Hearing Re-search, 34(3), 549–558. https://doi.org/10.1044/jshr.3403.549

Moeller, M. P., Tomblin, J. B., Yoshinaga-Itano, C., Connor, C. M. D., & Jerger, S. (2007). Current state of knowledge: Language and literacy of children with hearing impairment. *Ear & Hearing*, *28*(6), 740–753. https://doi.org/10.1097/aud.0b013e318157f07f

Mägi, K., Häidkind, P., & Kikas, E. (2009). Performance-approach goals, Task-avoidant behaviour and conceptual knowledge as predictors of first graders' school performance. *Educational Psychology*, *30*(1), 89–106. https://doi.org/10.1080/01443410903421323

Nittrouer, S., Muir, M., Tietgens, K., Moberly, A. C., & Lowenstein, J. H. (2018). Development of Phonological, lexical, and SYNTACTIC abilities in children with cochlear implants across the elementary grades. *Journal of Speech, Language, and Hearing Research*, *61*(10), 2561–2577. https://doi.org/10.1044/2018_jslhr-h-18-0047

Nott, P., Cowan, R., Brown, P. M., & Wigglesworth, G. (2009). Early language development in children with profound hearing LOSS fitted with a device at a young Age: Part I—THE time period taken to Acquire first words and first word combinations. *Ear & Hearing*, *30*(5), 526–540. https://doi.org/10.1097/aud.0b013e3181a9ea14

Piersel, W. C., & McAndrews, T. (1982). Concept acquisition and school progress: An examination of the boehm test of basic concepts. *Psychological Reports*, *50*(3), 783–786. https://doi.org/10.2466/pr0.1982.50.3.783

Rufsvold, R., Wang, Y., Hartman, M. C., Arora, S. B., & Smolen, E. R. (2018). The impact of language input on deaf and hard of HEARING preschool children who USE listening and spoken language. *American Annals of the Deaf*, *163*(1), 35–60. https://doi.org/10.1353/aad.2018.0010

Schwanenflugel, P. J., & Akin, C. E. (1994). Developmental trends in lexical decisions for abstract and concrete words. *Reading Research Quarterly, 30,* 251-264.

Spencer, P. E. (2004). Individual differences in language performance AFTER Cochlear implantation at one to three years of age: CHILD, family, and Linguistic factors. *Journal of Deaf Studies and Deaf Education*, *9*(4), 395–412. https://doi.org/10.1093/deafed/enh033

Tomblin, J. B., Harrison, M., Ambrose, S. E., Walker, E. A., Oleson, J. J., & Moeller, M. P. (2015). Language outcomes in young children with mild to severe hearing loss. *Ear & Hearing*, *36*(Supplement 1). https://doi.org/10.1097/aud.0000000000000219

Werfel, K. L., Reynolds, G., Hudgins, S., Castaldo, M., & Lund, E. A. (2021). The production of complex syntax in spontaneous language by 4-YEAR-OLD children with hearing loss. *American Journal of Speech-Language Pathology*, *30*(2), 609–621. https://doi.org/10.1044/2020_ajslp-20-00178