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A Survey of Speech Sound Production in Children with Visual Impairment

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A SURVEY OF SPEECH SOUND PRODUCTION IN CHILDREN WITH VISUAL IMPAIRMENT

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DEDICATION

As this project represents the summation of my graduate studies, an academic endeavor that I pondered for quite some time, I find it appropriate to dedicate this to the faculty and staff of the Speech and Hearing program at Cleveland State University. This department is filled with individuals who will, without hesitation, offer assistance and advice in all academic areas, as well as non-academic concerns. Without their continual support, encouragement, and guidance, I would not have been able to begin pursuit of this goal, let alone achieve completion.

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ABSTRACT

Few studies have explored the characteristics of speech sound productions in children with visual impairments. Similarly, there is little research on how speech-language pathologists provide therapy to improve speech sound productions in children with visual impairments. This study addressed the need for research evidence upon which speech-language pathologists might base their clinical practices. The intent of this report is to contribute to the available information on successful speech-language therapy for speech sound productions in children with visual impairments.

Fifteen speech-language pathologists responded to a survey that inquired about speech sound productions in the children with visual impairments on their caseloads. Respondents reported on the characteristics of 46 children's speech sound production, including errors attributed to deficits in articulation and motor speech and to phonological processes. Also reported were the children's co-existing medical diagnoses and developmental conditions, and the history and nature of their visual impairments. Respondents reported on children's previous treatments for speech sound productions and noted the length of time children had received therapy.

Data were analyzed to determine the characteristics of speech sound productions amongst this sample. The children, as a group, demonstrated developmental speech delays, in some cases well into their teen years. The evidence revealed that the presence of medical and developmental conditions influenced the speech delays in the majority of the children. It cannot be concluded that any of the characteristics of the children's

speech sound productions were the direct result of having visual impairments. Although the respondents reported effective treatment techniques that resulted in improvement of these children's speech sound productions, the results show improvement for a sample of children who have a variety of developmental disorders, not for a specific sample of children with visual impairments.

This study contributes a detailed report of speech sound production characteristics in children who, despite a diversity of co-existing diagnoses, have visual impairment in common. Findings provide practicing speech-language pathologists with a point of reference regarding the characteristics of speech sound productions in children with visual impairments, as well as efficacious techniques for treating children with visual impairments.

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INTRODUCTION

Within the field of speech-language pathology, speech-language pathologists (SLPs) use language development norms to assess children's growth in the language domains of phonology, semantics, syntax, morphology, and pragmatics, and speech sound production norms to assess children's developmental acquisition of speech sounds. For children who do not meet normative expectations, SLPs provide interventions to strengthen their communication abilities. Many children experience the various medical diagnoses and developmental conditions that affect speech and language acquisition and use. For many children, speech and language development are affected by impairments in cognition, the use of sensory information, and perceptual and motor skills.

The present study concerns children who experience a disorder of the development of speech sound production. A variety of prevalence data is available for speech sound production disorders in children. A recent systematic review estimated that up to 25% of children have some form of speech sound production disorder (Law, Boyle, Harris, Harkness, & Nye, 2000). In some cases of speech sound production disorder, an origin for the problem can be identified. One study estimated that about 3% to 4% of the children referred for therapy for speech disorders have apraxia of speech (Delaney &

Kent, 2004), which would indicate a motor origin for the speech sound production disorder. Developmental intellectual disability is a condition that may account for the onset of speech sound production deficits (American Speech-Language-Hearing Association [ASHA]; n.d.b). ASHA (n.d.b) reported several figures for the occurrence of intellectual disability, most of which hovered in about the 1% range.

Sensory and perceptual deficits may account for the onset of speech sound production deficits. About 15% of children between the ages of 6 and 19 have some form of hearing loss, from slight to severe, with most cases being milder (ASHA, n.d.a). Children with hearing loss are at risk for speech sound production disorders (ASHA, n.d.a). The National Federation of the Blind (2016) reported that the percentage of youth under age 20 that has some degree of visual disability is about 2.4% (694,300 children). There is some evidence that this sensory and perceptual deficit may have a negative effect on the development of speech sound production (Brouwer, Gordon-Pershey, Hoffman, & Gunderson, 2015), but there is, on the whole, little available information on how children with visual impairment (VI) fare in terms of speech sound production development and disorders. The most common sensory impairment that SLPs encounter is hearing loss; rarely do SLPs have the opportunity to provide interventions for children with VI (House & Davidson, 2000). There is a need for much more information on the characteristics of speech sound productions in children with VI, as well as on the co-occurrence of developmental speech sound production disorders and VI.

1.1. Statement of the Problem

There is some research available about language development and use in children with VI. Much of the research addressed pragmatic and social communication deficits in

this population (e.g., Perez-Periera, 2006). Other studies explored how children with VI have difficulty with meanings of words, i.e., semantic development (Andersen, Dunlea, & Kekelis, 1993), and some authors have explored the morpho-syntactic deficits that hinder the use of certain elements of language, such as pronouns and prepositions (Dunlea & Andersen, 1992). Where the research to date is lacking, however, is in (1) identifying whether certain speech sound production characteristics are common in children with VI and (2) providing evidence for how SLPs approach speech sound production interventions for this low incidence population.

1.2. Rationale for the Present Study

The Centers for Disease Control and Prevention ([CDC]; n.d) reported that vision disorders are the most prevalent disabling childhood condition in those aged birth to 18. The advocacy group Prevent Blindness (n.d.b) identified the factors that can be involved in the development of VI: genetic, environmental, and family history. There is a higher rate of developing a VI if neurodevelopmental disorders are present. Prevent Blindness (n.d.a) reported that about 6% of children with special health care needs tend to have unmet vision care needs, the presumption being that the special health care needs are addressed as a priority.

The American Foundation for the Blind ([AFB]; n.d) outlined several educational and intervention needs for children with VI. The AFB noted that educational goals for students with VI do not differ from those for typically developing children, and these must include effective communication and social competence. The AFB suggested that interventions should be provided using a team approach, and that educators should provide modifications and adaptations that are appropriate and meet the needs of the

individual child. The AFB recognized communication skills as one of the areas that may require specialized adaptations and methods of instruction.

The current study attempted to address potential areas of concern for SLPs who service children with VI. SLPs, on the whole, receive ample education and training for providing quality services to children with hearing impairments, but little to no education regarding providing services for children with VI (Brouwer, Gordon Pershey, & Warkenthien, 2013). To enhance SLPs' knowledge, the current research endeavored to offer a glimpse into the speech sound production characteristics of a sample of children with VI. In addition, by giving SLPs the opportunity to report on effective treatment methods used with children with VI, the study created a resource for SLPs who are providing treatment for speech sound production errors in children with VI.

1.3. Research Questions

The purpose of this Master's thesis was to use survey data reported by SLPs to answer the following research questions. Findings were obtained to (1) create a profile of the speech sound production characteristics exhibited by a sample of children with VI; (2) examine SLPs' reports of successful interventions for children with VI; (3) explore SLPs' perceptions of the relationship of VI to speech sound production. The research questions are:

1) What are the characteristics of speech sound production in children with VI who are serviced by SLPs?
2) What treatment approaches do SLPs report as promoting successful remediation of speech sound production errors in children with VI?

3) Do SLPs report evidence that would suggest that a lack of visual input is related to speech sound production in children with VI?

Research question 1 probed for the specific speech sound and phonological errors that occurred in the children with VI served by the respondents. To answer this question, this study relied on reports from SLPs on the children's speech sound productions. Research question 2 inquired about the specific approaches SLPs used for effective treatments. To answer this question, the study relied on SLPs' reports of remediation approaches they used. Finally, research questions 3 explored the SLPs' professional perceptions and judgments. SLPs are required to have specific knowledge of medical conditions and impairments that affect speech, language, and communication skills, and must be able to determine when a condition or impairment has an impact on speech sound production (ASHA, n.d.c). To answer question 3, the study obtained SLPs' perceptions regarding the origin of the speech sound production errors exhibited by the children with VI whom they served.

In Chapter 2, a review of previous research in the areas of speech, language, and communication in children with VI will be presented. In Chapter 3, the methodology for the current study will be described, so that the procedures and instrumentation for obtaining the data to answer the research questions are apparent. In Chapter 4, the results of the study will be provided. Chapter 5 will synthesize the information gathered and form conclusions about (1) the speech sound production characteristics of children with VI, (2) SLPs' therapy practices, and (3) the relationship of speech sound production and VI in this sample of children.

CHAPTER II

LITERATURE REVIEW

The research questions stated in Chapter 1 suggest a need to explore the information that previous reports have documented regarding the speech and language of children with VI. Chapter 2 will first discuss the overall language development of children with VI, with a focus on the pragmatic language needed for communication and social interaction. This chapter then reviews the literature on social skills development, communicating emotions, morphological development, and semantic language development, followed by information on articulation, motor speech, and phonological development, and, finally, phonological awareness in children with VI. SLPs' professional knowledge in the area of VI will be addressed, as well as a brief review of co-morbid diagnoses in children with VI that can affect speech and language development.

2.1. Overall Language Development in Children with VI

In their textbook *Children with Disabilities (2007),* Batshaw, Pellegrino, and Roizen stated that it might be expected that a child with a severe VI would have early childhood developmental delays. Regarding communication development, an infant's

inability to make eye contact with his/her parents might affect that child's attachment and socialization skills. An infant with a VI may also be delayed in preverbal communication skills, which rely on visual observation and imitation. However, "in the child with average intelligence, speech and language become typical by school age" (p. 150). Barring any other disabilities or impairments, children with VI will be likely to achieve speech and language milestones, but their language will most likely not contain body language and facial expressions comparable to sighted children. Children with VI may also have inadequate conversational skills. Overall, children who have only a vision deficit are expected to reach typical language development norms.

2.1.1 Pragmatic Language Development in Children with VI

Pragmatics is the domain of language that deals with the use of language in interactional settings. Speakers who are pragmatically competent use language well to interact, and are often said to have good social skills. Pragmatic language encompasses a variety of skills; among them are the ability to respond appropriately in differing social situations, the ability to interpret verbal and non-verbal cues to gain insight as to the intent of a message, and the knowledge that the language concerning a conversation topic will change depending on the perspective of the person communicating. Studies of pragmatic language in children with VI described this population's strengths and weaknesses in this domain of language.

Perez-Pereira (2006) summarized common language deficits in children with VI. Pragmatic deficits are most notable because of this population's disproportionate egocentric language use when compared to sighted children. These children are often unaware of what or who is around them; consequently, their use of language consists of

speaking about their own actions, describing themselves, or conveying only their needs. Children with VI may call out frequently to obtain information about their surroundings. A reported deficit is that they may not verbalize to gain a potential conversational partner's attention, presumably because they are not aware that the communication partner is present or is busy doing something.

Another deficit is the children's frequent utilization of repetitions and imitations of the speech of others. "Learning and using whole phrases or formulas for specific contexts and activities allows blind children to participate in social interactions" (Perez-Pereira, 2006, p. 359) and is indicative of how repetition and imitation may help some children with VI learn language. The need to repeat can be attributed to a delay in the ability to generalize phrases, descriptions, and conventional conversational behaviors to new situations. Perez-Pereira stated that all children use repetitions and imitations as a way to acquire language, but "[b]lind children relied on the use of modified and expanded imitations and self-repetitions to a greater extent than did sighted children…" (p. 360). The author concluded that these differences point to a more Gestalt (holistic and rote-learned) approach to language acquisition that is adopted by some children with VI.

Children with VI may not understand how to apply language to new situations beyond an original situation where they first heard certain specific phrases, descriptions, or conventions spoken. It stands to reason that children with VI would be less aware of contextual variations and the nuances of language that occur in different settings. Their language might be more formulaic because they have not learned how to adjust their language to varying contexts, which is because they are perhaps not aware of contextual

variations. The children are generalizing their language usage across situations, which may be helpful some of the time and awkward at other times.

Perez-Pereira and Castro (1992) studied children's use of pragmatic language functions in a longitudinal case study of a set of twins–one blind and one sighted child. The children were studied between the ages of 2.5 and 3.5 with a goal of distinguishing the ways the children used language. The researchers used a transcribed sample of spoken language and categorized the children's communicative intent per utterance. The results of this study indicated that the blind child had more egocentric language, i.e., "description of her own actions or her own intentions…instead of descriptions of external objects and events and their properties" (p. 29). Perez-Pereira and Castro stated that this aligns with previous research by Dunlea (1989) in which it was discovered that blind children's language is self-centered, with very little regard for external objects or people.

Perez-Pereira and Castro noted that the blind child gained attention by using vocatives (i.e., calling people's names) and greeting terms, also in line with previous research. However, these researchers categorized these frequent uses as "a means to get information about the presence and location of people in the room" (p. 31). In comparison, the sighted child used language that was more externally oriented, which the researchers proposed can be attributed to her knowledge of the presence of other people or objects; in addition, the sighted child showed a decrease in the use of self-centered language over time, which further exemplified the sighted child's awareness of other people and/or objects. Perez-Pereira and Castro concluded that sighted children's ability to recognize other people leads to language that is better for conversational interactions.

Perez-Pereira and Castro's last conclusion is the most important. A child's inability to see objects, people, or events potentially has a detrimental effect on his/her language development. Dunlea and Andersen (1992) said that because children with VI must rely on auditory information, they are more adept at developing morphologically and syntactically accurate language skills. These children are not visually distracted by paralinguistic actions and are forced to make use of all of the aural information they are receiving. These children have no concept of body language, facial cues, or gestures because they cannot see them. There is no understanding that the non-verbal language actions actually enhance the communication experience. While these studies can definitively pinpoint where children with VI may have a language deficit, there is not a conclusive reason as to why, outside of the fact that these children lack sight.

Pragmatic Language and Social Skills Development. Salleh, Jelas, & Zainal (2011) conducted a study to assess the social skills of students with VI. While the development of social skills is dependent upon many factors other than language skills, language competence does play a part in the ability to be socially appropriate. Although an assessment of social skills is not a direct assessment of pragmatic language skills, there are aspects of pragmatic language skills that are embedded in overall social skills (e.g., interpreting body language, situational awareness, and interaction skills). The authors posited that children with impaired social skills may lack the required aptitude to communicate socially, regardless of their overall language competency. Salleh et al. compared 74 students with VI to 89 sighted students as a control group. The Social Skills Assessment Tool for Children with Visual Impairment (SSAT-VI) by McCallum & Sacks (1993) was used as the research instrument; teachers used the assessment's checklist to

measure three areas: the basic aspects of social behavior, skills needed for interpersonal relationships, and cognitive social behavior. Within these three areas are subfields that give insight into pragmatic language use, such as body language, communication skills, interactions skills, interpreting social situations, and performance of social skills.

Salleh et al. found that students with VI scored adequately in areas related to language (body language, communication skills, interactions skills, interpreting social situations, and performance of social skills), but that the children with VI scored lower in all areas when compared to sighted peers. The two lowest mean scores for the children with VI were body language and interpreting social situations. Body language referred to posture, gaze, head movement, and gestures, so it is assumed that the children's production of these non-verbal expressive communication behaviors was assessed, versus the children's ability to interpret body language. Interpretation of body language can be inferred to be included within the sections of this assessment that measured interpreting social skills

Salleh et al. (2011) concluded that "…the social skills of children with VI were at lower levels compared to sighted students. Students with VI were at the lowest level in terms of the basic social behavioral aspect because competency in body language such as eye contact is difficult for the blind child" (p. 94). Not being able to see a conversation partner's body language leaves the child relying solely on verbal communication. This can lead to misunderstandings when a speaker is using body language, facial expressions, or gestures that would allow a sighted child to make inferences about the meaning of a message based on the speaker's physical behaviors, in comparison to the actual words being said.

The observed difficulties with interactional skills, interpretation of social situations, and performance of social skills speak to how a child with VI may miss chances to participate in meaningful communication opportunities. "The inability to see among children with VI makes it difficult for them to imitate other people's behavior" (p. 94). The authors contended that "appropriate social behavior…is learned incidentally at a very young age and is not consciously thought of when one engages in social interactions" (p. 94). This implication can be generalized to communication, in that these children have not been able to watch social communication and its various components. Contextual cues in the environment, which these children are not privy to, play a large role in communication; these children may not be able to discern a specific referent (e.g., an object or event in the environment), which leads to communicative confusion and difficulty with topic maintenance. If these children have never watched people communicate, it can be concluded that they do not have the capacity for the non-verbal subtleties involved in turn taking and in communication breakdown and repair. In short, children with VI may not be aware of what people physically do when they are talking.

Salleh et al. stated that the deficiency in social skills "…adds to the factors that contribute toward a lack in social competency among students with VI" (p. 95). Also, "the acquisition of social skills is not a natural occurrence for visually impaired children but these skills require training and they must be nurtured throughout the students' educational years" (p. 95). This study offered a strong argument for SLPs to include pragmatic language interventions when working with children in this population.

Pragmatic Language and Communicating Emotions. In another study, Dyck, Farrugia, Shochet, and Holmes-Brown (2004) explored emotional recognition and

understanding abilities in children with sensory (hearing or vision) deficits. Again, while emotion recognition and understanding are not in and of themselves dependent upon language skills, pragmatic language competence reflects some degree of emotion recognition and understanding. In this study, the authors referred to a "mind reading" ability that indicates that a child can use internal state words (such as "believe," "think," or "imagine"), can understand emotion based on the ability to take another's perspective, and can differentiate between their own and others' relations to the same propositional content. These are important abilities that demonstrate the development of a theory of mind, that is, the capacity to realize that others have their own perspectives, and the ability to differentiate one's own perspective from that of others.

Of the 83 participants in the Dyck, Farrugia, Shochet, and Holmes-Brown study, 26 had visual impairments, 23 had hearing impairments, and 34 children had no sensory impairments. There were groups of children (aged 6-11) and adolescents (aged 12-18) within each population. The authors used the Wechsler Intelligence Scale for Children, 3rd edition (WISC; Wechsler, 1993) and the author-created Emotion Recognition Scales (ERS; Dyck, Ferguson, & Shochet, 2001). For the purposes of this paper, only the results of the participants with VI will be discussed. Reported results for the aggregate of children and adolescents with VI indicated delays in emotion recognition ability, "but [they] are not significantly delayed in acquiring emotion understanding" (p. 795).

Dyck et al. stated that as compared with verbal matched children with no sensory impairments, children with VI had "a specific deficit in recognizing emotions from tones of voice modifying the meaning of semantic content" (p. 797). Dyck et al. noted that the results seemed contradictory, as persons with VI ostensibly rely on auditory cues and

might be likely have a heightened ability to discern pitch, volume, and memory for sounds, but the authors stated that learning about appropriate communicative responses may not occur if visual feedback is not available. The authors also contributed a hypothesis that "…a vision-impaired person may attend preferentially to semantic content and be less attentive to tone of voice cues that modify the meaning of speech" (p. 798). Dyck et al. pointed out that a previous study by Peterson, Peterson, and Webb (2000) concluded that children with VI lack access to visual cues that show how another is feeling. Dyck et al. asserted that the deficit is related to ineffectively using the intact sense—hearing—to obtain vocal cues that betray a person's emotions.

Dyck et al. concluded that the inability to recognize emotion by children with VI lessens with age or experience—the children aged 6-11 showed more of a delay than the adolescents aged 12-18 when compared to the non-sensory impaired children—and is something that can be remediated; however, the deficit still exists within this population. Pragmatic competence is partially dependent upon the ability to recognize and understand others' emotions. Children with better pragmatic skills can interpret and make inferences, can understand non-literal language, are attuned to the context of comments, and can display non-egoistic language capacities. A deficit in emotion understanding is sometimes related to a deficit in pragmatic competence, which puts a child at risk for social communication errors that directly affect communicative competency.

2.1.2. Morphological Development in Children with VI

Morphology is the area of language that deals with how words are formed. English morphemes consist of words and affixes. Morphemes are the building blocks that are placed together to form sentences. Children acquire classes of morphemes, such as

nouns, verbs, pronouns, articles, and conjunctions, which are commonly referred to as parts of speech. Morphological development contributes to children acquiring a varied vocabulary and the ability to use words in sentences.

Contributing to the pragmatic deficits for children with VI is their morphological misuse of pronouns. As Andersen, Dunlea, and Kekelis (1993) found, this population demonstrated irregular use of pronouns and often had difficulty with pronoun reversals (mistaking I/you, he/she, her/him, etc.). The children studied were able to use pronouns to describe their own actions, but were unaware of how to use pronouns with regard to their conversational partners. Their difficulty revealed an inability to understand that the use of pronouns will change when the speaker or referent changes. Additional research by Dunlea and Andersen (1992) dissected word class acquisition further and made the distinction that these children may have acquired the correct morphemes in various word classes, such as pronouns, but did not have the capacity to generalize their use, which made overall morpheme acquisition problematic. The researchers concluded that children with VI may rely on both conceptual knowledge and linguistic knowledge in communicative situations, both of which inform their acquisition and use of morphemes.

2.1.3. Semantic Language Development in Children with VI

Semantics is the domain of language that has to do with word meaning. Children tend to learn the meanings of the words that are pertinent to the reality that they experience. Young children talk about the people, objects, places, and actions in their environments. Learning words usually relates to having some sort of sensory experience, often in the context of play or other aspects of children's ordinary daily lives. It is

difficult for any children to learn the meanings of words that represent items or experiences that are not familiar to them.

Perhaps the most obvious difference in language development for children with VI is in semantic development. For children who cannot see, word meanings can be quite restricted. Brouwer et al. (2013) quoted an SLP who treats children with VI as saying, "We were cleaning out the refrigerator and we passed around a watermelon. None of them knew what it was because to them it was always cut up in little squares."

In the case of children with VI, multisensory experiences can help them learn to label objects that they cannot see. But what about learning words and concepts that do not have sensory properties? Labeling objects that they can manipulate manually or naming the people with whom they have contact is a much easier task than understanding and using words with more abstract meanings. In this sense, Andersen et al. (1993) reported that many previous studies determined that children with VI are similar in early word development to non-sensory impaired children. The semantic content of their language includes labels for objects and people, along with action words and the ability to talk about themselves within social communication contexts. According to the researchers, the differences in development appear as a lack of generalization of meaning to other referents; these children may struggle to conceptualize the idea that a word meaning can be applied to anything other than the instance in which they obtained the meaning of that word. Applying the term "watermelon" first to "little squares" and then to a whole melon requires semantic generalization skill. Andersen et al. asserted that there is a time "where children treat words as if they are proper names" (p. 26). Children with VI may not be able to generalize information about a word or referent and then use that word with a

different referent, rather in the way that proper names may refer to a singular person in their environments.

Perez-Pereira (2006), in a summary of language development in children with VI at the level of blindness, opposed the conclusions made by Andersen et al. (1993) that blind children have a decreased ability to generalize words to other words within a larger category of meaning. According to Perez-Pereira, "blind people are able to form concepts that are equivalent to those formed by sighted individuals" (p. 358). Perez-Pereira's point of contention was that blind children "…may have difficulties in using a given word for a variety of items simply because they have restricted experience and cannot use, for instance, the word *dog* for a dog that is walking unless it barks, or a verb for an action performed by another person unless the action has an audible component" (p. 358). The point is that the child cannot use a referent for an object that the child cannot see; he/she must experience it, aurally or manually, to be able to refer to it.

Perez-Pereira reported that at around age four children who are blind are "able to comprehend that words such as *green* and *red* refer to concrete characteristics of objects that they cannot perceive" (p. 358). The author indicated that children who are blind use the same words as sighted children and use them in the same morphological way as sighted children. His argument was that, ultimately, children who are blind use information from language—instead of sensory information—to acquire and understand the meanings of words that sighted children understand and acquire with the help of sensory information. This points to the children's metalinguistic understanding that words have meaning, whether or not they have visual access to experiencing that meaning.

James and Stojanovik (2007) utilized a parent checklist to investigate vocabulary and grammar skills in eight children with VI between the ages of seven and 17. The children were estimated to be in the lower third of performance abilities. In a longitudinal study of four children who were blind, Brambring (2007) examined the acquisition age for 29 verbal skills. Brambring chose these children because they had no other impairments, which made a comparison with typically developing children less complicated. The 29 verbal skills assessed included observable items found in nine categories, such as pronouns, syllables, first words, grammar, sentence construction, imitation, and object naming. According to the results, children who were blind acquired approximately 80% of these items later than typically developing children. Brambring concluded that development of verbal skills was only slightly delayed in children who were blind, but that the sequence of development was comparable to the children without VI. It should be noted that acquiring personal and possessive pronouns was especially difficult for the children who were blind, while object naming was an area in which the children with VI demonstrated a developmental lead.

These assertions about semantic language development in children with VI still leave certain considerations unaddressed. Although these children may understand that their words have meanings and that those words are associated with referents they cannot perceive, this does not mean that these words are used often (or perhaps may not be used at all). When asked to describe an object, their language is probably not going to be as robust in description as sighted peers. For example, when describing grass, these children could have been told that it is green and use that descriptor for it, but they could also misuse adjectives in their descriptions. A wrong descriptor could be used to describe

objects (e.g., red grass, green sky), which does not point to mastered semantic knowledge and could also lend itself to pragmatic language deficits in social situations.

2.2. Speech Sound Production, Phonological Development, and Phonological Awareness in Children with VI

For children to produce speech sounds accurately, they must be able to aurally discriminate the sounds that they hear in the speech of others, and they must have the motor and linguistic abilities to imitate those sounds. They must store the sounds in their memories as auditory, motor, and linguistic representations, and be able to call upon those memories when they need to use their sound repertoire in connected speech.

In the textbook *Articulatory and Phonological Impairments: A Clinical Focus,* Bauman-Waengler (2012) defined articulation as "the totality of motor processes involved in the planning and execution of sequences of overlapping gestures that result in speech" (p. 4). Speech sound development occurs as a child begins to master the articulatory procedures for the speech sounds represented in his/her language. Articulation first develops when a child learns a motor plan in preparation for moving his/her articulators (e.g., tongue, lips) to produce a specific phoneme. Each phoneme has a specific motor plan involving where the articulators are placed, whether voicing is involved, and the way air flows to produce the sound. Once the motor plan has been developed, it is executed to produce speech sounds. "Speech sounds represent physical sound realities; they are the end products of articulatory motor processes" (p. 5).

2.2.1. Norms for the Development of the Articulation of Speech Sounds

Sander (1972) explored the typical ages when children master speech sounds. Sander offered a definition of speech sound acquisition as being the age when children

correctly articulate a sound in the three positions of words (initial, medial, and final) a majority of the time. Sander observed the ages at which children commonly met these criteria. This allowed for formulating a developmental progression in speech sound acquisition, which serves as the norms that are still used today. Sander's developmental norms for speech sound mastery are as follows in Figure 1, Average Age Estimates of Speech Sound Mastery.

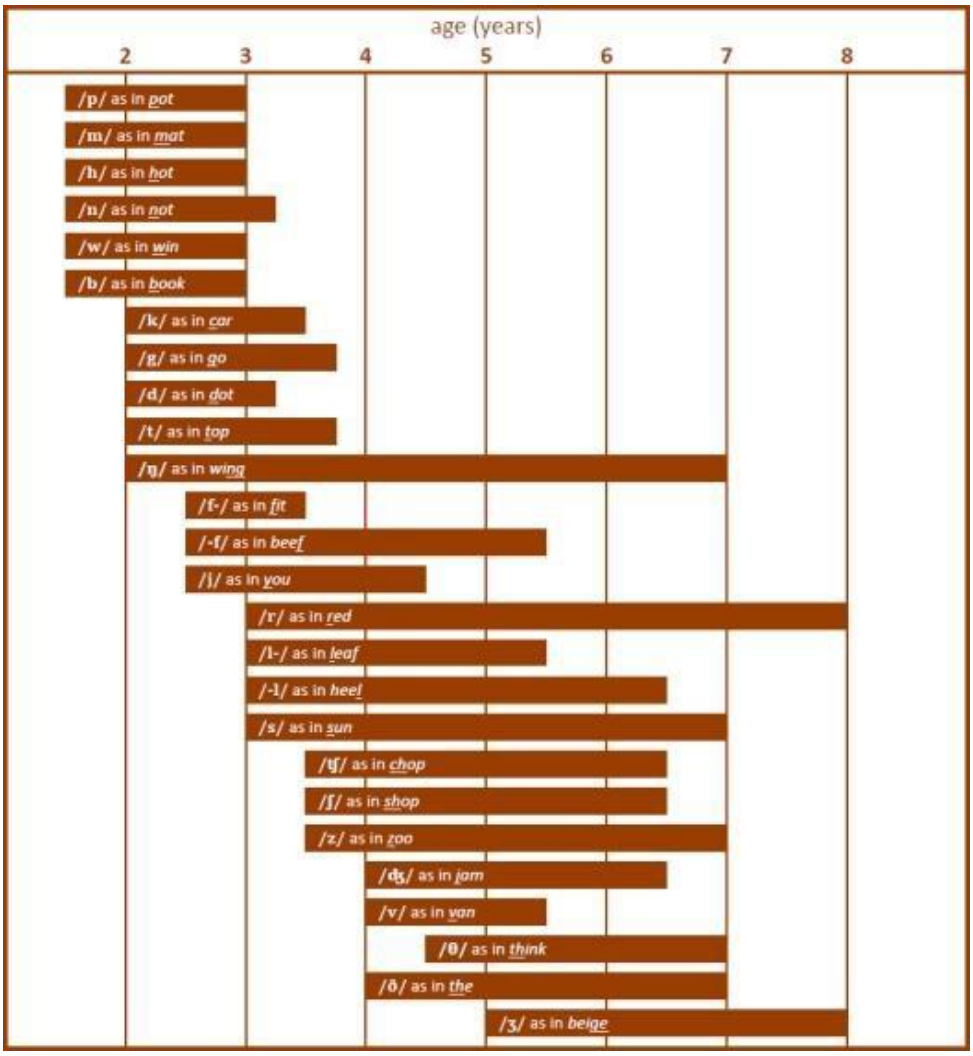

Figure 1. Average age estimates of speech sound mastery. (From Sander, 1972.)

2.2.2. Phonological Development

Phonology is the domain of language that deals with the mental representations of speech sounds. Phonological development refers to how a child acquires the linguistic rules for the production of the phonemes in his/her language. Phonological development is different from speech sound development in that the child learns "…the contrasts between sounds that convey difference in meaning" (Bauman-Waengler, 2012, p. 113). This distinction is important because a child's speech sound production errors can be rooted in difficulties with articulation or in phonology. A child might have an articulation disorder (a breakdown in the motor planning and execution) that would cause her to produce a sound incorrectly. Or, a child might have a phonological disorder, where, for example he/she "may have the correct speech sound form, in other words, be able to produce [p]-[b], [t]-[d], and [k]-[g], [but] this child might leave off these sounds at the end of a word" (p. 65). In this example, the child's articulation is adequate, but her phonology is disordered; she does not use speech sounds in a way that would be in keeping with the patterns and rules for the use of these phonemes in her language. The child's mental representations for the use of these speech sounds are not adequate, but all that can be observed is that she uses sounds in words incorrectly.

These incorrect productions result in a typically occurring event in a child's phonological development called a phonological process. Phonological processes are the simplified sounds that some children produce, based upon their simplified mental representations. Bauman-Waengler stated that "phonological processes are innate and universal …. [they] are … easier for a child to produce and are substituted for sounds, sound classes, or sound sequences …" (p. 78).

Many children produce phonological processes to help them utilize and organize their language's specific phonological system. Phonological processes help children learn how to revise their phonological system until they reach the goal of typical adult productions. Children's errors may change over time as their mental representations of speech sounds evolve.

Most errors involving phonological processes are patterned simplifications of the typical usages of phonemes. In English, there are about 20 unique phonological processes (Williams, 2003) that occur within three general patterns: (1) syllable structure processes, which occur when sound changes alter the structure of a syllable (e.g., cluster reduction, /fip/ → /flip/—a four-sound syllable becomes a three-sound syllable); (2) substitution processes, which occur when one sound class replaces another (e.g., devoicing of voiced sounds, /pop/ → /bob/—the /b/ is incorrectly produced as a devoiced /p/); and (3) assimilatory processes, where a nearby sound influences the target sound (e.g., nasal assimilation, /man/ → /ban/—the final /n/ caused the /b/ to be nasalized into /m/).

Each pattern of phonological processes contains several unique processes that represent that pattern of phonological error. There are many different processes that either alter the structure of a syllable, involve sound substitutions, or are a function of assimilations. Children may use many of these phonological processes or they may use none of them, but they are typical occurrences in children's speech as children learn the phonological rules of language. "Suppression" is the clinical term for when a child has acquired the mature mental representations of speech sounds and no longer needs the patterns of simplifications (Williams, 2003). The child's errors disappear, and parents commonly say that the child "outgrew" the earlier way of speaking. Many processes will

be suppressed at an earlier age, often in the preschool years. For most children, all of the phonological processes will most likely be suppressed by the age of 9 (as an example of later suppression, consonant cluster substitution, /stweet/ → /street/, where the /r/ is pronounced as a /w/, is held to be the last process to be suppressed).

In summary, some children exhibit speech sound production errors due to articulation disorders. Other children mispronounce sounds in words due to phonological disorders. Some children exhibit disorders of both articulation and phonology. ASHA (2004) has adopted an inclusive term, speech sound disorder (SSD) to represent the overall clinical indications that are involved in any of these diagnoses.

2.2.3. Motor Speech Disorders

In the textbook *Assessment and Treatment of Articulation and Phonology Disorders in Children* (2007), Peña-Brooks and Hegde describe two types of neurogenic speech disorders: apraxia and dysarthria. Apraxia is defined as a "motor programming disorder resulting from neurological damage…." (p. 350). Apraxia is a neurological disorder that results in the inability to voluntarily execute muscular movements that can't be attributed to a muscular disorder, paralysis, or incoordination. There are several types of apraxia: oral, limb, and, specific to this study, apraxia of speech. It is noted as being observed in adult populations who have experienced neurological damage. Developmental apraxia (or childhood apraxia) is diagnosed in children. Pediatric cases may arise from known neurological damage, or may exist in children where no apparent origin can be identified.

"Apraxia of speech…is an impaired ability to program and execute volitional movements for the production of phonemes and words" (Peña-Brooks & Hegde, 2007, p.

351). Children who have been diagnosed with apraxia of speech may exhibit any of the following speech characteristics: typical or atypical errors in articulation, unintelligibility, inconsistent errors of articulation, resonance problems resulting in hyper– or hypo–nasality, and voicing errors during articulation. Childhood apraxia of speech is a motor speech disorder that impairs a child's ability to plan and carry out the muscle movements that are necessary for precise articulation of speech sounds.

Peña-Brooks and Hegde (2007) describe dysarthria as "a neuromotor speech disorder affecting one, various, or all parameters of speech production: respiration, phonation resonance, articulation, and prosody" (p. 361). Dysarthria can affect all speech production processes because it causes muscle weakness, paresis, or incoordination. The etiology of dysarthria can vary but includes damage to the central or peripheral nervous systems, degenerative disorders, trauma, and infections. As dysarthria is a neuromotor disorder, it will affect any muscular movements involved in the production of speech, including imprecise or distorted articulation, irregular articulation patterns, and weak speech sound production.

Both apraxia and dysarthria are neurogenic disorders that cause weakness or incoordination in the muscles that are used to produce speech. When assessing speech sound production errors in children, it is necessary to consider either diagnosis (and in some cases, the presence of both) as being the causative agent.

2.2.4. Studies of Speech Sound Production in Children with VI

There are not many studies that address speech sound production in children with VI, and these studies offer inconsistent results. Perhaps one reason for the contradictory results among studies of speech sound production in persons with VI is, as Elstner (1983)

observed, that there really is no homogeneous population of persons with VI. Differences in speech sound production capabilities in persons with VI can vary, and can be influenced by the many different etiologies for VI, age of onset of VI, severity of impairment, and co-morbid conditions. These many factors can result in mixed arrays of individual differences.

Mills (1987) compared speech sound production in three children with VI with same aged peers who had typical vision. In this case, the children with vision exhibited more precision producing articulation targets than did the children with VI. As a group, the children without VI were more accurate with visible speech sounds, but had less correct articulation with non-visible speech sounds (the author noted that the children without VI were given more trials of words). Mills found that the children with VI were slower in the acquisition of visible speech sounds and had differing error patterns when compared to sighted peers. Mills posited that the errors occurred because "…acoustic and articulatory information cannot be sufficiently exploited to achieve adult articulatory competence" (p. 156).

While Mills stated that visual input assists in children's production of phonemes and syllables, he concluded that the lack of visual input did not make the children with VI more susceptible to speech sound production errors when compared to same aged peers. Mills reported that neither weaknesses in speech sound acquisition and production or imprecision of articulation are more likely to occur for those phonemes that are visible when uttered (e.g., labial and labiodental phonemes, for example, /b/ and /f/, respectively). In essence, the visual input of how to place the articulators to produce the phoneme did not negatively affect the children with VI any more than it affected the

children without VI. However, because of the articulatory imprecision apparent in children with VI, Mills concluded that the lack of visual input does hinder the overall speech acquisition process.

As reported by Brouwer et al.(2015), a few studies revealed some differences in the speech discrimination abilities of adult and child speakers with VI (Gougoux, Lepore, Lassonde, Voss, Zatorre, & Belin, 2004; Hugdahl, Ek, Rintee, Tuomainen, Haaral, & Hamalainen, 2004; Lucas, 1984). Ménard, Dupont, Baum, and Aubin (2009, pp. 1406-1407) suggested that differences in auditory discrimination abilities in persons with VI might have an impact on speech sound production, but added that "apart from differences in discrimination abilities between congenitally blind speakers and sighted speakers, the lack of access to visual information might also induce differences in the use and/or control of the speech articulators (especially the visible ones)." Lewis (1975) noted the importance of visual input for early speech sound production, and reported that babies with VI who were in the pre-babbling stage produced fewer imitations of labial speech gestures. Elstner (1983) and Mills (1987) reported various studies that documented phonological disorders in older children with VI. James and Stojanovik (2007) reported that articulation skills in a sample of eight children with VI between the ages of 7 and 17 were in approximately the lower third of performance abilities. LeZak and Starbuck (1964) found that 37% of 173 children with VI exhibited speech disorders. House (2000) compared the speech of 12 adults with VI to 12 matched sighted peers. The participants with VI scored significantly lower on standardized speech measures and exhibited a greater number of visible errors in articulatory placement.

These various studies are relevant as they show that children with VI may develop their speech sound production skills differently from sighted children. In summary, although the research to date does not identify a link between VI and speech sound production deficits, children with VI have limited or no access to visual cues to aid auditory discrimination or to visual models of articulatory gestures.

2.2.5. Phonological Awareness

In children who are beginning to read and write, phonological awareness is required so that children can learn to identify the phonemes within words. Children move from an unconscious awareness of the speech sounds they use to a conscious awareness of how to blend sounds together to form words and how to segment words into their component sounds. Children learn that different sounds make up words, phrases, and sentences. Many studies have been conducted regarding phonological awareness in children with VI, typically in conjunction with their literacy preparedness (Barlow-Brown & Conelly, 2002; Dodd & Conn, 2000; Gillon & Young, 2002). Children with VI are not exposed to environmental print and may not understand the concept of a grapheme (a printed letter) until they begin to learn to read braille and experience tactile letter representations (Hatton, Erickson, & Lee, 2010). In the Hatton et al. study, there were some children who could not identify letters but who were able to complete a phonological awareness task. The authors suggested that the assumed axiom that a child must be able to recognize graphemes before being phonologically aware was not observed in the four children involved in their study. Hatton et al. posited that these children may have been more focused on auditory stimuli, which made them more able to

manipulate sounds. This conclusion is plausible because children with VI rely on oral language for their linguistic and conceptual input.

Monson and Bowen (2008) reviewed the literature relating phonological awareness to learning to read braille. Beginning readers of braille can generally be expected to develop phonological awareness skills in the same manner as readers of print. Gillon and Young (2002) examined 19 children with VI who were learning to read braille. Most of the good readers had strong phonological awareness skills. The participants showed patterns of strengths and weaknesses in their development of phonological awareness that followed the developmental patterns of sighted children. Just as phonological awareness skills facilitate sound-symbol correspondences in sighted children, so may phonological awareness help children with VI develop an understanding of the connection between the tactile stimulus for a word and its spoken representation. In sum, there is ample evidence that optimal literacy instruction for children with VI incorporates phonological awareness (see, for example, the methods described by the Iowa Braille School, 2015).

2.3. SLPs' Professional Knowledge of VI

In cases where children with VI have an articulation or phonological impairment, an SLP will be tasked with assessment and interventions. When treating sighted children, SLPs frequently provide visual stimuli to help children develop better speech sound productions, either by providing visual models of articulatory movements or using graphemes to represent the differences in phonemes. As reported by Brouwer et al. (2013), it is important to begin a professional dialogue about speech sound production in children with VI and identify the techniques that might be used to remediate error sounds.

Since there is little research evidence on which to base therapy practices, successful therapies may provide the available evidence upon which to base clinical practice.

In a survey of SLPs, House and Davidson (2000) analyzed whether SLPs felt competent in providing assessments and interventions for children with sensory impairments. The researchers specifically compared hearing impairment and VI, and explored the compounded sensory impairment of deaf-blindness. The results were not surprising: a large portion of the SLPs surveyed indicated that they had been educated at some point about hearing impairments and they felt comfortable treating children with hearing impairments. To the contrary, a small portion of SLPs reported being educated about VI. A worrisome statistic arising from this survey is that while 69% of the sample of SLPs had provided services for children with VI, 49% percent of the SLPs reported not having any education about VI and 59% did not feel knowledgeable about children with VI. The SLPs surveyed were not unaware of their own knowledge deficits: they acknowledged the need for more training in the area of VI but reported not knowing where to access resources to increase their knowledge base. This study showed a real need for more education about providing services for this population.

A 2015 study by Brouwer et al. surveyed VI professionals who provided services to students with VI. The VI professionals were asked whether the students with whom they worked were receiving services for speech sound production errors. In total, 18 VI professionals reported on 120 students with VI. The authors included only the students who had typical cognition or a mild cognitive disability, in order to draw conclusions about the correlation of VI and speech sound production without being obstructed by other limiting developmental factors.

Overall, the results indicated that a higher percentage of children with VI had previously or were currently receiving treatment for speech sound production impairments than the percentage found among the general population. Results demonstrated that, within the sample, there was a higher percentage of speech sound production deficits currently being treated in the early childhood population (52%), but treatment rates were also high for other age groups within the sample (early elementary at 32%; late elementary-adolescent at 18%). In sum, 29% of the sample was currently being treated for speech sound production errors. For students who had previously received intervention for speech sound production errors, the percentage was higher for early elementary age (45%) and late elementary-adolescent age (45%) than for the early childhood age portion of the sample (32%). An average percentage of 42% of the sample had previously received treatment for speech sound production errors. The reported average occurrence rates for children with VI currently receiving treatment (28%) and for those who had previously received treatment (42%) "…far exceed the prevalence figure of 8% to 9% for speech sound disorders in children in the general population (National Institute on Deafness and Other Communication Disorders [NIDCD], 2010)" (p. 39).

Because Brower et al. included only children with typical cognition and mild cognitive disabilities, the study afforded the opportunity to review a sample of children for whom other disabilities were not a concern. The portion of the sample of children with typical cognition (18%) who were receiving treatment for speech sound production also exceeded the NIDCD rating of 8% to 9% of children in the general population. From this statistic it can be concluded that more children with VI required speech sound

production interventions than the percentage of children as a whole that require speech sound production interventions.

A reported limitation of the Brouwer et al. study was that the data were reported by VI professionals, based on their clinical judgment and record reviews, as opposed to data from the SLPs serving the children on whom the reporting was based. While it may be easy for VI professionals to hear more overt speech sound production errors, some errors are minute and would need to be determined by an SLP. To address this limitation, Brouwer et al. (2013) gathered information pertaining to how SLPs assess and treat children with VI. The presenters conducted semi-structured telephone interviews with ten SLPs who serviced children with VI. Interviewees indicated that they never received speech and language training specific to the VI population. The SLPs learned from various other sources to develop their practices for children with VI, among them professional development in other fields (e.g., VI and special education), collaborating with other service professionals, and of course, trying methods out and seeing what worked. This study reinforced the idea that SLPs need to be educated about VI and must take into account how visual input affects speech sound production.

Specific to speech sound production assessment, the SLPs reported that they struggled with the inappropriateness of standardized assessments, as most are created for children with sight. Most standardized tests use pictures to elicit target sounds but use very few auditory stimuli. The interviewees stated that their assessments for speech sound production usually started with a conversational language sample. The SLPs also recommended the Assessment Link between Articulation and Phonology (ALPHA; Lowe, 1986), a non-standardized assessment, presumably because, while there are

pictures provided, the test-taker is also given a sentence model to repeat while data are taken on speech sound production, making it an option for assessing children with VI.

The SLPs reported that they faced challenges when choosing therapy materials for children with VI. One of the SLPs stated that materials can be adapted by overlaying existing materials with sheets that contain braille. There are pre-made braille materials; for instance, McDonald's has braille menus. Also noted were places were braille is readily available, such as bathroom signs and elevators. Another SLP made a football tackling game, taking something already used for intervention (a football field game) but adapting it to include a tactile component for children with VI.

The SLPs recognized the need for differentiated assessments and interventions for children with VI. Adapting materials that are visual to include an auditory and/or tactile component is a simple way to make materials accessible for children with VI. The SLPs recommended collaboration, with one stating "[g]o be part of a team—don't do it on your own. Whoever else is working with the kids—find them. We all benefit from teams, always." This is an important sentiment, as it is one way that SLPs who have little to no training on how to service children with VI can gain knowledge about VI, or about a specific child. Working with colleagues serves to advance the SLPs' knowledge base and informs further service delivery.

2.4. Children with Multiple Impairments

According to Batshaw et al. (2007), a VI in childhood can have negative "effects on physical, neurological, cognitive, and emotional development. A severe VI causes delays in walking and talking and affects behavior and socialization" (p. 137). VI may

occur exclusively, but it is more commonly associated with other impairments or disorders, including cognitive impairments and birth related complications.

Batshaw et al. (2007) provided specific information about other impairments. According to the authors, "more than half of children with severe intellectual disability and one quarter of children with mild intellectual disability have sensory impairments, of which vision impairments, especially strabismus and refractive errors, are the most common" (p. 252). In these children, speech and language impairments are common even when not combined with a cognitive impairment. Specific to cognitive disability, deficits exist in language comprehension and production and in nonverbal reasoning skills.

Children with VI may have coexisting cerebral palsy, autism, social communication disorder, acquired brain injury, genetic disorders, infections of the neurological system, metabolic disorders, and disorders of growth and development. Each of these conditions will be briefly described.

2.4.1. Cerebral Palsy

Children with cerebral palsy have a "significant impairment of functional mobility that is associated with signs of neurological dysfunction" (Batshaw et al., 2007, p. 387). Cerebral palsy can be differentiated from other motor impairments based on that fact that symptoms of the impairment are commonly correlated to insults to the brain while it is in its developing state. VI is a condition commonly associated with cerebral palsy and can include the following: retinopathy of prematurity, nystagmus (involuntary oscillating eye movements), homonomous hemianopsia (a loss of one part of the visual field), strabismus (misalignment of the two eyes in relation to one another) (Cooper & Cooper, 2016), and

hyperopia (farsightedness). Children with cerebral palsy can also have hearing, speech, and language impairments, including articulation difficulties due to the lessened motor ability to control articulator and vocal fold movements (dysarthria or apraxia), and expressive and/or receptive language disorders. With regard to societal independence, it is noted that parents' main concerns are communication and socialization; these functional concerns make sense, as these areas are germane to living an independent life.

2.4.2. Autism and Social Communication Disorder

According to the autism advocacy group Autism Speaks (2016), the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (American Psychological Association, 2013) uses specific criteria to diagnose autism and a related diagnosis, social communication disorder (SCD), an impairment that is specific to pragmatic communication. For a diagnosis of autism to be made, an individual must demonstrate the following: a) deficits in social communication and social interactions; b) repetitive behavior patterns; c) symptoms that are recognized during the individual's early developmental period; d) symptoms that cause severe deficits in social, occupational, and other functional areas; and e) symptoms and deficits that cannot be explained by cognitive disability or global developmental delay.

To be diagnosed with SCD, an individual must exhibit the following: a) deficits in use of verbal and nonverbal communication, such as: in social communication, inability to change language to match social situations, inability to comprehend figurative language, and inability to maintain topic or change topic appropriately; b) the deficits demonstrated lead to inability to communicate effectively and participate socially; c)

symptoms that are recognized during an individual's early developmental period; d) symptoms and deficits that cannot be explained by cognitive disability, global developmental delay, autism, impairments in the morphosyntactic domain of language, or other medical or neurological conditions.

2.4.3. Acquired Brain Injury

Acquired brain injury (ABI) is defined by the National Institute of Neurological Disorders (NINDS, 2016) as a "sudden trauma caus[ing] damage to the brain." The Brain Injury Society (2016) adds that ABI is not present at birth and is not related to a congenital or degenerative disease. Some results of an ABI are confusion, blurred vision or tired eyes, ringing in the ears, trouble in executive functioning (e.g., attention, memory, and concentration), and slurred speech (dysarthria). Cortical vision impairments may occur. Disabilities that can be a consequence of an ABI depend on how severe the insult is, where the insult is located, and the overall health of the individual. Individuals may experience deficits in cognition, sensory processing, expressive and receptive language, voice, swallowing, and mental health. ABI can affect the brain focally or globally. Communication is often found to be impaired when damage occurs in the frontal and temporal lobes, as these are the specific speech and language areas of the brain.

Batshaw et al. (2007) noted that common communication impairments after brain injury are receptive language deficits (connected to auditory-perceptual deficits and/or to language comprehension) and articulation and speech motor function deficits. It is logical to posit that a brain injury would result in cognition deficits. Children with ABI typically have deficits in social communication areas, as their executive functioning deficits lead to

tendencies for tangential expression. Some children with ABI are unable to summarize ideas or deliver their messages concisely.

2.4.4. Genetic Disorders

Genetic disorders are caused by a defect in fetal cells or abnormal cellular development. This can occur because of an "unequal division of the reproductive cells, the deletion of a part of a chromosome, or the mutation in a single gene" (Batshaw et al., 2007, p. 20). There are numerous genetic syndromes that are correlated with visual abnormalities: Aicardi syndrome, CHARGE syndrome, galactosemia, homocystinuria, Hurler syndrome, Lowe syndrome, Marfan syndrome, Osteogenesis imperfecta, osteopetrosis, Stickler syndrome, tuberous sclerosis, Tay-Sachs disease, trisomy 13, trisomy 18, and Zellweger syndrome. Many children have dysmorphic physical features. Eye disorders associated with these syndromes include retinal abnormalities, cataracts, cloudy cornea, extreme myopia, retinitis pigmentosa, and dislocation of the lens (p. 140). Many children with genetic disorders have speech, language, and intellectual disabilities.

2.4.5. Infections of the Neurological System

The National Institute of Neurological Disorders and Stroke (NINDS, 2016) provides information on meningitis, encephalitis, and other infections of the neurological system. Meningitis and encephalitis are infections in the brain and/or spinal cord that result in inflammation. The consequences of this inflammation can include headaches and confusion, as well as more dangerous conditions such as brain damage and stroke. These neurological infections can have differing effects, depending on which areas of the neurological system are infected, and can affect speech and language, focally or globally.

Individuals who acquire these neurological infections can incur problems with speech and hearing, vision, muscle weakness, permanent brain damage, and stroke.

2.4.6. Metabolic Disorders and Disorders of Growth and Development

Metabolic disorders or disorders of growth and development are usually hereditary, but they might not be diagnosed until symptoms emerge (Batshaw et al., 2007). A metabolic disorder is a disruption of normal metabolism, the process that changes food into energy; this is accomplished at the cellular level and is responsible for myriad biochemical processes in the body. Depending on the type of metabolic disorder or the affected enzyme, symptoms may include intellectual disability, progressive developmental delay, severe developmental impairment, neurological impairment, muscular tension, bone abnormalities, cataracts, cloudy corneas, blindness, and deafness, as well as many other physical impairments. Disorders of growth and development are related to endocrine disorders and may induce atypical rates of growth, large or small stature, or other differences in physical appearance (e.g., of the hair on the head or body) (Sargis, 2016; U.S. National Library of Medicine, 2014).

Overall, Batshaw et al. (2007) determined that many overlapping disabilities or impairments can be present in children with VI. Depending on the primary impairment, secondary communication deficits may present differently. For instance, in children with primary diagnoses of cerebral palsy or ABI, speech sound production issues may be apparent. It is important to pay attention to the specific symptoms that children are exhibiting and "repeated assessments may be necessary to determine the primary developmental disability" (p. 252). According to the authors, children who are diagnosed

with developmental disabilities are "at a higher risk for VI than children in the general population" (p. 153).

2.5. Chapter Summary: Speech and Language Deficits in Children with VI

The studies reviewed in this chapter showed that children with VI as their sole impairment characteristically exhibit pragmatic and semantic deficits, both of which can be attributed to the VI. Pragmatic language may be weak because children are unaware of their environment and its interactional cues, and semantic impairments may occur because the children cannot see objects to assign verbal meaning to them. Phonological awareness skills are sometimes delayed in children with VI, but there is growth in these skills as children learn braille; it is at that time that they associate sounds with the braille representations of graphemes.

Notably, regarding speech sound production, the lack of simultaneous dual sensory input (hearing and vision) can have a detrimental effect on the precision of speech sound production in children with VI. One study showed that the proportionate occurrence of children with VI with speech sound production deficits is greater than the proportionate occurrence of children with speech sound production deficits in the general population (Brouwer et al., 2015).

Of import is the amount of training SLPs feel that they have when attempting to provide remediation for children with sensory impairments. In survey and interview studies (House & Davidson, 2000; Brouwer et al., 2013, respectively), SLPs stated that they did not feel confident in their background knowledge of VI and, while they tried to provide services, the SLPs noted their need for education and training to provide services

for this population. One challenge in providing services for children with VI is that although VI can be the sole impairment for a child, it often is not. Other coexisting conditions cannot be excluded when assessing and treating the speech and language problems in this population.

CHAPTER III

METHODOLOGY

3.1. Introduction

This thesis reports the results of a survey constructed by Dr. Kyle Brouwer of the University of South Dakota, with input from Dr. Monica Gordon-Pershey of Cleveland State University. The Institutional Review Board for the Use of Human Subjects in Research of the University of South Dakota approved the study. The purpose of the survey was to allow SLPs who serviced children with VI to report on the characteristics of the speech sound productions and the nature of the speech sound production deficits in the children that they served. The SLPs reported on the compositions of their caseloads, i.e., whether the children with speech sound production deficits had a VI as a sole diagnosis, or had other developmental disabilities along with VI.

Dr. Brouwer sent the survey electronically to SLPs who serviced children with VI. The survey provided a chance to create an inventory of the characteristics of the speech sound productions and errors in the sample of children served by the respondents and to obtain information regarding treatment techniques that proved to be successful in remediating the children's speech sound production errors.

Each SLP was given the opportunity to report on up to 50 children. The participants were given $5 compensation per child reported.

3.2. Procedures

The survey was administered using the following procedures.

3.2.1. Survey Distribution and Participants Recruited

Via email, Dr. Brouwer and his student assistants, Kia Miller and Sara Westhoff, contacted 20 directors of state schools for children with VI in the following states: Alabama, Arkansas, California, Hawaii, Illinois, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, New York, North Dakota, Pennsylvania, South Carolina, Tennessee, Utah, Vermont, Virginia, and Wisconsin. These states were chosen due to the ease of finding online information on how to contact the state schools for children with VI. The investigators made their initial contact in March, April, and May of 2015. They asked directors of the state schools to forward the survey to their staff SLPs. In addition, Dr. Brouwer sent the survey to 16 SLPs who attended the Brouwer et al. 2013 ASHA convention presentation on SLP practices for children with VI and provided their follow-up contact information. Dr. Brouwer also sent the survey to one SLP in South Dakota directly.

The investigators sent one follow up email to all potential respondents who had not completed the survey within one month of the initial contact. In the end, there were 37 attempts to obtain responses: 20 from state schools, 16 from participants at the ASHA convention, and one direct inquiry to the SLP in South Dakota. Since it is unknown how

many staff SLPs are employed in the state schools, response rate will be calculated based on the assumption that one SLP is employed per school.

3.2.2. Participant Training

The survey instructed respondents to watch a 10-minute training video created by Westhoff prior to their consenting to participate and beginning their responses. The training video was located on Youtube.com and was accessed at https://www.youtube.com/watch?v=kO-18FY2ocg. This link is now inactive and the video is no longer available. Participants consented using a consent form on the website www.psychdata.com, an online tool to create and send out surveys, where they also completed the survey.

3.3. Instrumentation

The survey is reproduced below and found in Appendix A. Much of the survey asked the SLPs to report on the nature and characteristics of the speech sound production skills of the children they serviced. In sum, the survey questions provided demographic data, VI status, speech sound production and phonological processes data, information on co-morbid disorders or impairments, and language disorder diagnoses in these children. There were questions about the children's speech sound production therapy histories and questions about the SLPs' impressions of the children's speech sound productions as related to their VI. There were 26 questions in the survey: 6 were open-ended and 20 were forced-choice. There was no time limit in which the participants were required to complete the survey.

The survey is shown below, in order to provide explanatory information regarding response options given to survey takers for the forced-choice questions and the skip logic built into the survey for specific questions. When a question had an open-ended option for "other (please specify)," the respondents were given space to write in a response of up to 1000 characters. The explanatory information is italicized below and a screen shot of the actual survey is found in Appendix A. Definitions for the severity of VI used in the survey were taken from previous research by Brouwer et al. (2015) as based on the International Statistical Classification of Diseases and Related Health Problems ([ICD-9]: World Health Organization, 2004), the American Optometric Association guidelines (2007, p.71), and the Individuals with Disabilities Act (IDEA, 2004).

3.4. Survey

Speech Sound Development in Children with Vision Impairments

The remainder of this survey requires you to provide clinical information about the children/teens with vision impairments for whom you have provided ***speech sound production therapy*** (treatment of phonology, articulation, apraxia, dysarthria).

You may include children/teens with vision impairments for whom you have provided speech sound production therapy and other interventions (language, fluency, voice, AAC, social, cognitive, hearing, other).

Do not report on children/teens with vision impairments for whom you have provided interventions that did not include speech sound production therapy.

The questions that follow are designed to be answered as a report of one student with a vision impairment. When you finish the questions, you may choose to begin the set of questions again and report on another student, or you may end your participation. You

Survey continued on next page

may respond to the questionnaire as many times as you choose in order to characterize as many individual children/teens with a vision impairment as you care to describe. You may keep adding individual children/teens, up to a maximum of 50 children/teens.

Remember, the inclusionary criteria are:

The child/teen is age birth to 21.

The child/teen has a vision impairment as defined by this survey.

You provided the child/teen with interventions for speech sound production.

For each question, please select the best option given. Each question has a comment box that allows you to offer a response that is not listed or where you can add any additional information.

Here is a review of the severity levels of vision impairment.

Description of Severity of Visual Impairments, with Corrective Lenses:

1. Low Vision (20/60 to 20/200): a moderate visual impairment; not necessarily limited to distance vision. Includes difficulty reading at normal viewing distance and seeing details.
2. Legally Blind or Severe Low Vision (20/200 to 20/500): Gross orientation and mobility are generally adequate, but difficulty seeing traffic signs, bus numbers, etc. Reading requires high power magnifiers and/or very short reading distances.
3. Blind (20/500 to No Light Perception): Problems with visual orientation and mobility, vision is unreliable except under ideal circumstances, or possibly no light perception.
   Functioning at the Definition of Blindness (FDB): Visual functioning is reduced by a brain injury or dysfunction. Visual acuity is not possible to determine using the Snellen Chart.

1. Student's initials (use real or pseudo initials; however, make sure that you do not use the same initials for another child):

2. Student:
   a. Age (*response options included ages 1-21*)

Survey continued on next page

b. Gender (*response options included male or female)*
c. Race/Ethnicity (*response options included African American, Caucasian, Asian, Native American, Pacific Islander, Hispanic/Latino, Caribbean, Arabic/North African, Asiatic Indian, Other/Multiracial)*
d. Severity of Vision (*response options included Low Vision, Legally Blind, Blind, Functioning at the Definition of Blindness)*
e. Vision Impairment Present Since Birth *(response options included yes, no, or unsure)*

3. Hearing Status: *(if respondents answered "no apparent hearing impairment", they were taken to question 6; all other responses continued to question 4)*
    a. No Apparent Hearing Impairment
    b. Mild Hearing Loss
    c. Moderate Hearing Loss
    d. Severe Hearing Loss
    e. I am not sure

4. Does this student wear hearing aids?
    a. Yes
    b. No
    c. Unsure

5. Can this student's need for speech sound production therapy be related to the student having a hearing loss?
    a. Yes
    b. No
    c. I am not sure

6. Is the student learning braille (or has learning)?
    a. Yes
    b. No
    c. I am not sure

7. Speech contains:
    a. 0-4 speech sounds in error more than 50% of the time.
    b. 5-8 speech sounds in error more than 50% of the time.
    c. 9+ speech sounds in error more than 50% of the time.
    d. I am not sure.
    e. The child is generally non-verbal.

Reference list: *(used to answer questions 8 and 9)*

/b/ (e.g., boy) /p/ (e.g., pan) /g/ (e.g., game) /k/ (e.g., cat, kite) /d/ (e.g., dog) /t/ (e.g.,

Survey continued on next page

tiger)

/ʧ/ (e.g., child) /ʤ/ (e.g., jump) /r/ (e.g., run) /l/ (e.g., light) /z/ (e.g., zoo) /s/ (e.g., sun)

/ʃ/ (e.g., shoe) /ʒ/ (e.g., measure) /θ/ (e.g., think) /ð/ (e.g., the) /f/ (e.g., fast) /v/ (e.g., vehicle)

/h/ (e.g., height) /m/ (e.g., man) /n/ (e.g., nine) /ŋ/ (e.g., ring) /w/ (e.g., water) /j/ (e.g., yellow)

8. Which of the following does the child misarticulate greater than 50% of the time in any position in words and is inappropriate for chronological age? *(multiple answers allowed)*
    a. /b/ /p/ /g/ /k/ /d/ /t/ /ʧ/ /ʤ/ /r/ /l/ /z/ /s/

9. Continued from question 8: Which if the following does the child misarticulate greater than 50% of the time in any position in words and is inappropriate for chronological age? *(multiple answer allowed)*
    a. /ʃ/ /ʒ/ /θ/ /ð/ /f/ /v/ /h/ /m/ /n/ /ŋ/ /w/ /j/ other

10. If any other speech sound production errors are occurring, please describe below.

11. Speech sound errors are primarily:
    a. Distortions (articulation)
    b. Phonological processes
    c. Combination of both articulation and phonological processes
    d. Apraxia
    e. Dysarthria

12. If phonological processes are evident, which are most occurring? *(multiple answers allowed)*
    a. Fronting (e.g., gate → date)
    b. Backing (e.g., bat → gat)
    c. Stopping (e.g., sun → tun)
    d. Devoicing (e.g., dad → tat)
    e. Voicing (e.g., kite → gite)
    f. Cluster Reduction (e.g., black → back)
    g. Final Consonant Deletion (e.g., dog → do)
    h. Gliding (e.g., red → wed)

Survey continued on next page

i. No phonological processes
j. Other

13. If other phonological processes are occurring, please describe below

14. This student's speech sound production problem:
    a. is related to a vision problem (e.g., both have the same origin, such as cerebral palsy)
    b. is probably related to a vision problem
    c. is probably not related to a vision problem
    d. I do not know whether this child's speech problem is related to a vision problem

15. This student's speech sound production skill is:
    a. Expected for age level
    b. Expected given the child's primary diagnostic conditions (e.g., cerebral palsy)
    c. Unexpected for age level
    d. Unexpected for the child's primary diagnostic conditions (e.g., cerebral palsy)
    e. I do not know the relationship between the child's primary diagnostic conditions and the speech sound production problem

16. This student has been diagnosed with: *(multiple answers allowed)*
    a. Mild language delay/disorder
    b. Moderate language delay/disorder
    c. Severe language delay/disorder
    d. Mild Cognitive Impairment
    e. Moderate Cognitive Impairment
    f. Severe Cognitive Impairment
    g. A genetic disorder (any syndrome, sequence)
    h. Cerebral palsy, prematurity, low birth weight, other birth-related issues
    i. Encephalitis, meningitis, other illness of the brain
    j. Brain injury after the age of 2
    k. Autism
    l. Injury to or disease of the eye or visual mechanism
    m. Metabolic or growth/development disorder
    n. I am not sure
    o. No other diagnoses
    p. Other (please specify) _____

17. If the student has other primary diagnosis (e.g., Down Syndrome, Fragile X) or if you would like to provide other relevant information to explain your responses for

Survey continued on next page

this student, use the space below. (Optional)

Optional section questions 18-26:

It would be very helpful to know more about the student's speech history. Please report on previous therapy and development for the following questions if possible.

18. I have sufficient history with this student and would like to report about previous therapy *(if respondents answered "yes", they were taken to question 19; if they responded "no", reporting for that student ceased and the respondent was taken to the beginning of the survey.)*
    a. Yes
    b. No

Reference list: (used to answer question 19 and 20)

/b/ (e.g., boy) /p/ (e.g., pan) /g/ (e.g., game) /k/ (e.g., cat, kite) /d/ (e.g., dog) /t/ (e.g., tiger)

/ʧ/ (e.g., child) /ʤ/ (e.g., jump) /r/ (e.g., run) /l/ (e.g., light) /z/ (e.g., zoo) /s/ (e.g., sun)

/ʃ/ (e.g., shoe) /ʒ/ (e.g., measure) /θ/ (e.g., think) /ð/ (e.g., the) /f/ (e.g., fast) /v/ (e.g., vehicle)

/h/ (e.g., height) /m/ (e.g., man) /n/ (e.g., nine) /ŋ/ (e.g., ring) /w/ (e.g., water) /j/ (e.g., yellow)

19. Which of the following FORMER speech sound goals are no longer in error? *(multiple answers allowed)*
    a. /b/ /p/ /g/ /k/ /d/ /t/ /ʧ/ /ʤ/ /r/ /l/ /z/ /s/

20. Continued from question 19: (*multiple answers allowed)*
    a. /ʃ/ /ʒ/ /θ/ /ð/ /f/ /v/ /h/ /m/ /n/ /ŋ/ /w/ /j/ other (please specify)_

21. Which of the following phonological processes are no longer in error?
    a. Fronting (e.g., gate → date)
    b. Backing (e.g., bat → gat)

Survey continued on next page

c. Stopping (e.g., sun → tun)
d. Devoicing (e.g., dad → tat)
e. Voicing (e.g., kite → gite)
f. Cluster Reduction (e.g., black → back)
g. Final Consonant Deletion (e.g., dog → do)
h. Gliding (e.g., red → wed)
i. No phonological processes
j. Other (please specify)

22. In my work with this student, the most effective speech intervention techniques have been: (skip if you do not have familiarity or do not have success to report).

23. Progress:
    a. This student has made adequate yearly progress in speech improvement, given age and other conditions.
    b. This student makes some yearly progress in speech improvement, given age and other conditions.
    c. This student does not make yearly progress in speech improvement, given age and other conditions.
    d. I do not know whether this student makes yearly progress in speech improvement.

24. Please mark all areas where you have evidence of improvement (your work with the child, prior SLPs' work, other evidence) *(multiple answers allowed)*
    a. Fronting (e.g., gate → date)
    b. Backing (e.g., bat → gat)
    c. Stopping (e.g., sun → tun)
    d. Devoicing (e.g., dad → tat)
    e. Voicing (e.g., kite → gite)
    f. Cluster Reduction (e.g., black → back)
    g. Final Consonant Deletion (e.g., dog → do)
    h. Gliding (e.g., red → wed)
    i. No phonological processes
    j. Other (please specify)

25. Please describe the most effective speech sound intervention techniques that you used with this student.

26. The total amount of time that you provided speech sound production therapy for this student was:
    a. less than one school year-under 9 months
    b. one full school year
    c. more than one full school year, but less than two

Survey continued on next page

d. two full school years
e. more than two full school years, but less than three
f. three full school years
g. more than three full school years, but less than four
h. four or more school years

3.5. Procedures for Data Analysis

The online survey tool yielded a de-identified data set of anonymous reports. Had Dr. Brouwer obtained identifiers that could have been linked with the survey data, Dr. Brouwer did not share any identifying information with the author of the present study.

To discern the number of respondents, the present author counted the number of discrete Internet Protocol (IP) addresses shown in the survey response report. This confirmed that there were 15 unique SLPs who furnished reports on 46 children. Analyses yielded a quantitative report of the data, predominantly reported as the frequency of response for each item on the survey. Descriptive statistics were used to compute the response frequencies for all of the survey questions. Some survey questions also allowed for comparisons of frequencies of response among the response choices given within the survey question.

The descriptive measures provided the data needed for an exploration of the nature of the characteristics of the speech sound productions of a sample of children with VI, as reported by their SLPs. Chapter 4 presents an analysis of the survey responses, in terms of speech sound production characteristics for the entire sample and sub-sets of the sample, such as groups based on age, gender, severity of VI, and co-existing conditions. Commonalities are explored in order to determine if patterns emerged.

The methods of data analysis employed in this study made it possible to obtain sufficient data to draw conclusions about the speech sound production characteristics of this sample of children with VI .The methods for evaluation of the descriptive data provided the potential for several interpretations, such as, for example, comparisons pertaining to the similarities and differences across the children. The methods for analysis of the present data included comparisons to published normative data on typically developing same aged peers, such that the similarities and differences between the present sample and the normative information could be observed.

To report how SLPs provided speech sound production treatments for the children in this sample, frequency counts established the effectiveness of the speech sound production therapies that these children have received. Frequency counts also documented the SLPs' impressions about the relationship of each child's speech sound productions to the presence of the child's VI.

CHAPTER IV

RESULTS

This chapter reports the results of the survey and the analyses of the data. The survey provided SLPs' reports of information regarding children with VI whom they serviced, including descriptions of their speech sound production characteristics, speech sound errors and error patterns, co-occurring diagnoses, and intervention techniques and strategies. The survey questions and responses will be used to answer the research questions stated in chapter 1, which are:

1) What are the characteristics of speech sound production in children with VI who are serviced by SLPs?
2) What treatment approaches do SLPs report as promoting successful remediation of speech sound production errors in children with VI?
3) Do SLPs report evidence that would suggest that a lack of visual input is related to speech sound production in children with VI?

The data gathered to respond to research question 1 entailed several levels of detail. First, responding to this question required assessment of the demographic details of the sample (questions 1-6). Certain demographic characteristics, such as children's

ages, severity of VI, and hearing status, contributed to an understanding of the characteristics of the children's speech sound production. Next, responses to survey questions 7 through 13 indicated how the SLPs identified the characteristics of the children's speech sound production errors. Finally, questions 14-17 provided extensive detail on the characteristics of the sample, evidencing that their speech sound production characteristics existed in the setting of coexisting diagnoses.

Research question 2 was addressed using responses to survey questions 18-26, which asked SLPs to report on previous speech-language therapy in terms of the effectiveness of speech intervention techniques and progress toward therapy goals. Research question 3 was addressed based upon information provided in Question 14. However, the information obtained in questions 15-17 pertaining to the children's coexisting conditions offers additional evidence about why these children may have produced speech sound production errors for reasons beyond their lack of visual input.

4.1. Results for the Overall Sample

The survey appears in Appendix A. Overall, the survey obtained reports from 15 SLPs on 47 children. The survey was sent to 37 SLPs; with 15 SLPs responding, there was a 41% response rate. One respondent's results for one child were excluded from the study as the SLP was not able to complete the survey beyond reporting demographic data (i.e., no speech or language data were reported). Thus, there were 15 SLPs reporting on 46 children. The minimum number of children reported per SLP was 1; the maximum number of children reported on was 9.

The survey was composed of 26 questions pertaining to the children's demographic data, vision and hearing status, history of speech and language treatments

and the disorders that were treated, coexisting conditions, and their experiences with successful treatment techniques. With 26 responses possible for each of the 46 children, this survey had the potential to yield 1,196 data points.

Within this chapter, the 26 questions will be grouped into 5 categories for analysis: Questions 1-6, demographics and visual impairment information; Questions 7-10, speech sound production errors for entire sample; Questions 11-13, phonological processes reported; Questions 14-17, notable subsets of the sample based on co-existing diagnoses; and Questions 18-26, information on the children's previous speech-language therapy.

4.1.1. Questions 1-6: Demographics and Visual Impairment Information

Questions 1-6 provided demographic data and the children's histories regarding vision and hearing. These data are reviewed in tabular form in Table 1: Frequency of Responses for Questions 1-6. Question 1 asked the SLP to provide the child's initials or pseudo initials, which garnered 46 responses. Question 2 asked for demographic information and history of the vision impairment, with five areas requiring responses. Fifteen SLPs reported on 46 children in all five areas: age (4, 4, 5, 5, 5, 5, 6, 6, 7, 7, 7, 7, 7, 8, 8, 9, 9, 9, 9, 9, 10, 10, 10, 11, 11, 11, 11, 11, 12, 12, 12, 13, 13, 14, 14, 14, 14, 15, 17, 17, 18, 18, 19, 19, 20, & 22); gender (26 Female, 20 Male); Race/Ethnicity (5 African American, 2 Native American, 29 Caucasian, 6 Hispanic/Latino, 2 Pacific Islander, and 1 child listed as Other); Severity of Vision Impairment (22 reported as Low Vision, 14 reported as Legally Blind, and 10 reported as Blind); and whether the vision impairment had been present since birth (41 responded yes, with 5 reporting no). Question 3 probed for these children's hearing status. The 46 responses were: mild hearing loss (2),

moderate hearing loss (3), severe hearing loss (1), and normal hearing (40). Question 4, which asked if the child being reported on wears hearing aids, yielded 6 responses, which corresponds to those 6 children identified with any level of hearing loss in question 3. Three SLPs reported yes and 3 SLPs reported no. Question 5 inquired if the child's need for speech sound production therapy could be related to the child having a hearing loss. There were 6 responses, with 5 being yes and 1 being that the SLP was not sure. Question 6 probed if the child is learning or had learned braille. Out of 46 responses, 21 were yes and 25 were no.

Table I

Frequency of Responses for Questions 1-6

Survey Question	Number of Responses
1. Provide student initials	47
2a. Provide student age	47
2b. Provide student gender	47
2c. Provide student race/ethnicity	47
2d. Provide student severity of vision	47
2e. Have vision impairment present since birth?	47
3. Hearing Status	47
4. Does this student wear hearing aids?	6
5. Can this student's need for speech sound production therapy be related to the student having a hearing loss?	6
6. Is the student learning braille (or has learned)?	46

4.1.2. Questions 7-10: Report of Speech Sound Production Errors for Entire Sample

The next set of questions, numbers 7 through 10, dealt with the number of speech sound production errors each child demonstrated and which specific speech sounds were

in error. Question 7 asked the SLPs to report for each specific child how many speech sounds were produced in error more than 50% of the time. This information is reported in Table II, Number and Type of Speech Sound Production Errors Reported.

Of the 46 responses, 25 reported that a child had 0-4 errors; 8 reported 5-8 errors; 8 reported 9 or more errors; and 5 reported that the child was generally non-verbal. Questions 8 and 9 probed which phonemes were in error more than 50% of the time and were inappropriate for chronological age. There were 46 responses to both questions across the 24 phonemes listed. Reported as being in error were /p/ at 9 times; /m/ at 6 times; /h/ at 5 times; /n/ at 6 times; / w/ at 4 times; /b/ at 6 times; /k/ at 8 times; /g/ at 9 times; /d/ at 3 times; /t/ at 6 times; /ŋ/ at 8 times; /f/ at 11 times; /j/ at 6 times; /r/ at 10 times; /l/ at 13 times; /s/ at 17 times; /ʧ/ at 15 times; /ʃ/ at 16 times; /z/ at 13 times; /ʤ/ at 11 times; /v/ at 8 times; /θ/ at 19 times; /ð/ at 18 times; and /ʒ/ at 8 times. The option for "other" was reported 3 times.

Table II

Number and Type of Speech Sound Production Errors Reported

Survey Question	Number of Responses											
7. Speech contains:	0-4 errors			5-8 errors			9+ errors			Generally non-verbal		
	25			8			8			5		
8. Which of the following does the child misarticulate greater than 50% of the time in any position in words and is inappropriate for chronological age?	/p/	/m/	/h/	/n/	/w/	/b/	/k/	/g/	/d/	/t/	/ŋ/	/f/
	9	6	5	6	4	6	8	9	3	6	8	11

Table continued on next page

9. Which of the following does the child misarticulate greater than 50% of the time in any position in words and is inappropriate for chronological age?	/j/	/r/	/l/	/s/	/ʧ/	/ʃ/	/z/	/ʤ/	/v/	/θ/	/ð/	/ʒ/	Other
	6	10	13	17	15	16	13	11	8	19	18	8	3
10. If other speech sound production errors are occurring, please describe below:	14												

Representations of speech sound production errors, distributed by age.

Questions 7, 8, and 9 lent themselves to considerable analysis. In order to analyze the children's reported speech sound production skills, the sample was divided into two age groups: children up through age 8 and children ages 9 and older. According to the Sander (1972) developmental norms reported in Chapter 2, all speech sounds are expected to be mastered in typically developing children by 8 years of age. There were 46 responses from 15 SLPs indicating all of the speech sounds that the children currently produced in error. Of the 46 responses, 31 responses indicated errors that children age 9 or older produced. Figure 2, Speech Sounds Currently Being Treated, by Age is based upon questions 8 and 9, which probed for the phonemes that were in error more than 50% of the time and were inappropriate for chronological age. There were 46 responses to both questions across the 24 phonemes listed. In this figure, the x-axis notes each of the 24 consonantal phonemes in order of typical acquisition. The y-axis notes the number of

children represented by the survey results that were currently being treated for each speech sound.

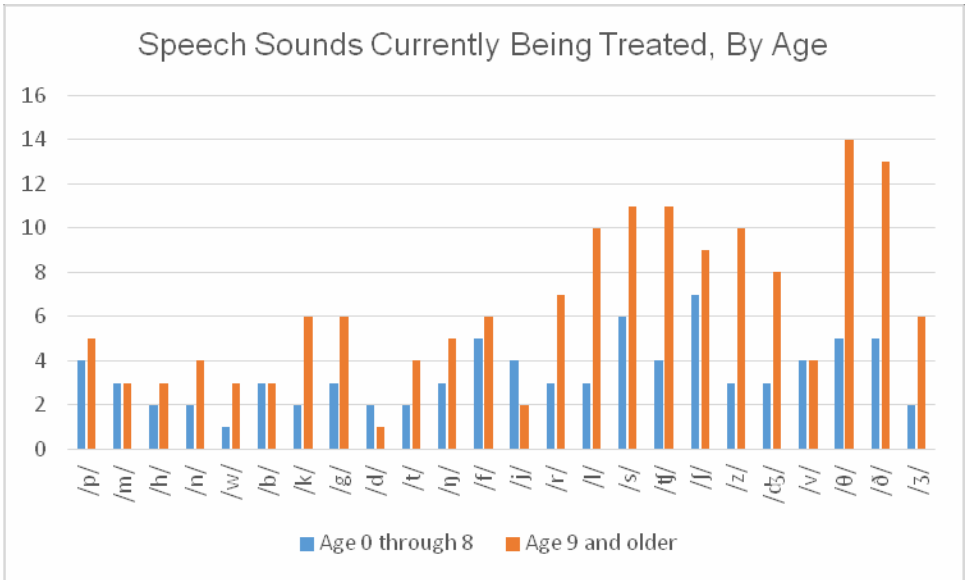

Figure 2. Speech Sounds Currently Being Treated, by Age.

It appears that, for all children, the later developing sounds were more likely to be produced in error, and that among the children ages 9 and older some were still producing errors on all of the speech sounds. Except for two phonemes (/d/ and /ʃ/), children ages 9 and older demonstrated more speech sound errors. For any typically developing child, speech sounds are expected to be mastered by age 8, based on Sander's developmental norms. This sample showed a higher percentage of atypical speech sound development than might be predicted by the norms.

Representation of phonemes currently being treated in the sample, distributed by gender. The data revealed speech sound production errors by gender. Of the 46 children reported on, 26 (47% of the sample) were female and 20 (43% of the sample) were male. Speech sound production errors by gender are shown in Figure 3, Speech Sounds Currently Being Treated, by Gender. The y-axis indicates the number of

children who demonstrated the speech sound in error. The number of errors peaked at 10 for females and 9 for males. Out of 24 phonemes being reported, there were 13 phonemes where female children had a higher occurrence of errors.

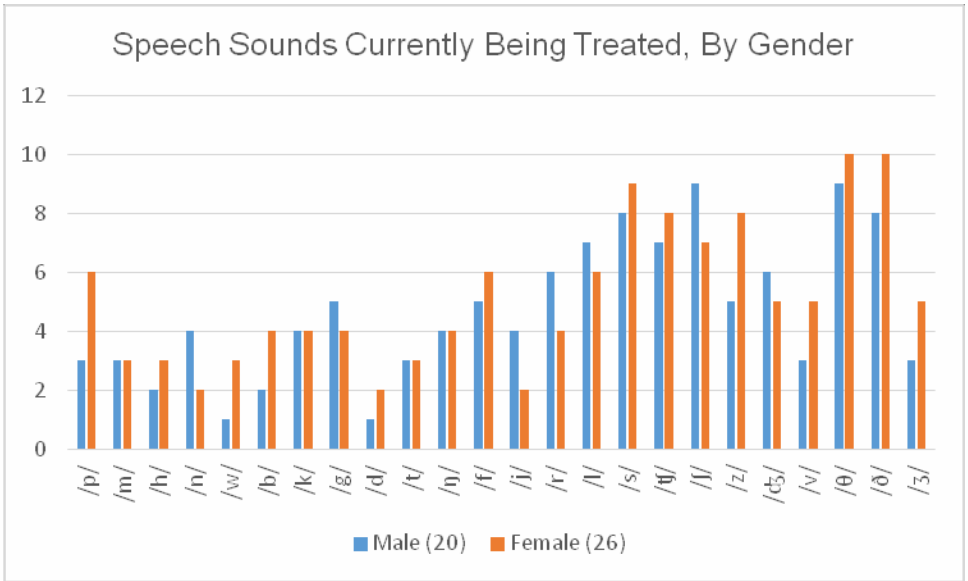

Figure 3: Speech Sounds Currently Being Treated, by Gender

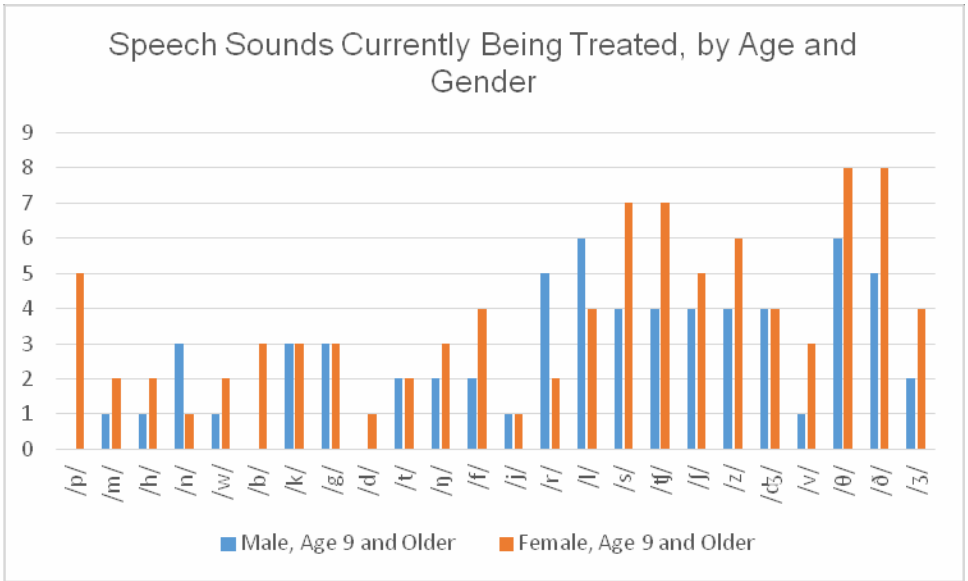

Figure 4. Speech Sounds Currently Being Treated in Age 9 and Older, by Gender.

Representation of phonemes currently being treated in the sample based on severity of VI. The survey respondents reported a degree of severity of VI for each child based on the following definitions (Brouwer et al., 2015) provided in the survey:

- Low Vision—(20/60 to 20/200): A moderate visual impairment; not necessarily limited to distance vision. Includes difficulty reading at a normal viewing distance and seeing details.
- Legally Blind or Severe Low Vision—(20/200 to 20/500): Gross orientation and mobility are generally adequate, but difficulty seeing traffic signs, bus numbers, etc. Reading requires high power magnifiers and/or very short reading distances.
- Blind—(20/500 to no light perception): Problems with visual orientation and mobility; vision is unreliable except under ideal circumstances, or possibly no light perception.
- Functions at the Definition of Blindness (FDB): Visual functioning is reduced by brain injury or dysfunction. Visual acuity is not possible to determine using the Snellen Chart (Snellen, 1862).

Of the 46 responses, there were 10 reports of children who are blind, 14 reports of legally blind, and 22 reports of low vision. There were no reports of functioning at the definition of blindness. In Figure 5, Speech Sounds Currently Being Treated, by Severity of VI, the x-axis notes each of the 24 consonantal phonemes in order of acquisition and the y-axis represents the number of children in the sample who demonstrated that speech sound error. The data showed that except for one phoneme, /w/, there was more representation by those children categorized as low vision, probably due to the higher representation of children with low vision in the sample.

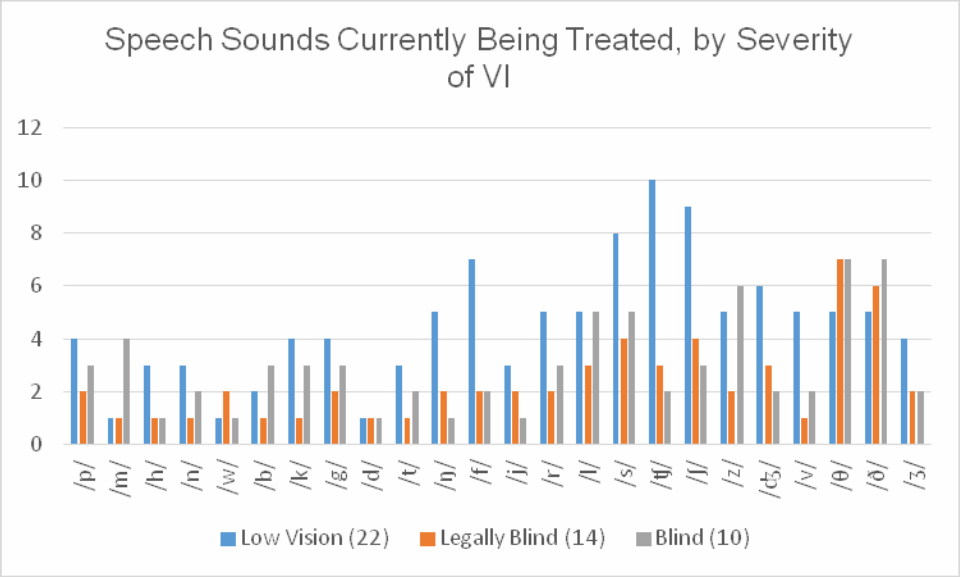

Figure 5: Speech Sounds Currently Being Treated, by Severity of VI

Question 10 asked the SLPs to provide more information about speech sound production errors that the children were demonstrating; 13 open-ended responses were recorded. The following statements were reported:

- This client has difficulty with initial sounds in words and with producing accurate syllables. This is all likely linked to his difficulty with oral motor skills and CP diagnosis.
- Final consonant deletion. Substitutes effortful /b/ for many sounds. Can produce /l/ in isolation consistently, but cannot produce it in blends. Cluster reduction.
- Cluster reduction.
- Cluster reduction of s-blends.
- Had previous therapy focused on /θ/ and /ð/ (voiced and voiceless), /l/, /s/, /z/, and /ʃ/.
- /s/-blends are misarticulated greater than 50% of the time in any position.

- /l/-blends.
- Previous therapy targeted voiced/voiceless /θ/ and /ð/, /r/, /l/. This student just finished school-based speech therapy in the last two months.
- Blends.
- Student has severe cerebral palsy and is unable to produce words that [are] intelligible without a known context.
- We are working on pre-Braille activities–student is too young to teach Braille, so we are exposing student to tactile scanning and Braille/ Print Text books. Also, the student has been fitted for hearing aids, but at present does not tolerate when they are in his ears and turned on. He will tolerate them when they are in his ears and turned off.
- Nasalization of all sounds.
- We attempted to obtain bilabial sounds with limited progress.

P**honeme errors of entire sample.** The data revealed in questions 7-10 allowed for the creation of a composite table. Table III, Speech Sound Errors as Reported for the Entire Sample, lists the speech sounds that respondents reported as currently being in treatment. All 24 phonemes were being treated for at least one child within the sample. Absent the children reported as being non-verbal, all other children in the sample had some speech sound production errors. Some SLPs did not report specific speech sound errors, but indicated that those children's speech sound productions could be categorized as distortions. To serve as an overview for the entire sample, Table III provides information regarding the children's severity of VI and whether the VI has been present since birth. The far right column, "Coexisting Conditions," indicates the subsets of

children with coexisting conditions that can be found later in this chapter in the discussion of questions 14-17.

Table III

Speech Sound Errors as Reported for the Entire Sample

Age	Gender	Speech Sounds Currently Being Treated	Severity of VI	VI Present Since Birth	Coexisting Conditions
4	Female	/f/, /r/, /l/, /v/ /θ/, /ð/	Low vision	Yes	Complex conditions, birth through age 8
4	Male	No specific sounds are reported as being treated	Legally blind	Yes	Dual sensory impaired
5	Male	No specific sounds are reported as being treated-reported as non-verbal	Legally blind	Yes	Non-verbal
5	Male	/p/, /g/, /j/, /s/, /ʧ/, /ʃ/, /ʤ /	Legally blind	Yes	Complex conditions, birth through age 8
5	Female	No specific sounds are reported as being treated-reported as non-verbal	Low vision	Yes	Non-verbal
5	Female	No specific sounds are reported as being treated	Legally blind	No	Complex conditions, birth through age 8
6	Female	No specific sounds are reported as being treated	Legally blind	Yes	Complex conditions, birth through age 8
6	Female	/p/, /m/, /h/, /n/, /w/, /b/, /k/, /g/, /d/, /t/, /ŋ/, /f/, /j/, /r/, /l/,/s/, /ʧ/, /ʃ/, /z/, /ʤ/, /v/, /θ/, /ð/, /ʒ/	Blind	Yes	Complex conditions, birth through age 8
7	Male	/ŋ/, /j/,/s/, /ʃ/, /θ/, /ð/	Low vision	Yes	Complex conditions, birth through age 8
7	Male	/p/, /m/, /h/, /n/, /b/, /k/, /g/, /d/, /t/, /ŋ/, /f/, /j/, /r/, /l/,/s/, /ʧ/, /ʃ/, /z/, /ʤ/, /v/, /θ/, /ð/, /ʒ/	Low vision	Yes	Motor speech disorders

Table continued on next page

7	Female	No specific sounds are reported as being treated-reported as non-verbal	Low vision	Yes	Non-verbal
7	Male	/f/, /s/, /ʃ/, /θ/, /ð/	Legally blind	No	Mild language disorder
7	Male	/p/,/m/ /b/, /f/, /v/	Blind	Yes	Complex conditions, birth through age 8
8	Female	/s/, /ʃ/, /z/	Blind	Yes	Complex conditions, birth through age 8
8	Male	/ʧ/, /ʃ/	Low vision	Yes	No other diagnoses
9	Male	/n/, /k/, /g/, /ŋ/, /f/, /ʧ/, /ʃ /,/ʤ/, /θ/, /ð/	Low vision	Yes	Dual sensory impaired
9	Male	/r/, /l/	Low vision	Yes	Complex conditions, age 9 and above
9	Female	No specific sounds are reported as being treated-reported as non-verbal	Low vision	Yes	Non-verbal
9	Male	/h/, /n/, /w/, /k/, /g/, /t/, /ŋ/, /f/, /j/, /r/, /l/, /s/, /ʧ/, /ʃ/, /z/, /ʤ/, /v/, /ʒ/	Low vision	Yes	Complex conditions, age 9 and above
9	Female	/s/, /ʧ/,/ʃ/ /z/	Low vision	Yes	Mild language disorder
10	Male	/s/, /z/, /θ/	Legally blind	Yes	Complex conditions, age 9 and above
10	Female	/p/, /b/, /k/, /g/, /ŋ/, /f/, /s/, /ʧ/, /z/, /ʤ/, /θ/, /ð/, /ʒ/	Low vision	No	Dual sensory impaired
10	Female	/w/, /ŋ/, /ʧ/, /ʃ/, /ʤ/, /ʒ/		Yes	Complex conditions, age 9 and above
11	Male	No specific sounds are reported as being treated-reported as non-verbal	Legally blind	Yes	Non-verbal
11	Male	/m/, /n/, /k/, /g/, /t/, /r/, /l/, /ʧ/, /ʃ/, /z/, /ʤ/, /θ/, /ð/, /ʒ/	Blind	Yes	Motor speech disorders

Table continued on next page

11	Male	/l/	Blind	Yes	Complex conditions, age 9 and above
11	Female	/l/, /θ/, /ð/	Legally blind	Yes	Complex conditions, age 9 and above
11	Male	/s/, /z/, /θ/, /ð/	Blind	Yes	Mild language disorder
12	Female	No specific sounds are reported as being treated	Low vision	Yes	Complex conditions, age 9 and above
12	Female	/s/	Low vision	Yes	No other diagnoses
12	Female	/p/, /m/,/b/, /l/, /θ/, /ð/	Blind	No	Complex conditions, age 9 and above
13	Female	No specific sounds are reported as being treated	Low vision	Yes	Complex conditions, age 9 and above
13	Female	/s/, /z/, /θ/, /ð/	Blind	Yes	Dual sensory impaired
14	Female	/s/, / ʧ /,/ʃ/, /z/	Low vision	Yes	Complex conditions, age 9 and above
14	Female	/θ/, /ð/	Legally blind	Yes	Complex conditions, age 9 and above
14	Male	/r/, /l/, / ʧ /,/ʃ/ /ʤ/	Low vision	Yes	Mild language disorder
14	Male	/s/	Low vision	Yes	No other diagnoses
15	Female	/ ʧ /, /ʃ/, /ʤ/, / ʒ /	Low vision	No	Motor speech disorders
17	Female	/p/, /m/, /h/, /n/, /w/, /b/, /k/, /g/, /d/, /t/, /ŋ/, /f/, /j/, /r/, /l/,/s/, /ʧ/, /ʃ/, /z/, /ʤ/, /v/, /θ/, /ð/, /ʒ/	Legally blind	Yes	Motor speech disorders
17	Female	/k/, /g/, /r/, /l/, /s/, /z/, /θ/, /ð/	Blind	Yes	Motor speech disorders
18	Male	/r/, /l/, /θ/, /ð/	Legally blind	Yes	Motor speech disorders
18	Female	No specific sounds are reported as being treated	Low vision	Yes	Complex conditions, age 9 and above

Table continued on next page

19	Female	/p/,/f/, /ʧ/, /v/	Low vision	Yes	Motor speech disorders
19	Female	/θ/, /ð/	Legally blind	Yes	Complex conditions, age 9 and above
20	Female	/p/, /h//t/, /f/, /v/	Low vision	Yes	Complex conditions, age 9 and above
22	Male	/θ/, /ð/	Blind	Yes	Complex conditions, age 9 and above

Table III Speech Sound Errors as Reported for the Entire Sample, is visually represented in Figure 6, Speech Sounds Currently Being Treated, Over Sample. The x-axis notes each of the 24 consonantal phonemes in order of typical acquisition. The y-axis notes the number of children currently being treated for each speech sound. As Figure 6 shows, more of the later developing sounds were still in error.

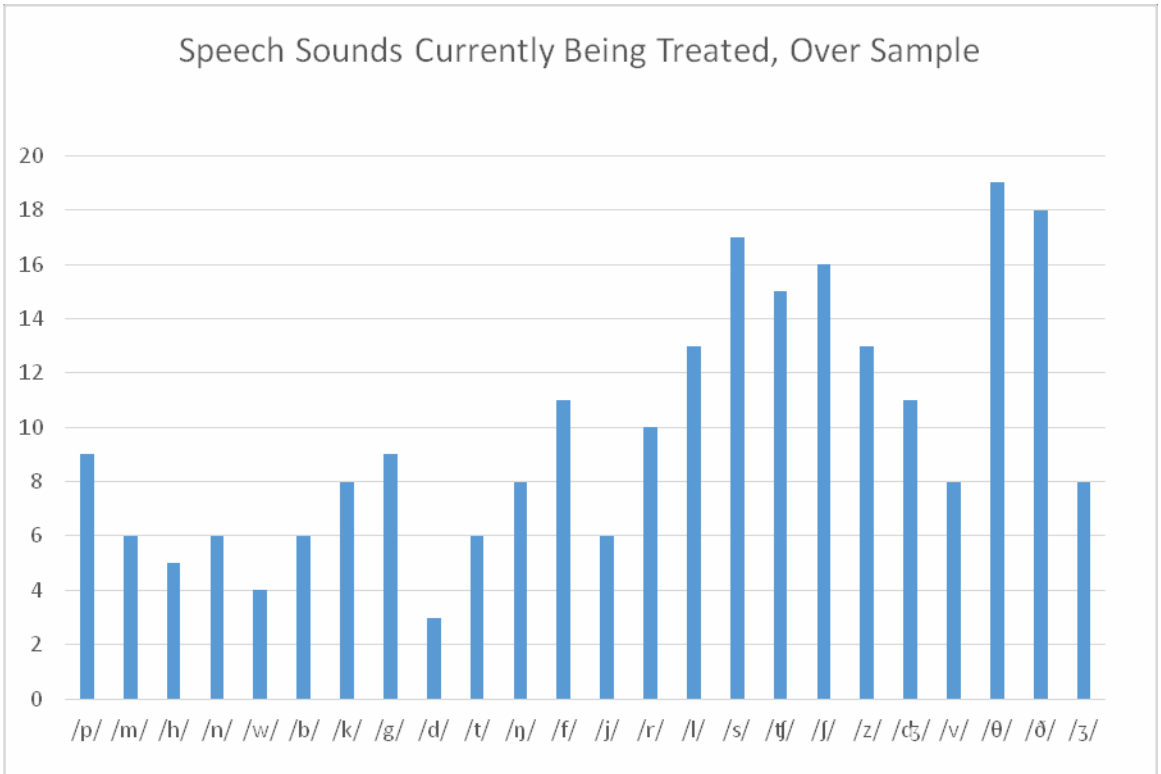

Figure 6: Speech Sounds Currently Being Treated, Over Sample

Overall, these children with visual impairment had delayed speech sound production mastery when compared to developmental norms (Sander, 1972).

4.1.3. Questions 11-13: Phonological Processes Exhibited within the Sample

Questions 11 through 13 dealt with the presence of phonological processes. Question 11 yielded 46 responses that described each child's speech sound productions. These reports included the following: distortions (articulation errors) were reported 25 times, a combination of articulation and phonological processes was reported 8 times, apraxia and dysarthria were reported 6 times each, and phonological processes was reported once. Questions 12 and 13 addressed phonological processes, with question 12 asking to specify which phonological processes occurred most often. Responses for Question 12 included checking the response boxes for several phonological processes: fronting at 3 times, backing at 1 time, stopping at 2 times, devoicing at 2 times, voicing at 2 times, cluster reduction at 9 times, final consonant deletion at 3 times, gliding at 6 times, "other" was reported 5 times, and 14 responses indicated the child exhibited no phonological processes. Here the responses for Questions 11 and 12 were inconsistent. Although for Question 11 there were a total of 9 responses affirming the presence of phonological processes, in Question 12 a total of 28 instances were reported, along with 3 "other" responses. It should also be noted that in the open-ended Question 10, SLPs indicated the phonological processes of nasalization once and cluster reduction once (cluster reduction was then chosen as an option for Question 12). Question 13, which asked the SLPs to indicate if other phonological processes were evident, yielded one report of nasalization, one report of syllable deletion, and one report of interdentalization (/θ/ or /ð/ for /f/, /d/, and /v/).

Table IV, SLPs' Categorization of Speech Sound Errors and Figure 8, Speech Sound Errors Currently Being Treated, by SLPs' Categorization of Speech Sound Errors, portrays the data reported. Table IV shows the number of responses obtained for each question and breaks down the number of response options per question. Figure 8 provides a visual representation of speech sounds that were currently being treated within each categorization of speech sound error reported by the respondents. In Figure 8, it is evident that those children whose speech sound errors were categorized as distortions had a higher percentage of speech sounds in error when compared to other categorizations such as apraxia, dysarthria, and phonological processes. This is likely because a higher percentage of SLPs categorized the children's speech sound errors as distortions.

Figure 9, Phonological Processes Demonstrated, Over Sample, provides a visual representation of the number of phonological processes reported by the SLPs. The x-axis indicates the number of children reported as exhibiting that phonological process. The y-axis indicates the phonological process option provided by the survey. There were 31 instances of a phonological processes reported amongst the sample and 14 children who exhibited no phonological processes.

Table IV

SLPs' Categorization of Speech Sound Errors

Survey Questions	Number of Responses				
11. Speech sounds are primarily:	Distortions	Combination of articulation and phonological processes	Apraxia	Dysarthria	Phonological processes
	25	8	6	6	1
12. If phonological processes are evident, which are most occurring	Fronting	Backing	Stopping	Devoicing	Voicing
	3	1	2	2	2
	Cluster reduction	Final consonant deletion	Gliding	No phonological processes	Other
	9	3	6	14	3
13. If other phonological processes are occurring, please describe below:	3				

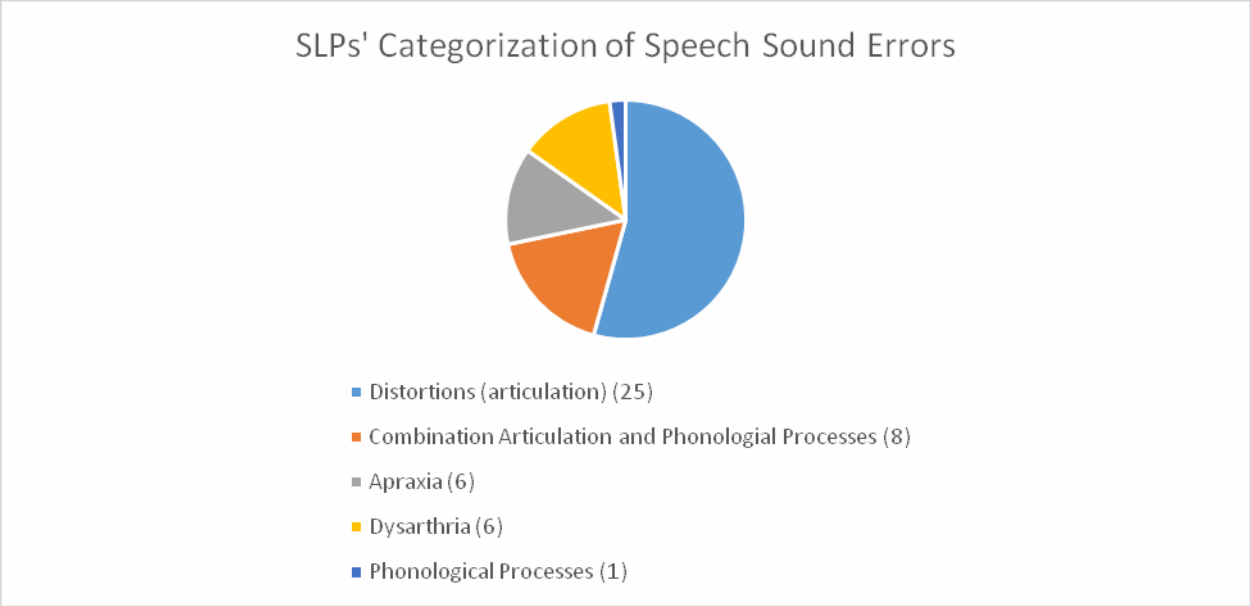

Figure 7: SLPs' Categorization of Speech Sound Errors

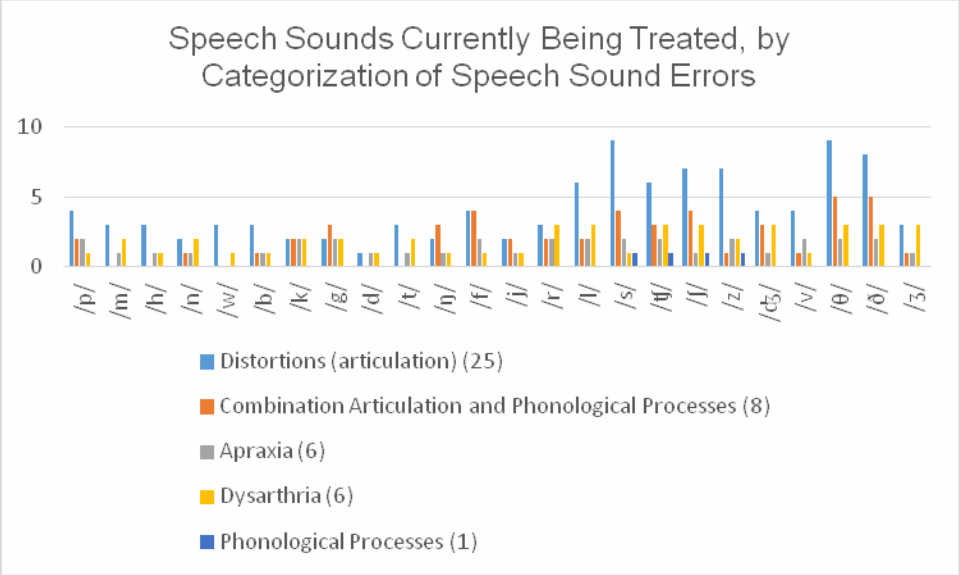

Figure 8: Speech Sounds Currently Being Treated, by Categorization of Speech Sound Errors.

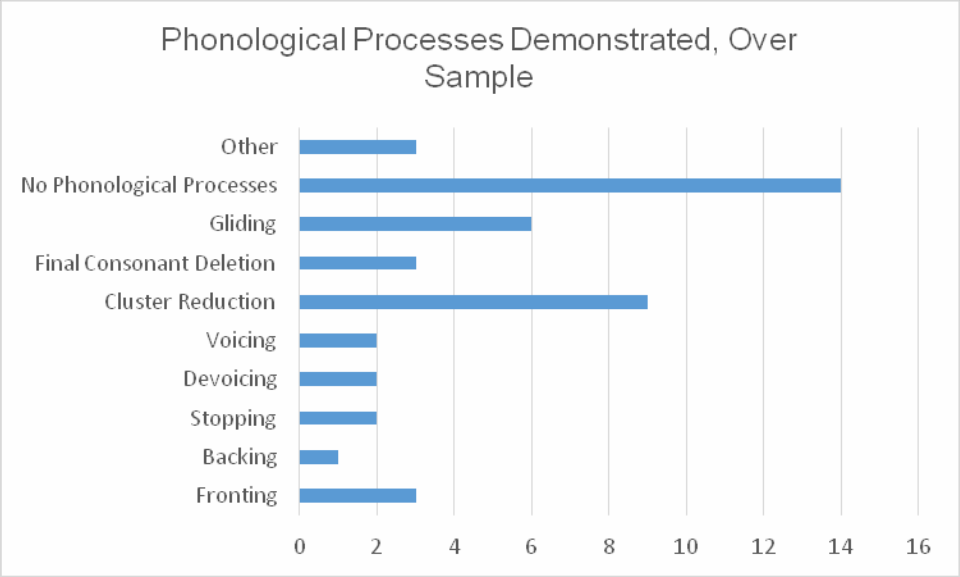

Figure 9: Phonological Processes Demonstrated, Over Sample.

4.1.4. Questions 14-17: Notable Subsets of the Sample

Questions 14 through 17 asked the respondents to relate each child's speech sound production to the child's other diagnoses. Forty-six SLPs responded to question 14, which asked how the speech sound production problem was related to the children's vision problem. There were 4 options for this question: that the speech sound production problem was related to a vision problem (e.g., both have the same origin, such as cerebral palsy), which received 5 responses; that the speech sound production problem was probably related to a vision problem, receiving 4 responses; that the speech sound production problem was not related to a vision problem, which received 31 responses. There were 6 responses that indicated that the relation of the speech sound production problem to the vision problem was not certain.

Question 15 asked for the SLPs' opinions about the children's speech sound production skills. There were 4 responses that indicated that four children's speech sound production skill was expected for age level; 14 reports that the speech sound production

skill was expected given the child's primary diagnostic condition (e.g., cerebral palsy); 24 reports that speech sound production skill was unexpected for age level; there was 1 report that indicated that speech sound production skill was unexpected given the child's primary diagnostic conditions (e.g., cerebral palsy); there were 3 reports by the SLPs indicating that they did not know the relationship between the primary diagnostic condition and the speech sound production problem.

Question 16 provided a chance for the SLPs to give more information about the other diagnoses that the children have. This question asked the SLPs to indicate each child's other diagnoses, with 16 options from which to choose. Table V, Relation of Vision Problems to Other Diagnoses portrays the reported data for Questions 14-17.

Table V

Relation of Vision Problem to Other Diagnoses

Survey Question	Number of Responses				
14.The student's speech sound production problem:	Is related to a vision problem	Is probably related to a vision problem	Is probably not related to a vision problem	Do not know	
	5	4	31	6	
15.The student's speech sound production skill is:	Expected for age level	Expected given primary diagnosis	Unexpected for age level	Unexpected given primary diagnosis	Do not know
	4	14	24	1	3

Table continued on next page

16.This student has been diagnosed with:	Mild language delay/disorder 5	Moderate language delay/disorder 11	Severe language delay/disorder 7	Mild cognitive impairment 4
	Moderate cognitive impairment	Severe cognitive impairment	A genetic disorder (any syndrome, sequence)	Cerebral palsy, prematurity, low birth weight, other birth-related issues
	12	4	9	20
	Encephalitis, meningitis, other illness of the brain	Brain injury after the age of 2	Autism	Injury to or disease of the eye or visual mechanism
	3	1	3	8
	Metabolic or growth/development disorder	I am not sure	No other diagnoses	Other (please specify)
	1	1	4	11
17. If the student has other primary diagnosis (e.g., Down Syndrome, Fragile X) or if you would like to provide other relevant information to explain your responses for this student, use the space below	12			

For questions 16, there were 5 reports of a mild language delay/disorder; 11 reports of a moderate language delay/disorder; 7 reports of a severe language delay/disorder; 4 reports of a mild cognitive impairment; 12 reports of a moderate cognitive impairment; 4 reports of a severe cognitive impairment; 9 reports of a genetic disorder (any syndrome or sequence); 20 reports of cerebral palsy, prematurity, low birth weight, other birth-related issues; 3 reports of encephalitis, meningitis, other illness of the brain; 1 report of a brain injury after the age of 2; 3 reports of autism; 8 reports of injury or disease to the eye or visual mechanism; 1 report of a metabolic or growth development disorder; 1 report of the SLP being unsure; 4 reports indicating there were no other diagnoses; and 11 reports indicating the option "other." There were 11 open-ended responses offered. It is possible that some of these open-ended responses should have been included within the forced-choice options. The 11 open-ended responses were:

- Unspecified disorder; this student is classified as deaf-blind, having both a vision impairment and hearing loss. He has severe structural abnormalities in his mouth and has had facial surgery. He will likely have future surgeries. Increasing overall intelligibility is the focus of therapy, rather than specific sounds due to structural abnormalities.
- Cerebral palsy, limited ambulation (needs assistance) and typically uses a wheelchair.
- Albinism.
- Cohen syndrome.
- Fetal alcohol syndrome. Received recent medical diagnosis of autism; did not qualify for educational identification of autism.

- Student has retinopathy of prematurity. Was born at 24 weeks.
- Has severe rod-cone dystrophy causing loss of eyesight at about four years old.
- Cortical visual impairment, and orthopedic impairment (cerebellar hypoplasia).
- Low tone, articulation disorder.
- She had a degenerative disease. She was born with vision, but was gradually going blind over time.
- Epilepsy.

Question 17 asked the SLPs to report whether the student had other primary diagnoses, or if there was more information needed to explain the responses that were given for that particular student. Twelve open-ended responses were obtained:

- Cerebral palsy, very high palate, and difficulty with independent feeding that all impact his ability to articulate sounds clearly. Articulation therapy has focused on accurate initial sounds in words and accurate syllables to increase intelligibility instead of specific sound errors. This client cognitively has a lot to say and has strong receptive language skills. He is severely delayed in speech production, but not in language (receptive), suspected due to structural abnormalities of his mouth and cerebral palsy.
- He has improved his ability to correct errors in sounds and the focus of therapy is moving towards only focusing on language.
- Student is adopted and has albinism. She likely had limited language exposure (and none in English) prior to being adopted at close to age 2. She is quickly making progress in language and articulation therapy and we have even started

working on sound awareness for sounds such as /th/ and /r/ which are common errors at age 3.

- Student was born premature, had in utero stroke. Eye condition: microcornea, Glaucoma (secondary to microcornea) and aphakia (secondary to microcornea). Basis of eye condition: anatomical.
- Congenital cataracts; congenital glaucoma.
- Moebius syndrome.
- Optic nerve hypoplasia.
- Peter's anomaly.
- The student sustained TBI [traumatic brain injury] in MVA [motor vehicle accident] approximately 4 years ago in Texas and exhibits severe deficits for short and long-term memory, which affects sustained progress with therapy. She has been at the residential school for almost three years. She has also undergone neuropscyhological testing at area hospital.
- In-utero stroke.
- Diagnosed with Treacher-Collins syndrome.
- 6Q Deletion - a genetic disorder that includes varying degrees of blindness, agenesis of the corpus callosum, microcephaly. My client is completely blind in one eye legally blind in the other. She has language but it is mostly echolalia and babble.

In order to analyze the children based on their coexisting diagnoses, it was necessary to collapse these various diagnoses into manageable subsets. Seven subsets emerged based on their diagnostic commonalities. Questions 14-17 provided the

information that was used to categorize children into seven diagnostic subsets, as seen in Figure 10, Subsets of the Sample. Of the 46 children, only three children had no other diagnoses that are known to affect speech sound production. It is apparent that these other diagnoses cannot be overlooked and that the speech sound production errors could not be solely attributed to VI.

Each child was assigned to only one subset, even when the child had multiple diagnoses. Assigning children to just one subset was determined by considering a hierarchy of the diagnostic importance of the setting in which the VI occurred. For example, if a child was identified as being non-verbal, but also qualified for the motor speech disorder subset, he/she was placed in the non-verbal subset based on reason that being non-verbal has more diagnostic importance in his/her case. The most complicating or disabling condition was used to categorize each child. Potentially, the most disabling condition would have the greatest detrimental effect on speech sound production.

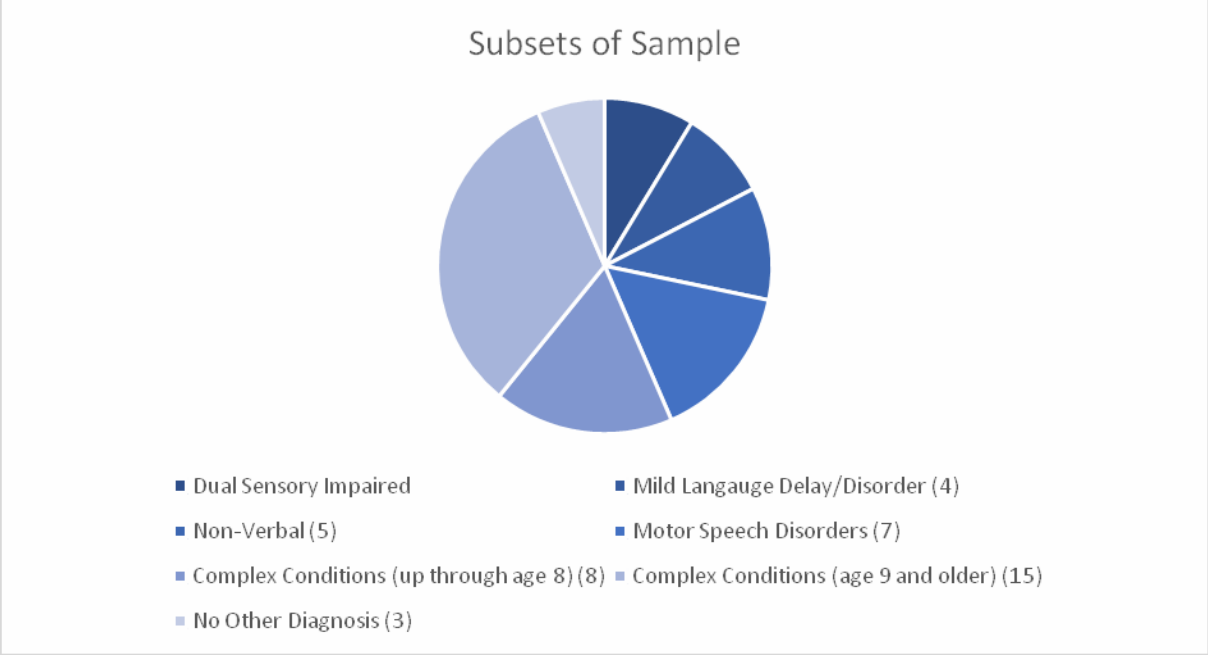

Figure 10: Subsets of the Sample.

It is evident that VI co-occurred with other impairments or conditions, or appeared in the setting of other impairments or conditions. These seven subsets help explain why the children with VI might produce speech sound production errors.

4.2. Subsets of the Sample

The 46 children were each assigned to a subset. The subsets are:

- Children with no other diagnoses,
- Children with dual sensory impairments,
- Children with mild language disorder,
- Children with motor speech disorders,
- Children identified as non-verbal,
- Children with complex conditions, up through age 8,
- Children with complex conditions, age 9 and older.

4.2.1. Children with No Other Diagnoses

There were 3 children reported to have had no other diagnoses. The three children in this subset account for 3 of the 46 children on whom information was obtained, representing 6% of the sample. These children presented with VI and speech sound production errors that could not be attributed to any other diagnoses. These children, who were all age 8 or older, had in common several traits: normal hearing; low vision as the severity of VI; they were in the process of learning or had learned braille; they had no phonological disorders; in the SLP's opinion, the child's speech sound production irregularities are probably not related to a vision problem; and the speech sound production errors are categorized as distortions of /s/ for two children, with the third child demonstrating distortions of /ʧ/and /ʃ/. Table VI, Children with No Other Diagnoses and

Figure 11, Speech Sounds Currently Being Treated, with No Other Diagnoses, illustrate these children's speech sound production errors.

Table VI

Children with No Other Diagnoses

Age	Gender	Speech Sounds Currently Being Treated	Other Information
8	Male	/ʧ/, /ʃ/	Distortions
12	Female	/s/	Distortions
14	Male	/s/	Distortions

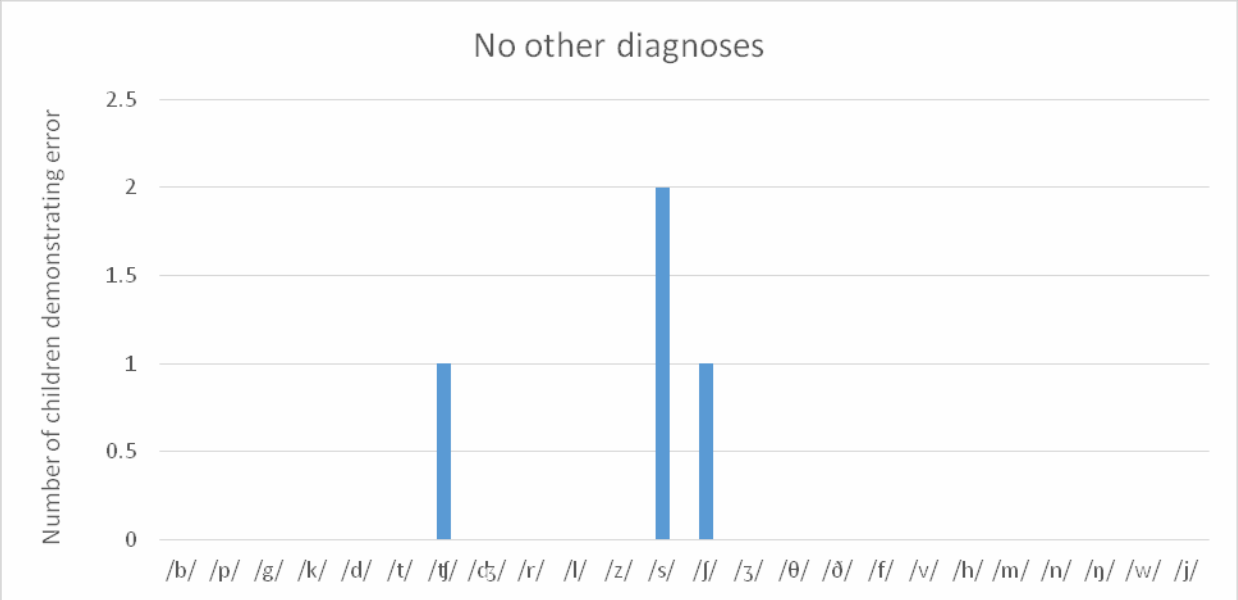

Figure 11: Speech Sounds Currently Being Treated, with No Other Diagnoses

4.2.2. Dual Sensory Impaired

There were a total of six children who were reported as having some level of hearing impairment. Two of those children were reported as having a motor speech disorder (apraxia or dysarthria) but were identified as non-verbal. They were excluded from this subset on the grounds that being non-verbal is the more disabling condition for

speech sound production errors; they are reported within the non-verbal subset. For the dual sensory impaired subset, four children—representing 9%—of the sample were categorized. These four children, combined with the three children from the subset of children having no other diagnoses, account for seven of the 46 children. Three of the four children in the dual sensory impaired subset were age 9 or older.

Question 5 asked if a child's need for speech sound production therapy was a result of a hearing impairment. Within this representation of children with dual sensory impairment, SLPs indicated that three of these children's speech sound production therapy needs were suspected to be a consequence of the hearing impairment. Two of the children, identified as having a severe or moderate hearing impairment, were reported as having nine or more speech sounds in error while the other two children, both identified as having a mild hearing impairment, were reported as having zero to four speech sounds in error. Table VII, Children with Dual Sensory Impairment, and Figure 12, Speech Sounds Currently Being Treated, by Dual Sensory Impairment, illustrate the nature of the speech sound production errors in this subset.

Table VII

Children with Dual Sensory Impairment

Age	Gender	Hearing Aids	Speech Sounds Currently Being Treated	Other Information
4*	Male	No	Sounds not reported	Genetic disorder: Peter's Anomaly
9	Male	Yes	/n/, /k/, /g/, /ŋ/, /f/, /ʃ/, /ʃ /,/ʤ/, /θ/, /ð/	Mild language delay/disorder; identified as deaf-blind; unspecified genetic disorder; and CP/prematurity/low birth weight/birth-related issues
10	Female	Yes	/p/, /b/, /k/, /g/, /ŋ/, /f/, /s/, /ʧ/, /z/, /ʤ/, /θ/, /ð/, /ʒ/	Moderate language delay/disorder; injury to or disease of the eye or visual mechanism; this student also has a cochlear implant
13	Female	No	/s/, /z/, / θ /, / ð /	No other diagnoses

*While no specific speech sounds were reported to be in error for this child, it was reported elsewhere that the child exhibits nasalization of all sounds and sounds are characterized as distortions.

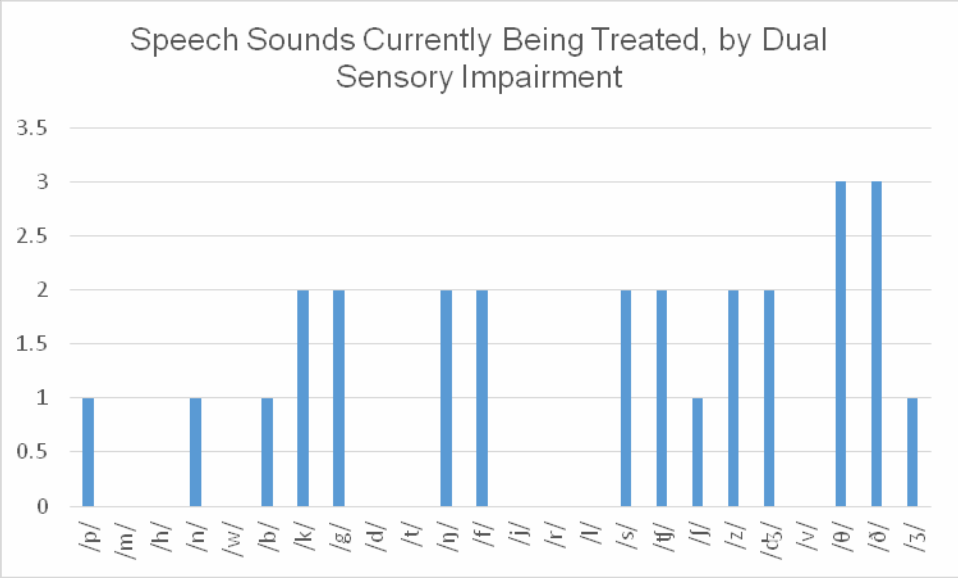

Figure 12: Speech Sounds Currently Being Treated, by Dual Sensory Impairmen

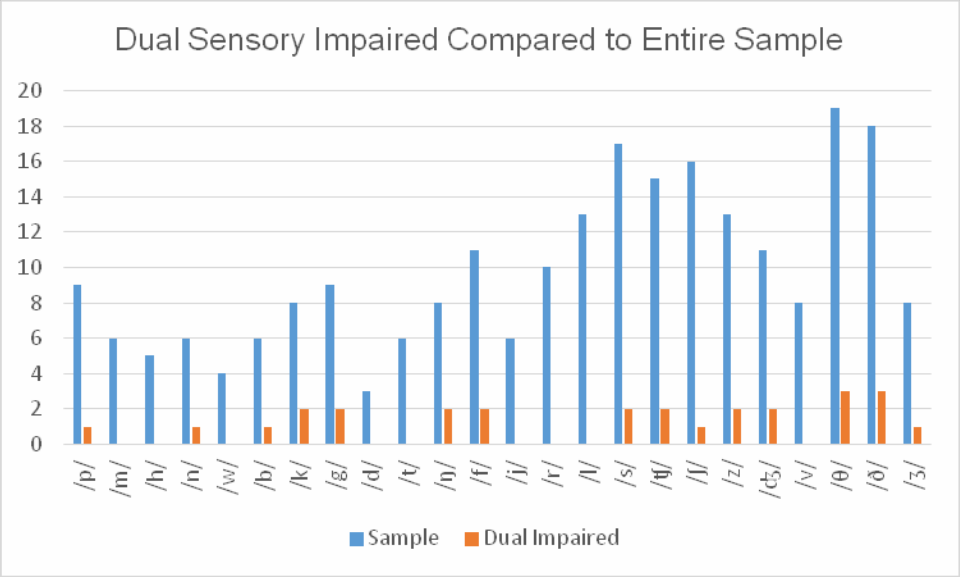

Figure 13: Dual Sensory Impaired Compared to Entire Sample.

4.2.3. Non-verbal

There were five children—representing 11% of the sample—identified as non-verbal, and there are thus no speech sound errors to analyze. These five children combined with the seven children in the two previous subsets account for 12 of the 46 children.

Two of the five children in this subset were reported to have a moderate hearing loss, but their data are being analyzed within this subset due to their lack of speech sound production (being nonverbal is the more disabling condition for speech sound production). As a group, the children in this subset all display motor speech disorders: two were identified as having dysarthria and three were identified as having apraxia. This subset also exhibited several co-occurring conditions, as shown in Table VIII, Children Identified as Non-verbal.

Table VIII

Children Identified as Non-verbal

Age	Gender	Identified Motor Disorder	Other Information
5	Female	Apraxia	Severe language delay/disorder; severe cognitive impairment; cerebral palsy, prematurity, low birth weight, other birth-related issues; encephalitis, meningitis, other illness of the brain; injury to or disease of the eye or visual mechanism; metabolic or growth/development disorder; epilepsy
5	Male	Apraxia	A genetic disorder (any syndrome, sequence); moderate hearing loss
7	Female	Apraxia	Cerebral palsy, prematurity, low birth weight, other birth-related issues
9	Female	Dysarthria	Severe language delay/disorder; severe cognitive impairment; cerebral palsy, prematurity, low birth weight, other birth-related issues; encephalitis, meningitis, other illness of the brain
11	Male	Dysarthria	A genetic disorder (any syndrome, sequence); Treacher-Collins syndrome; moderate hearing loss

4.2.4. Motor Speech Disorders

There were 12 children identified as having a motor speech disorder, which is 26% of the total sample. Five of these 12 children were identified as being non-verbal and were described in the subset shown in Table VIII, Children Identified as Non-Verbal. This leaves seven children within the motor speech disorders subset. With a current tally of 12 children in the subsets for no other diagnoses, dual sensory impairments, and non-verbal, the addition of these seven children leads to an aggregate of 19 of the 46 children accounted for within these subsets.

For these seven children, speech sound production errors were plentiful. These children also had a range of co-morbid conditions or impairments, as shown in Table IX, Children Identified with Motor Speech Disorders and Figure 14, Speech Sounds Currently Being Treated, by Motor Speech Disorder.

Table IX

Children Identified with Motor Speech Disorders

Age	Gender	Identified Motor Disorder	Speech Sounds Currently Being Treated	Other Information
7	Male	Apraxia	/p/, /m/, /h/, /n/, /b/, /k/, /g/, /d/, /t/, /ŋ/, /f/, /j/, /r/, /l/,/s/, /ʧ/, /ʃ/, /z/, /ʤ/, /v/, /θ/, /ð/, /ʒ/	Severe language delay/disorder; cerebral palsy, prematurity, low birth weight, other birth-related issues
11	Male	Dysarthria	/m/, /n/, /k/, /g/, /t/, /r/, /l/, /ʧ/, /ʃ/, /z/, /ʤ/, /θ/, /ð/, /ʒ/	Cerebral palsy, prematurity, low birth weight, other birth-related issues
15*	Female	Dysarthria	/ʧ/, /ʃ/, /ʤ/, /ʒ/	Moderate language delay/disorder; moderate cognitive Impairment; brain injury after the age of 2
17	Female	Dysarthria	/p/, /m/, /h/, /n/, /w/, /b/, /k/, /g/, /d/, /t/, /ŋ/, /f/, /j/, /r/, /l/,/s/, /ʧ/, /ʃ/, /z/, /ʤ/, /v/, /θ/, /ð/, /ʒ/	Cerebral palsy, prematurity, low birth weight, other birth-related issues.
17	Female	Apraxia	/k/, /g/, /r/, /l/, /s/, /z/, /θ/, /ð/	Moderate language delay/disorder; moderate cognitive impairment; severe cognitive impairment; cerebral palsy, prematurity, low birth weight, other birth-related issues; encephalitis, meningitis, other illness of the brain

Table continued on next page

18	Male	Dysarthria	/r/, /l/, /θ/, /ð/	Severe language delay/disorder; moderate cognitive impairment; cerebral palsy, prematurity, low birth weight, other birth-related issues
19	Female	Apraxia	/p/,/f/, /ʧ/, /v/	cortical visual impairment, and orthopedic impairment (cerebellar hypoplasia)

*This adolescent was in a motor vehicle accident four years prior to the survey. She is rehabilitating a traumatic brain injury. This adolescent's visual impairment was not present from birth; from this information, it is assumed that her speech sounds were previously typical.

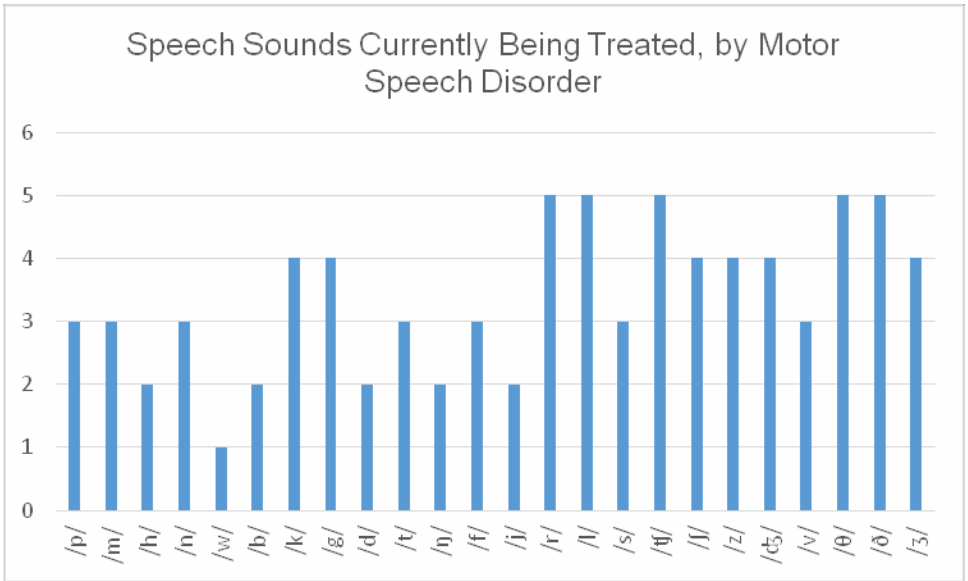

Figure 14. Speech Sounds Currently Being Treated, by Motor Speech Disorder

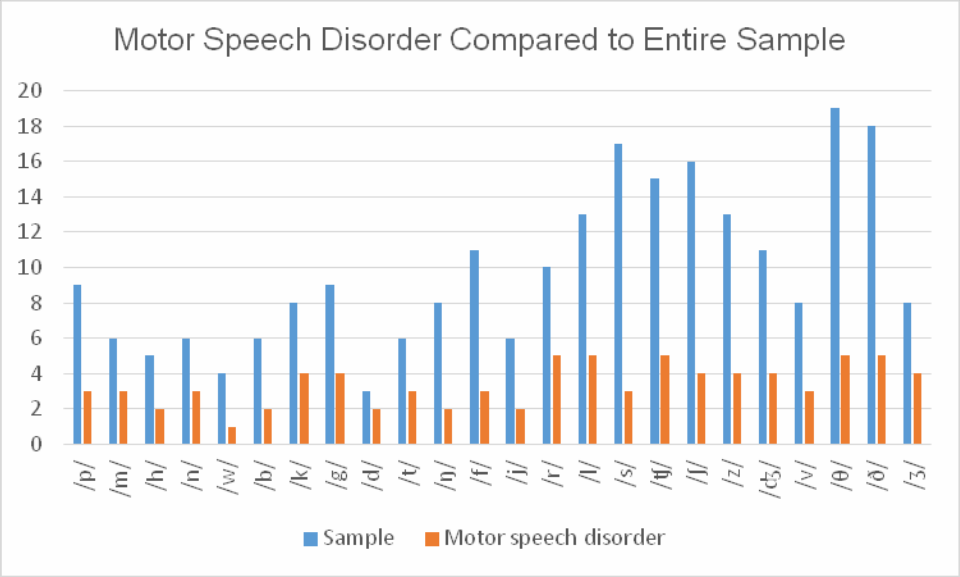

Figure 15. Motor Speech Disorder Compared to Entire Sample

4.2.5. Mild Language Disorder

This subset represents the least complicated cases amongst this sample of children with VI. There are four children—9% of the sample—in this subset. Thus far, 24 children have been tallied within the prior subsets; with the inclusion of this subset, 28 children have been counted.

The children with mild language disorder ranged in age from 7 to 14 years, and three children (75% of this subset) are male. All of these children were reported as having a mild language delay or disorder and normal hearing. One of the children had sustained an injury to or suffers from a disease of the eye or visual mechanism, and is the only one of the four where the visual impairment had not been present since birth; one child was reported as having a mild cognitive disorder; and one of the children was reported as having a "low tone, articulation disorder," but was not reported as having a motor speech disorder (apraxia or dysarthria), which precluded this child from being counted in the motor speech disorders subset. The speech sound production characteristics of this subset

are shown in Table X, Children with Mild Language Impairment and Figure 16, Speech Sounds Currently Being Treated, with Mild Language Disorder.

Table X

Children with Mild Language Impairment

Age	Gender	Speech Sounds Currently Being Treated	Other Information
7	Male	/f/, /s/, /ʃ/, /θ/, /ð/	Injury to or disease of the eye or visual mechanism
9	Female	/s/, /ʧ/,/ʃ/ /z/,	
11	Male	/z/, /s/, /θ/, /ð/	Low tone, articulation disorder
14	Male	/r/, /l/, /ʧ/,/ʃ/ /ʤ/	Mild Cognitive Impairment

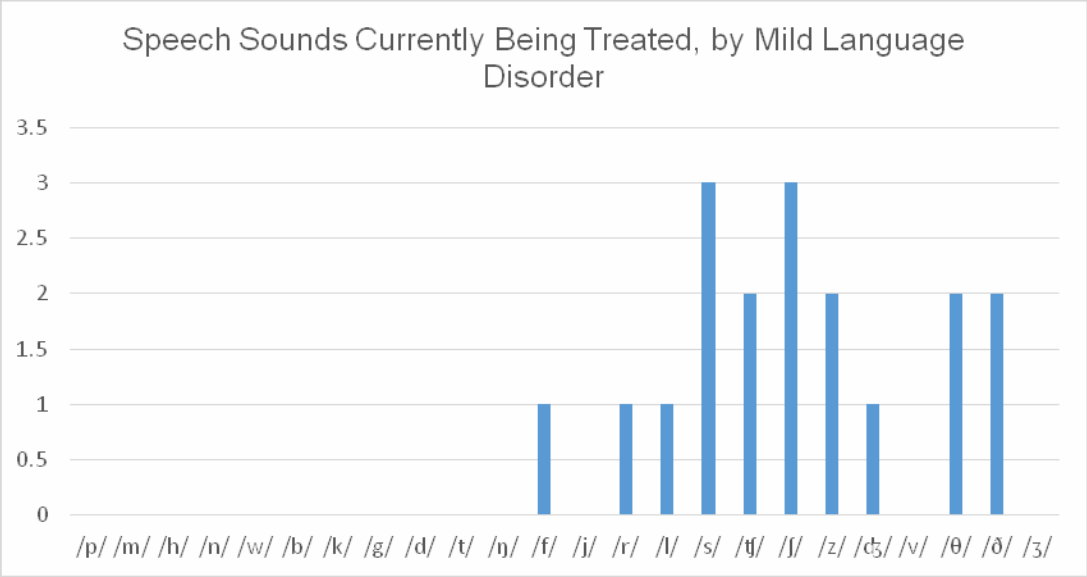

Figure 16: Speech Sounds Currently Being Treated, by Mild Language Disorder

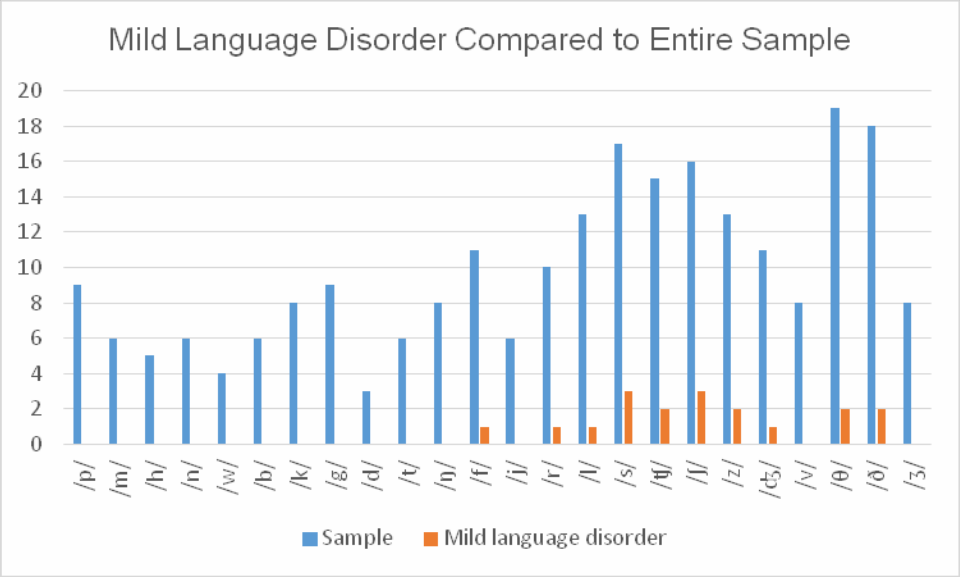

Figure 17: Mild Language Disorder Compared to Entire Sample.

4.2.6. Complex Conditions

The complex conditions subset represents complex cases that do not fit within the conditions of the other subsets. This subset is a compilation of children who have been precluded from the dual sensory impairment, non-verbal, motor speech disorders, and mild language impairment subsets based on the presence of other qualifying conditions that appear more critical. The complex conditions subset contains 23 children, which constitutes the remainder of the 46 reported cases (and is 50% of the sample). For purposes of making comparisons to the developmental norms for speech sound production, the complex conditions subset has been divided by age into two groups: children up through age 8 and children age 9 or older. The division was based upon Sander's (1972) determination that most typically developing children have acquired all English phonemes by about age 8.

Complex Conditions up Through Age 8. There are eight children in this group, comprising 17% of the total sample. The information for this subset is shown in Table XI

Children with Complex Conditions, Up Through Age 8, and Figure 18, Speech Sounds Currently Being Treated, by Complex Conditions Up through Age 8.

Table XI

Children with Complex Conditions, Up Through Age 8

Age	Gender	Speech Sounds Currently Being Treated	Other Information
4	Female	/f/, /r/, /l/, /v/ /θ/, /ð/	Albinism; adopted at age 2, with limited English language exposure prior to age 2
5	Male	/p/, /g/, /j/, /s/, /ʧ/, /ʃ/, /ʤ/	Moderate language delay/disorder; Mild Cognitive Impairment; Cerebral palsy, prematurity, low birth weight, other birth-related issues
5	Female	No specific speech sounds were reported as being treated; however, SLP reports that speech sound errors are primarily distortions.	SLP reports that this student had a degenerative disease, had been born with vision, but has gradually lost vision. Student, at the time of the survey, was reported as being legally blind.
6	Female	No specific speech sounds were reported as being treated; however, SLP reports that speech sound errors are primarily distortions. SLP states that there are no speech sound errors, that she is treating the student for language.	A genetic disorder (any syndrome, sequence): 6Q deletion. SLP reports that this student completely blind in one eye and legally blind in the other. Language mostly consists of echolalia and babble.
6	Female	/p/, /m/, /h/, /n/, /w/, /b/, /k/, /g/, /d/, /t/, /ŋ/, /f/, /j/, /r/, /l/,/s/, /ʧ/, /ʃ/, /z/, /ʤ/, /v/, /θ/, /ð/, /ʒ/	Severe language delay/disorder; A genetic disorder (any syndrome, sequence); Optic Nerve Hypoplasia

Table continued on next page

7	Male	/p/,/m/ /b/, /f/, /v/,	A genetic disorder (any syndrome, sequence): Moebius Syndrome
7	Male	/ ŋ /, /j/,/s/, /ʃ/, /θ/, /ð/,	Severe language delay/disorder
8	Female	/s/, /ʃ/, /z/,	Moderate language delay/disorder; Autism

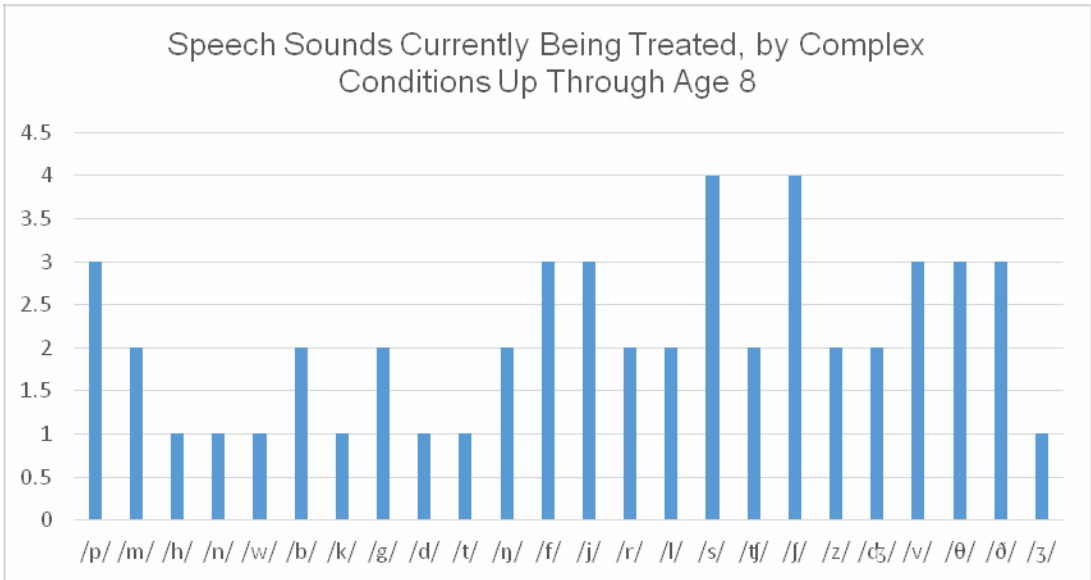

Figure 18: Speech Sounds Currently Being Treated, by Complex Conditions Up Through Age 8.

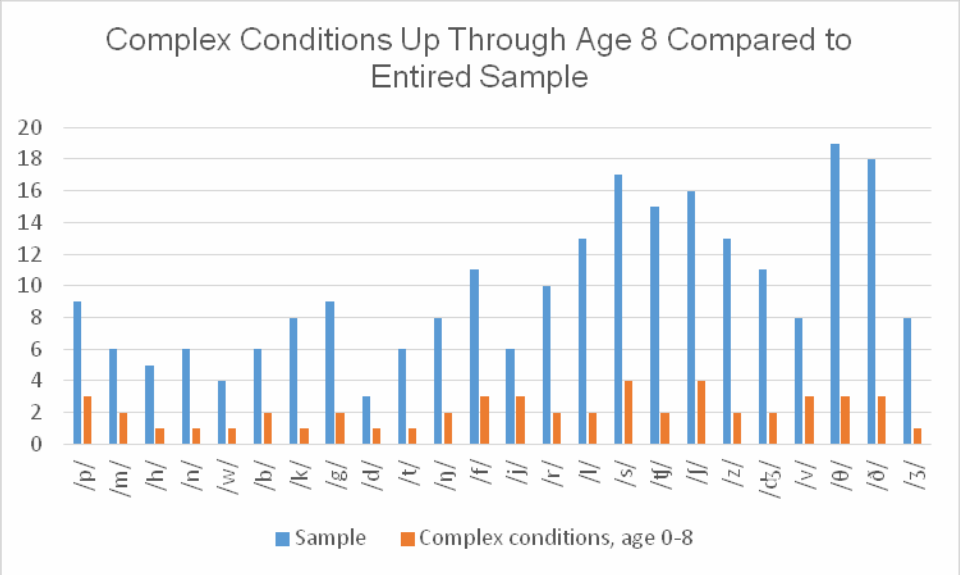

Figure 19: Complex Conditions Up Through Age 8 Compared to Entire Sample

Complex Conditions Age 9 or Older. This subset is comprised of children who were age 9 or older. This subset contains 15 children from the sample, 32% of the children on whom the SLPs reported. The age range of this subset is 9-22. Of the 15 cases, 11 were female and 6 were male. The details of this subset are found in Table XII, Children with Complex Conditions, Age 9 and Older, Figure 20, Speech Sounds Currently Being Treated, by Complex Conditions Age 9 and Older, and Figure 21, Complex Conditions Age 9 and Older Compared to Entire Sample.

Table XII

Children with Complex Conditions, Age 9 and Older

Age	Gender	Speech Sounds Currently Being Treated	Other Information
9	Male	/r/, /l/	Mild cognitive impairment; cerebral palsy, prematurity, low birth weight, other birth-related issues: fetal alcohol syndrome; autism
9	Male	/h/, /n/, /w/, /k/, /g/, /t/, /ŋ/, /f/, /j/, /r/, /l/, /s/, /ʧ/, /ʃ/, /z/, /ʤ/, /v/, /ʒ/	Severe language delay/disorder; moderate cognitive impairment; cerebral palsy, prematurity, low birth weight, other birth-related issues
10	Male	/s/, /z/, /θ/	Mild cognitive impairment cerebral palsy, prematurity, low birth weight, other birth-related issues: in utero stroke; injury to or disease of the eye or visual mechanism; microcornea, glaucoma (secondary to microcornea) and aphakia (secondary to microcornea). basis of eye condition: anatomical
10	Female	/w/, /ŋ/, /ʧ/, /ʃ/, /ʤ/, /ʒ/	Moderate language delay/disorder; severe cognitive impairment; injury to or disease of the eye or visual mechanism
11	Male	/l/	Cerebral palsy, prematurity, low birth weight, other birth-related issues: retinopathy of prematurity; injury to or disease of the eye or visual mechanism
11	Female	/l/, /θ/, /ð/	Moderate language delay/disorder; cerebral palsy, prematurity, low birth weight, other birth-related issues: in utero stroke, demonstration of dysarthria secondary to CP.

Table continued on next page

12	Female	No specific sounds are reported as being treated	Moderate language delay/disorder; moderate cognitive impairment
12	Female	/p/, /m/,/b/, /l/, /θ/, /ð/,	Moderate cognitive impairment; injury to or disease of the eye or visual mechanism; severe rod-cone dystrophy, loss of eyesight at age 4.
13	Female	No specific sounds are reported as being treated	Moderate language delay/disorder; moderate cognitive impairment; autism; injury to or disease of the eye or visual mechanism; congenital cataracts; congenital glaucoma
14	Female	/s/, /ʧ/,/ʃ/, /z/,	Moderate cognitive impairment; a genetic disorder (any syndrome, sequence): Cohen Syndrome
14	Female	/θ/, /ð/	Moderate language delay/disorder; moderate cognitive impairment; cerebral palsy, prematurity, low birth weight, other birth-related issues
18	Female	No specific sounds are reported as being treated	Moderate language delay/disorder; moderate cognitive impairment
19	Female	/θ/, /ð/	Moderate language delay/disorder; moderate cognitive impairment; cerebral palsy, prematurity, low birth weight, other birth-related issues
20	Female	/p/, /h/, /t/, /f/, /v/,	Cerebral palsy, prematurity, low birth weight, other birth-related issues
22	Male	/θ/, /ð/	Moderate cognitive impairment; cerebral palsy, prematurity, low birth weight, other birth-related issues

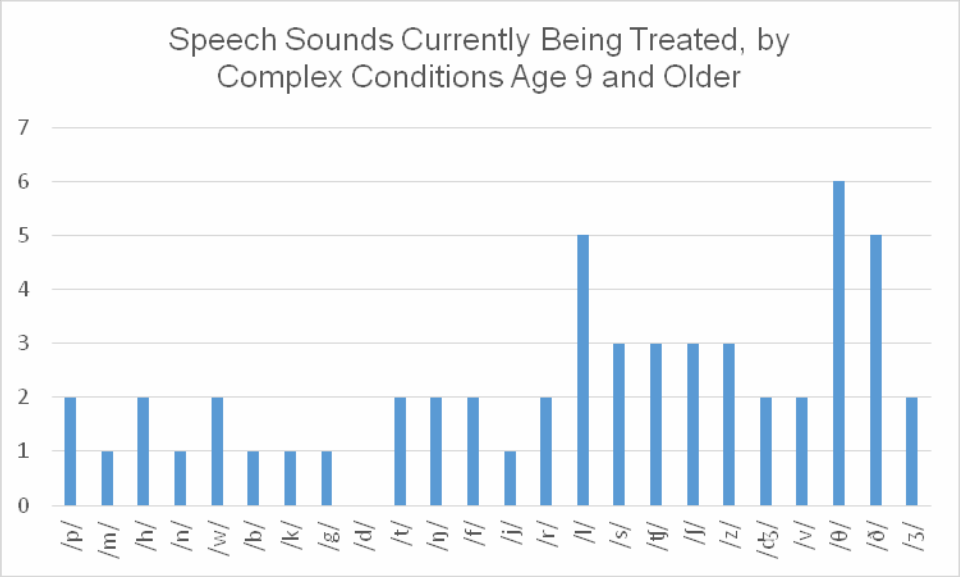

Figure 20: Speech Sounds Currently Being Treated, by Complex Conditions Age 9 and Older.

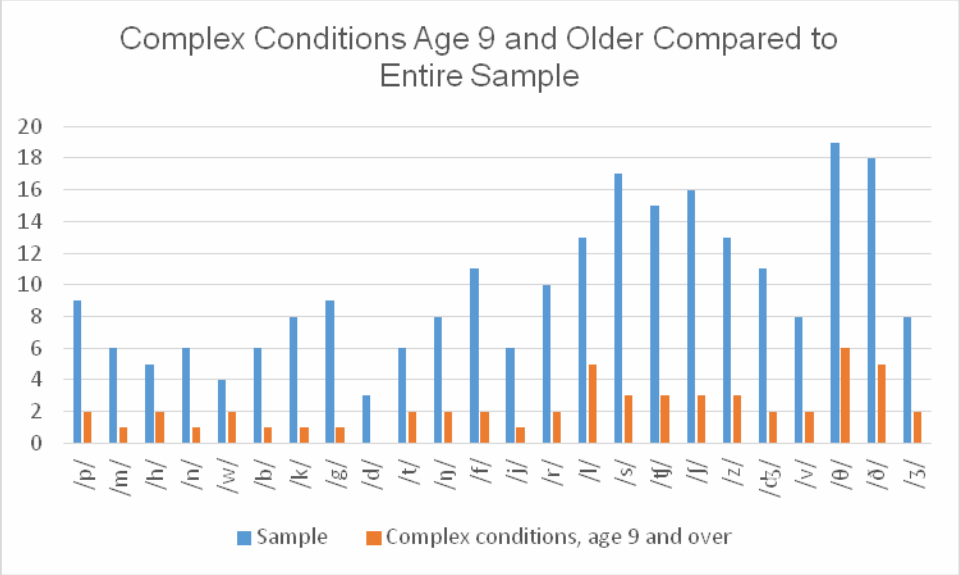

Figure 21: Complex Conditions Age 9 and Older Compared to Entire Sample

4.2.7. Questions 18-26: Survey Questions Pertaining to Previous Speech-Language Therapy

Questions 18-26 covered the child's history of participation in speech-language therapy. Question 18 asked whether the SLPs had sufficient history with the child to report on past speech-language therapy and if they would like to report about treatment history. There were 46 responses: 28 were yes and 18 responded no. Those who responded yes to question 18 continued with the remainder of the survey.

Questions 19 and 20 both probed for a description of previous speech sounds that were no longer in error. There were 18 responses to both questions across 24 phonemes. Reported as being in error were /p/ at 3 times; /m/ at 1 time; /h/ at 1 time; /n/ at 1 time; /w/ at 1 time; /b/ at 2 times; /k/ at 3 times; /g/ at 3 times; /d/ at 2 times; /t/ at 0 times; /ŋ/ at 0 times; /f/ at 1 time; /j/ at 0 times; /r/ at 3 times; /l/ at 6 times; /s/ at 5 times; /ʧ/ at 2 times; /ʃ/ at 3 times; /z/ at 2 times; /ʤ/ at 2 times; /v/ at 0 times; /θ/ at 4 times; /ð/ at 5 times; and /ʒ/ at 0 times. The option for "other" was reported 3 times. Those who answered "other" reported the following:

- Non-verbal
- While previously work focused on fronting of /k/ and /g/, now it focuses more on /k/ and /g/ clusters
- We never mastered speech sound production. We worked primarily on sign.

Question 21 inquired about previous phonological processes that were no longer in error. There were 18 responses. Fronting was reported 1 time, backing was reported 1 time, devoicing was reported 3 times, and cluster reduction was reported 1 time. It was

reported 8 times that no phonological processes were previously being treated. There was an option to choose “other,” which was reported 4 times:

- Gliding
- Non-verbal
- Gliding
- She has nearly eliminated fronting of /k/ and /g/, and k/g in clusters.

Question 22 asked for input about therapy techniques that the reporting SLPs found most effective in their interventions. There were 19 responses:

- Drill work to get as much motor practice as possible producing the sounds in isolation, then in words, then in phrases. He has a lot of functional vision and is a visual learner. He enjoys videos and models of the mouth to show accurate positions for articulation of specific sounds.
- Visual and tactile demonstration. Also, discrimination tasks of the student identifying if he said it correctly using audio-taping.
- Lots of short, repetitive drill and modeling of the correct placement.
- Short, repetitive drill. Using amplified auditory feedback, and modeling and student would discriminate correct or incorrect productions.
- Touch cues to articulators, verbal description of target placement.
- Modeling the sound for her to imitate. Description of the exact placement of articulators to produce the sounds. Using a tactile/3-D model of the mouth to allow her to "feel" where her tongue should be for certain sounds. Drill practice in words in the most successful position of words, then phrases, then sentences.

- Using games (like any student regardless of vision–games just need to be adapted to be tactile, auditory, or enlarged print). A model of the mouth to feel the placement of articulators. A mirror for her since she has a lot of functional vision.
- Tactile strategies.
- Teaching compensatory strategies for sound production due to significantly decreased lip movement (no lip closure) from syndrome. Strengthening other muscles to compensate through bubble blowing, horns, straw drinking (modified).
- Use of AAC.
- Using descriptions and tactile cues while using traditional articulation therapy. I use a lot of tactile objects to represent sounds when teaching cluster reduction and final consonant deletion.
- Traditional articulation therapy.
- Traditional articulation therapy.
- Traditional articulation therapy.
- The student also has a cochlear implant and requires intensive auditory training and auditory discrimination. Recordings of speech using animated apps is most effective for rehearsal and practice with sound discrimination tasks.
- Facilitating sounds (/t/ to stimulate the /s/).
- Tactile and facilitating sounds.
- If she makes an error in her speech, which is rare, I just have her repeat it that I model with a slower rate. She almost always corrects it.
- This student is non-verbal, we are currently working with a vision specialist to determine if tangible symbols are an appropriate method of AAC for this child.

Question 23 probed for the amount of progress the SLPs could report on the children. There were 28 responses to this question, with 15 reports indicating that the child made adequate yearly progress in speech improvement, given their age and other conditions; 8 reports indicating that the children made some yearly progress in speech improvement, given age and other conditions; and 5 responses indicating that the children were not making yearly progress in speech improvement, given age and other conditions.

Question 24 asked the SLPs to indicate the phonological processes for which the SLPs had evidence of improvement in these children. As directed by the survey, improvement could be judged by the SLPs' own work with the child, by report of a prior SLP's work with the child, or any other evidence. The following responses were given: fronting, backing, stopping, devoicing, and voicing were all reported once; backing and cluster reduction were reported twice; final consonant deletion was reported 3 times; there were 8 reports of no phonological process; and 8 responses where the SLPs selected the "other" option. The responses for "other" were:

- Gliding.
- /ʃ/, /ʧ/, /ʤ/, (as in jeep), and voiced /ð/ are all improved.
- Non-verbal.
- Gliding.
- Able to produce bilabials in medial position.
- Speech Intelligibility with unfamiliar listeners and age-appropriate language concepts.
- Now produces /s/ and /z/ in limited contexts, and /θ/ and /ð/in a wide variety of contexts with verbal cues.

- She has begun to eliminate her gliding of /l/ in the initial and medial position, but has a ways to go.

Question 25 was a write-in question that asked the respondents to describe the most effective speech sound intervention techniques that had been used for the children. Fourteen responses were obtained. .

- Lots of modeling, visual demonstration with tactile cues, and repetition.
- Verbal description of target placement, i.e., “Put your tongue between your teeth for the /θ/ and /ð/ sound."
- Standard articulation techniques such as games targeting repetition of sounds and play based therapy using toys to elicit sounds. Used a speech-generating device to model target sounds in words.
- Tactile cues for sound production (touching lips for bilabial, throat for glottals), pacing.
- Compensatory strategies.
- Use of AAC, some increase in imitation and word approximations.
- Using tactile objects and manipulatives to explain beginning, middle, and ending sounds. Also, a lot of modeling where he has to listen to the final sound.
- A lot of drilling and we use the iPad where he can record his speech. He listens to it and we discuss his errors.
- Traditional articulation therapy.
- Because of OC's visual and hearing impairments, typical sound intervention techniques do not always provide best results. She greatly benefits from auditory training that occurs during each therapy session and multimodal cueing (e.g.,

tactile + verbal). Sound discrimination (especially in isolation) works well to build words from beginning to end, as her speech intelligibility is significantly compromised secondary to final consonant deletion (associated with severe sensorineural hearing loss).

- I used SATPAC, which was very helpful for this student. He really enjoyed playing with the sounds in different facilitating contexts using silly words.
- Tactile and facilitating sounds/words. Using gloved fingers, Q-tips, etc. to stimulate correct placement, using words with final /t/ followed by a word with an initial /l/ to stimulate /l/ placement (e.g., potluck).
- The student demonstrated dysarthria secondary to CP. The whistle program showed some mild success for her, but motivation was a factor.
- As stated before, her deficits are mostly in language. I have absolutely no idea what to do with her because everything I was ever taught about eliciting language (or speech) used some sort of visual support.

Finally, question 26 asked whether a timeframe for treatment for this population could be proposed. The question asked for the total amount of time that the SLPs had provided speech sound production therapy for the child on which they were reporting. There was a total of 28 responses: 6 responses indicated the time spent providing treatment was less than one school year (under 9 months); 3 responses indicated that treatment lasted for one full school year; 4 responses indicated treatment for more than one school year, but less that two; 5 responses indicated treatment lasted for more than two full school years, but less than three; 5 responses indicated treatment for three full school years; and 5 responses indicated treatment lasted for four or more school years.

These data are provided in Table XIII, Report of Previous Speech Sound Treatment, and Figure 22, Current and Previous Speech Sound Treatment.

Table XIII

Report of Previous Speech Sound Treatment

Survey Questions	Number of Responses											
18. I have sufficient history with this student and would like to report about previous therapy.	Yes							No				
	28							18				
19. Which of the following FORMER speech sound goals are no longer in error?	/p/	/m/	/h/	/n/	/w/	/b/	/k/	/g/	/d/	/t/	/ŋ/	/f/
	3	1	1	1	1	2	3	3	2	0	0	1
20. Which of the following FORMER speech sound goals are no longer in error?	/j/	/r/	/l/	/s/	/ʧ/	/ʃ/	/z/	/ʤ/	/v/	/θ/	/ð/	/ʒ/	Other (please specify)
	0	3	6	5	2	3	2	2	0	4	5	0	3
21. Which of the following phonological processes are no longer in error?	Fronting		Backing		Stopping		Devoicing		Voicing			
	1		1		0		3		0			
	Cluster reduction		Final consonant deletion		Phonological processes		Other (please specify)					
	1		0		8		4					
22. In my work with this student, the	19											

Table continued on next page

most effective speech intervention techniques have been:						
23. Progress	Adequate yearly progress		Some yearly progress		Does not make yearly progress	
	15		8		5	
24. Please mark all areas where you have evidence of improvement (your work with the child, prior SLPs' work, other evidence	Fronting	Backing	Stopping	Devoicing	Voicing	
	1	2	1	1	1	
	Cluster reduction	Final consonant deletion	No phonological processes	Other (please specify)		
	2	3	8	8		
25. Please describe the most effective speech sound intervention techniques that you have used with this student.	14					
26. The total amount of time that you provided speech sound production therapy for this student was:	Less than one school year	One full school year	More than one but less than two school years	More than two but less than three school years	Three full school years	Four or more school years
	6	3	4	5	5	5

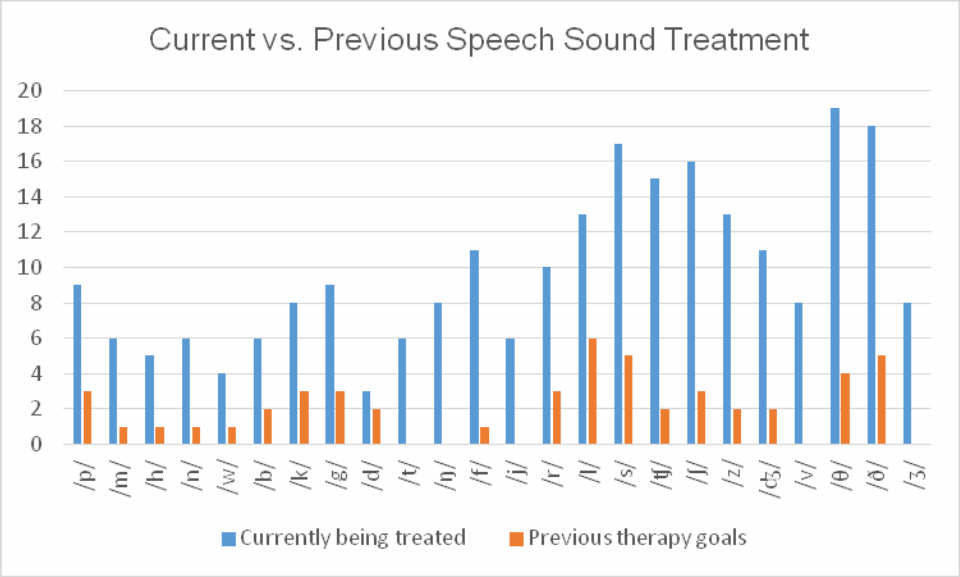

Figure 22: Current and Previous Speech Sound Treatment.

4.3. Summary of Results

The results obtained by the survey gave an overview of the characteristics of the speech sound productions of children with VI. SLPs reported information about specific phonemes in children with VI that were being treated, as well as the phonological processes that were being remediated. The answers to survey questions 1-17 depicted a broad picture of the characteristics of the speech sound productions of these children with VI and provided responses to research question 1.

4.3.1. Ages and Genders of the Children within this Sample

The age range of reported children was 4-22, which provided the opportunity to compare these children's speech sound production skills to Sander's (1972) established developmental norms. With 15 children up through age 8 and 31 children ages 9 and older, it was apparent that speech sound production errors commonly occurred in these children with VI well beyond the accepted typical age of mastery.

In this sample, genders were fairly equally represented, with 26 females and 20 males. Females accounted for slightly more speech sound errors per phoneme, which can easily be attributed to there being slightly more females being reported. This gender-diverse sample was useful for probing the speech sound production characteristics of children with VI.

4.3.2. Severity of VI

The sample was skewed to including more children with low vision. There were more children with low vision, at 22 reports, with legally blind reported 14 times and blind reported 10 times. The number of children identified as low vision was almost equal to the combined number of children who were legally blind and blind. As noted, children identified as low vision had more speech sounds in error, which can be attributed to the higher percentage of children reported as low vision.

4.3.3. Frequency of Reported Speech Sound Production Errors

Table XIV, Frequency of Reported Speech Sound Production Errors, allows for analysis of the frequency of error for each phoneme across the sample. In Table XIV, the number of production errors for each speech sound was ranked by frequency of report, from least to most often reported. Table XIV shows that the median number of errors was 8. Modes for this distribution were 6 and 8.

Table XIV

Frequency of Reported Speech Sound Production Errors

Speech Sound	Frequency of Reported Production Errors
/d/	3
"other"	3
/w/	4
/h/	5
/m/	6
/n/	6
/b/	6
/t/	6
/j/	6
/k/	8
/ŋ/	8
/v/	8
/ʒ/	8 Median
/p/	9
/g/	9
/r/	10
/f/	11
/ʤ/	11
/l/	13
/z/	13
/ʧ/	15
/ʃ/	16
/s/	17
/ð/	18
/θ/	19

This ranking revealed that certain phonemes were more frequently reported to be produced in error. The phonemes reported at the median frequency or more were /k/, /ŋ/, /v/, /ʒ/, /p/, /g/, /r/, /f/, /ʤ/, /l/, /z/, /ʧ/, /ʃ/, /s/, /ð/, and /θ/. It is important to note that the two phonemes reported the most were /ð/ and /θ/; these two phonemes are articulated in the same manner and with articulators in the same place, they only differ in voicing. More to the point, the articulatory placement for these phonemes is visible when spoken.

With almost twice the number of children in the sample being age 9 and older (31; with 15 being age 4-8), it is notable that of the sounds that occurred at the median frequency or greater, four sounds—/p/, /g/, /k/, and /f/—are considered to be earlier developing phonemes and are usually mastered by preschool children (Sander, 1972). However, the children's coexisting conditions were likely to have contributed to their developmental speech sound production delays.

4.3.4. Articulation, Motor Speech, and Phonology Disorders within the Sample

While some phonological processes were reported as currently being treated, these reports were not as prevalent as reports of specific articulation and motor speech disorders. Most of the co-occurring conditions that were evidenced by the children within this sample affected articulation and motor speech production; these could have been a causative factor for the children's speech sound production errors.

Twelve children were reported as having a motor speech disorder (apraxia or dysarthria), five of whom were also identified as non-verbal. There were 23 reports of children having a language delay or disorder, 20 reports of some level of cognitive impairment, and 69 reports of other diagnoses amongst the sample population. The 69 reports accounted for information provided in questions 16 and 17 and included various diagnoses such as genetic disorders, cerebral palsy, infections or injury to the brain, metabolic disorders, and specific diagnoses of Cohen Syndrome and Moebius Syndrome.

In summary, research question 1 was addressed by this detailed analysis of the characteristics of the speech sound productions of the children within this sample.

4.3.5. Speech Sound Production Therapy

Survey responses that addressed research question 2 include those for questions 18-26, particularly questions 22, 23, 24, and 25. It is necessary to note that questions 18-26 on the survey were optional. Question 18 asked if the SLP had provided previous therapy to the child and would like to report more information; for 28 of the 46 children, the response was yes. This is not a data rich sub-sample, but there was a variety of responses from which to extract information. The responses for questions 22 and 25, both dealing with effective treatment techniques, related to appropriate compensatory techniques for treating children with VI: tactile cues for articulation (e.g., touching the child's articulators to facilitate proper placement), drill work or traditional articulation therapy (e.g., repetition of sound production with instructions on articulatory placement), auditory discrimination tasks (i.e., hearing sounds repeatedly, and comparatively, to facilitate learning how sounds are different), and oral motor exercises for those children whose primary diagnosis limits motor movements, thus limiting motor speech tasks.

The survey inquired about yearly progress. Fifteen of the 28 responses to question 23 indicated that the children made adequate yearly progress in speech sound production. With regard to progress with phonological processes, the most responses given, which totaled 8, were that there were no phonological processes; 8 other responses were the option for "other," where gliding was reported as being successfully remediated in two cases. In sum, in response to research question 2, the SLPs used many techniques to effect successful speech sound production improvement among the children with VI.

4.3.6. Speech Sound Production as Related to VI

Regarding research question 3, when asked if the children's speech sound production errors could be attributed to VI, the SLPs' most frequent response was that the two factors were probably not linked. Question 15 probed the SLPs for information regarding the children's skill level of speech sound production. Twenty-four of the 46 responses obtained indicated that the observed errors were unexpected for the children's age levels. Fourteen responses indicated that the errors were expected given a child's primary diagnosis. This question was a forced answer question, which is notable because, ostensibly, all children age 9 and older with speech sound production errors should receive a skill level rating of speech sound errors being unexpected for age level. As 31 children were aged 9 and older, this may have been the only possible response choice for the SLPs, who may have also liked to indicate that the speech sound production errors could be a product of the children's primary diagnoses.

There were three children who had no other diagnoses. These children had normal hearing, no identified phonological processes, and no other diagnoses reported by the SLPs. All three of the children were reported as having speech production errors that could be characterized as distortions, and, of the sounds reported in error, which were /ʧ/ and /ʃ/ for one child, and /s/ for the other two children, all are later developing sounds. This small portion of the sample accounted for just a few children whose speech sound production errors could not be attributed to any other conditions.

CHAPTER V

CONCLUSIONS

The intent of this research was to explore SLPs' perceptions of the characteristics of speech sound productions in a sample of children with VI and to discover how SLPs who treated children with VI adapted their therapy techniques to provide successful remediations. Another intent was to determine whether these children's speech sound production characteristics could be related to the presence of VI. The survey provided an opportunity for SLPs to report extensive detail about their caseload children with VI, with considerable attention given to the children's co-existing medical and developmental conditions.

5.1. Speech Sound Production Characteristics in this Sample of Children with VI

5.1.1. Persistence of Developmental Delays

Research question 1 was asked in order to identify the speech sound production characteristics of children with VI who were being treated by SLPs. Based on the SLPs' reports, a consistent finding was that these children with VI required speech sound

interventions well after the age of 8. Notably, the typical age of mastery for all speech sounds among English speakers is 8 (Sander, 1972); therefore, the present findings showed that many of the children with VI had delays in their development of speech sound production. As Sander noted, in the general population a child's advancing age has a strong relationship with the improvement of speech sound accuracy. In this sample, age in itself seemed to have no relationship to the accuracy of the children's speech sound productions. With 65% of the sample being ages 9 and older, it was apparent that these children with VI required speech sound production therapy services well past the ages when typically developing children have mastered speech sounds. In response to survey question 14, 24 SLPs reported that the speech sound production skills being reported for a given child were unexpected given the child's age. In total, 54% of the sample had speech sound production errors that were inappropriate for their ages and evidenced persistent delays in speech sound acquisition.

5.1.2. Frequently Occurring Speech Sound Production Errors

The exact characteristics, attributes, or patterns of speech sound production errors for this sample of children with VI could not be identified due to the children's multiplicity of co-existing medical and developmental conditions. These conditions possibly contributed to children's speech sound productions in various ways. Some children had a single co-existing condition beyond VI, and some had multiple conditions that co-occurred, which resulted in a diverse sample.

Some patterns amongst the sample did emerge. It is notable that the two phonemes most frequently reported as currently being treated were the linguadental fricatives /θ/ and /ð/, reported at 19 and 18 times, respectively. When combined with

information obtained from questions 19 and 20 regarding previous speech sound goals, the number of production error reports rose to 23 for both /θ/ and /ð/, meaning that 50% of the sample had at one time received or was currently receiving treatment to remediate /θ/ and /ð/ (as previously noted by Brouwer, Gordon-Pershey, Wintering, Westhoff, & Miller, 2015). These two sounds were the sole phonemes in treatment for the oldest male, age 22, and oldest female, age 19, in the sample. According to Sander, these phonemes should be mastered by age 7 (/θ/) and 8 (/ð/).

Another pattern of atypical development was noted for the phonemes /k/, /p/, /g/, and /f/. For reference, /p/ is typically developed by age 3, with the three other phonemes—/k/, /g/, and /f/—typically mastered by age 4 (Sander, 1972). These four phonemes were reported in error at the median frequency (8 reports) or greater (/k/ at 8 times, /p/ at 9 times, /g/ at 9 times, and /f/ at 11 times). For phonemes /k/ and /g/, adolescents as old as 17 were receiving remediation. For phonemes /p/ and /f/, young adults up to the age of 20 were receiving remediation. The delays evidenced in this sample were different from common patterns of developmental delay and the associated ages of resolution of speech sound production delays.

When asked to categorize the children's speech sound production errors, SLPs reported that 54% of the sample—25 out of the 46 children—had articulation errors typified by speech sound distortions. The remaining 25 children had motor speech disorders or a combination of articulation errors and phonological processes. With a majority of the sample exhibiting articulation distortions, it can be concluded that these children with VI demonstrated imprecise articulation. Mills (1987) also reported imprecise articulation among his sample of children with VI.

Overall, of the 24 consonantal phonemes in English, there was no phoneme that every child in the sample had mastered, meaning that every phoneme was reported to be in error for at least one child. Sixteen phonemes (67%) were reported as being misarticulated at the median frequency (8 reports) or greater. The phonemes that were reported in error at the median frequency or greater were /k/, /ŋ/, /v/, /ʒ/, /p/, /g/, /r/, /f/, /ʤ/, /l/, /z/, /ʧ/, /ʃ/, /s/, /ð/, and /θ/. Across the sample, all 24 phonemes were reported as being in error for at least one child in the age 9 and older group. No child age 9 or older had mastered all 24 consonantal phonemes.

The sum of this data analysis demonstrated that this sample of children with VI displayed frequently occurring errors in speech sound productions.

5.2. SLPs' Treatment of Speech Sound Production Errors in this Sample of Children with VI

Research question 2 revealed information about the speech sound production treatment approaches that the SLPs implemented that promoted successful remediation of speech sound production errors in children with VI. Survey questions 22 and 25 answered this research question directly, with information extracted from survey questions 23 and 26 to support the efficacy of those treatments.

Before reporting the treatment methods that the SLPs reported as useful for children with VI, it is necessary to recall effective treatment approaches for children without sensory impairments for comparison. Williams (2003), in her textbook *Speech Disorders Resource Guide for Preschool Children*, described the three components of treatment efficacy as "the three E's": efficiency, effects, and effectiveness.

Williams indicated that efficiency can be determined by how long it takes a child to achieve his/her goal(s) and how much effort it took to effect the change(s). Effects refer to whether or not the changes that occurred for a child were significant. Lastly, effectiveness refers to whether the changes that occurred for the child can be attributed to therapy. These components of assessing the outcomes of interventions can help SLPs determine the efficacy of their treatments. This is an important way for an SLP to decide to continue or discontinue a treatment method for a given child.

Williams described the two treatment options for speech sound production errors as being phonological interventions or articulation interventions (also called phonetic interventions, or motor speech interventions). The choice of intervention depends on the types of errors a child is exhibiting.

According to Williams, the phonological approach considers the organization of a child's speech sound system. The child's discrimination and production of speech sounds is based on the child's mental representations of the phonological rules of language. Phonological disorders exhibit an error pattern. Sounds that have an aspect in common are all misarticulated. For example, a child might substitute all sounds produced in the back of the mouth with sounds made in the front of the mouth (i.e., cap→tap [the velar /k/ is replaced by the lingual alveolar /t/]; pad→pag [the lingual alveolar /d/ replaces the velar /g/]). This pattern would occur in the child's production of all velar phonemes and would affect the child's discrimination of accurate production of velars in the speech of another person. The child's conceptual knowledge of a class of speech sounds is impaired – in this case, velar sounds.

Williams noted that evidence-based phonological treatment begins with appropriate phonemic target selection. Selection can be based on differing rationales, including developmental norms for speech sound productions, with earlier developing sounds targeted first; or, basing a target on a child's stimulability for producing a sound (i.e., the child may be on the verge of acquiring a speech sound production, with his/her productions being acoustically very close); or, choosing a target based on markedness (i.e., overt phonological properties, such as voicing of sounds); or, selecting target sound comparisons using either minimally or maximally contrasting sounds (i.e., the sounds differ by just one feature – minimally – or by multiple features). The goal of a phonological approach is to familiarize the child with the rules for producing the sound class that is disordered (such as velars, in the example given earlier).

The articulatory approach for intervention, also known as the phonetic approach, is used with children who have impaired articulatory skills. These speech errors involve the physical production of speech sounds, not the phonological rules for conceptualizing speech sound classes. Articulation errors include motor speech disorders. The traditional approach to the correction of articulation errors, attributed to Van Riper (1939), consists of auditory discrimination training along with drill work (articulation practice) of target sounds in increasingly complex linguistic settings (i.e., speech sounds in isolation, then in syllables, words, sentences, and conversation). McDonald's sensory-motor approach (1964) uses the syllable as the smallest unit of speech and combines syllables with differing stress patterns. The paired stimuli approach, credited to Irwin and Weston (1971), uses a word containing the target sound that the child is producing accurately and pairs it with words that contain the target sound that the child is producing incorrectly.

These approaches all rely on repetition of motor skills to produce sounds accurately, with training in speech sound discrimination, articulator placement, and sequential practice that increases in complexity.

With regard to Williams' tenets of effects and effectiveness, several speech sound interventions proved to be effective for the SLPs working with the children with VI in the present study. Based on the 28 responses received for questions 22 and 25, the SLPs used traditional articulation therapy augmented with techniques that accommodate for the presence of VI, such as generous amounts of modeling, repetition, and tactile cuing for facilitating the production of speech sounds. The SLPs used repetitive drills and verbal description of articulatory placement with success. These techniques are not specific to children with VI and can be used in any treatment setting, but the responses appeared to indicate that these techniques were particularly helpful. What became overwhelmingly clear was that none of the SLPs reported knowledge or use of techniques that specifically target interventions for individuals with VI. This echoes the report by Brouwer et al. (2013), in which SLPs reported no specific speech therapy techniques for working with children with VI.

Responses to question 23 helped determine whether the SLPs' treatments were efficient (as described by Williams, 2003, as meaning accomplished in a reasonable period of time). Question 23 was optional, but 28 SLPs commented on a child's yearly progress. Fifteen responses asserted that the child being reported on made adequate yearly progress. Of the 28 responses received, 15, or 54%, claimed that the child had made progress, with consideration given to their age and primary diagnosis. This report contrasted with the fact that developmental speech sound production delays persisted for

54% of the sample, who had speech sound production errors that were inappropriate for their ages. This leads to speculation about whether children with VI might need speech sound production therapy for a greater number of years than sighted children who are addressing the same sounds. However, the presence of co-existing medical and developmental conditions in the children in this sample potentially contributed to the year-to-year continuation of speech therapy services for these children.

5.3. The Relationship of Speech Sound Production Characteristics and VI in this Sample

Research question 3 inquired whether the SLPs perceived that a lack of visual input was related to the speech sound productions of the children with VI whom they serviced.

Survey questions 14 and 15 informed the response to this research question 3. Of the 46 responses to question 14, 31 SLPs (67%) stated that the characteristics of the children's speech sound productions were probably not related to the vision problem. This means that 67% of the reports on individual children stated that the children's speech sound errors were probably not a consequence of the VI. Probing other reasons for speech sound production errors beyond the presence of VI, question 15 asked the SLPs whether the children's speech sound production skills were expected or unexpected based on age or primary diagnosis. Twenty-four of 46 responses (52%) stated that the children's speech sound productions were unexpected for age level, and 14 responses (30%) stated that the speech sound production skills were expected given the primary diagnosis. In part, the SLPs attributed speech sound production errors to developmental delays and co-existing diagnoses rather than to the presence of VI.

These responses provided insight as to how the SLPs perceived the effect of VI on a child's speech sound productions. Nearly 70% of the responses to question 14 indicated that the SLPs perceived the child's speech sound production errors as probably not related to the VI; while 30% of responses for question 15 indicated that SLPs perceived the speech sound production errors as being attributable to a child's primary diagnoses. Given that the SLPs had a forced response for question 15 to rate the children's speech sound production skills, 52% chose to indicate skills unexpected for age level. Only four responses demonstrated a certainty that a child's speech sound productions were related to the VI.

5.4. Implications

This study contributed information that has theoretical as well as practical implications. In terms of theoretical implications, this study addressed the problem that there is not a sufficient amount of information about speech sound development or speech sound impairments in children with VI, especially when compared to the research on pragmatic, semantic, and morphological language development among children with VI, and the literature on phonological awareness in children with VI. Nor does the literature on speech development in children with VI compare in quantity and specificity to the research on children with hearing impairments. The ample evidence generated herein may contribute to the theoretical understanding of speech sound production in children with VI, particularly when coexisting conditions are present.

A practical implication of this study is that it will give SLPs who encounter children with VI an indication of the characteristics of the speech sound productions of children with VI, including information on the errors that might occur in children in this

population. Presently, there are few other reports for SLPs to reference. Moreover, the information generated about the children's unique and lengthy developmental periods for speech sound acquisition and their variability in therapy progress over time could also offer practical value for SLPs looking for comparative information.

This report described the speech sound production errors that SLPs have successfully remediated. Thus, the present study offered additional evidence pertaining to successful practices by SLPs who serviced children with VI. Based on the responses received, the SLPs adapted their existing knowledge of articulation therapy strategies to provide the best possible interventions to children with VI, and they used the materials that were available to them for non-sighted learners (c.f., Brouwer et al., 2013).

5.5. Limitations

While this study provided a great deal of information about this sample of children with VI, there were some limitations to the study. The first limitation was the sample size. With only 46 children from which to glean data, a generalization to the overall population of children with VI cannot be made. Another limitation comes from the design of the survey. The questions regarding effective treatment methods were in an "optional" response section of the survey. A required response could have generated a better understanding of the treatment techniques that were effective when working with children with VI.

5.6. Future Research

SLPs would benefit from additional knowledge and training in order to provide quality interventions for children with VI, as House and Davidson (2000) and Brouwer et

al. (2013) reported. While the present data provided some useful information about the characteristics of speech sound productions among children with VI, future research should focus on gathering information on children with VI as their only medical or developmental condition, excluding children with multiple impairments and coexisting diagnoses. To gain a clearer understanding of what types of speech sound errors are prevalent in children with VI, a more homogenous sample will need to be obtained.

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APPENDIX

SURVEY

Speech Sound Development in Children with Vision Impairments

THE REMAINDER OF THIS SURVEY REQUIRES YOU TO PROVIDE CLINICAL INFORMATION ABOUT THE CHILDREN/TEENS WITH VISION IMPAIRMENTS FOR WHOM YOU HAVE PROVIDED *SPEECH SOUND PRODUCTION THERAPY* (TREATMENT OF PHONOLOGY, ARTICLUATION, APRAXIA, DYSARTHRIA).

YOU MAY INCLUDE CHILDREN/TEENS WITH VISION IMPAIRMENTS FOR WHOM YOU HAVE PROVIDED SPEECH SOUND PRODUCTION THERAPY AND OTHER INTERVENTIONS (LANGUAGE, FLUENCY, VOICE, AAC, SOCIAL, COGNITIVE, HEARING, OTHER).

DO NOT REPORT ON CHILLDREN/TEENS WITH VISION IMPAIRMENTS FOR WHOM YOU HAVE PROVIDED INTERVENTIONS THAT DID NOT INCLUDE SPEECH SOUND PRODUCTION THERAPY.

The questions that follow are designed to be answered as a report of one student with a vision impairment. When you finish the questions, you may choose to begin the set of questions again and report on another student, or you may end your participation. You may respond to this questionnaire as many times as you choose in order to characterize as many individual children/teens with a vision impairment as you care to describe. You may keep adding individual children/teens, up to a maximum of 50 children/teens.

Remember, the inclusionary criteria are:

The child/teen is age birth to 21.

The child/teen has a vision impairment as defined by this survey.

You provided the child/teen with interventions for speech sound production.

For each question, please select the best option given. Each question has a comment box that allows you to offer a response that is not listed or where you can add any additional information.

Here is a review of the severity levels of vision impairment

Description of Severity of Visual Impairments, with Corrective Lenses:

1. ***Low vision (20/60 to 20/200): a moderate visual impairment; not necessarily limited to distance vision. Includes difficulty reading at a normal viewing distance and seeing details.***
2. ***Legally Blind or Severe Low Vision (20/200 to 20/500): Gross orientation and mobility are generally adequate, but difficulty seeing traffic signs, bus numbers, etc. Reading requires high power magnifiers and/or very short reading distances.***
3. ***Blind (20/500 to No Light Perception): Problems with visual orientation and mobility, vision is unreliable except under ideal circumstances, or possibly no light perception.***
4. ***Functions at the Definition of Blindness (FDB): Visual functioning is reduced by a brain injury or dysfunction. Visual acuity is not possible to determine using the Snellen Chart.***

***1) Student's initials (use real or pseudo initials; however, make sure that you do not use the same initials for another child):**

[ ]

	Age	Gender	Race/Ethnicity	Severity of Vision (See Descriptions above)	Vision Impairment Present Since Birth
***2) Student**	--Select-- ▼ - Under 1 [Value=1] - 1 [Value=2] - 2 [Value=3] - 3 [Value=4] - 4 [Value=5] - 5 [Value=6] - 6 [Value=7] - 7 [Value=8] - 8 [Value=9] - 9 [Value=10] - 10 [Value=11] - 11 [Value=12] - 12 [Value=13] - 13 [Value=14] - 14 [Value=15] - 15 [Value=16] - 16 [Value=17] - 17 [Value=18] - 18 [Value=19] - 19 [Value=20] - 20 [Value=21] - 21 [Value=22]	--Select-- ▼ - Male [Value=1] - Female [Value=2]	--Select-- ▼ - African American [Value=1] - Caucasian [Value=2] - Asian [Value=3] - Native American [Value=4] - Pacific Islander [Value=5] - Hispanic/Latino [Value=6] - Caribbean [Value=8] - Arabic/North African [Value=9] - Asiatic Indian [Value=10] - Other/Multiracial [Value=7]	--Select-- ▼ - Low Vision [Value=1] - Legally Blind [Value=2] - Blind [Value=3] - FDB [Value=4]	--Select-- ▼ - Yes [Value=1] - No [Value=2] - Unsure [Value=3]

*3) Hearing Status:

- No Apparent Hearing Impairment [Value=1]
- Mild Hearing Loss [Value=2]
- Moderate Hearing Loss [Value=3]
- Severe Hearing Loss [Value=4]
- I am not sure [Value=5]

Question Logic
If [No Apparent Hearing Impairment...] is selected, then skip to question [#6]
If [Mild Hearing Loss] is selected, then skip to question [#4]
If [Moderate Hearing Loss] is selected, then skip to question [#4]
If [Severe Hearing Loss] is selected, then skip to question [#4]
If [I am not sure] is selected, then skip to question [#4]

Page Break

4) Does this student wear hearing aids?

- Yes [Value=1]
- No [Value=2]
- Unsure [Value=3]

5) Can this student's need for speech sound production therapy be related to the student having a hearing loss?

- Yes [Value=1]
- No [Value=2]
- I am not sure [Value=3]

*6) Is the student learning braille (or has learned)?

- Yes [Value=1]
- No [Value=2]
- Unsure [Value=3]

*7) Speech contains:

- 0-4 speech sounds in error more than 50% of the time [Value=1]
- 5-8 speech sounds in error more than 50% of the time [Value=2]
- 9+ speech sounds in error more than 50% of the time [Value=3]
- I am not sure [Value=5]
- The child is generally non-verbal [Value=4]

Reference list:

/b/ (e.g. boy) /p/ (e.g. pan) /g/ (e.g. game) /k/ (e.g. cat, kite) /d/ (e.g. dog) /t/ (e.g. tiger)

/tʃ/ (e.g. child) /dʒ/ (e.g. jump) /r/ (e.g. run) /l/ (e.g. light) /z/ (e.g. zoo) /s/ (e.g. sun)

/ʃ/ (e.g. shoe) /ʒ/ (e.g. measure) /θ/ (e.g. think) /ð/ (the) /f/ (e.g. fast) /v/ (e.g. vehicle)

/h/ (e.g. height) /m/ (e.g. man) /n/ (e.g. nine) /ŋ/ (e.g. ring) /w/ (e.g. water) /j/ (e.g. yellow)

		/b/	/p/	/g/	/k/	/d/	/t/	/tʃ/	/dʒ/	/r/	/l/	/z/	/s/
8)	Which of the following does the child misarticulate greater than 50% of the time in any position in words and is inappropriate for chronological age?	☐ [Checked=1]	☐ [Checked=1]	☐ [Checked=1]	☐ [Checked=1]	☐ [Checked=1]	☐ [Checked=1]	☐ [Checked=1]	☐ [Checked=1]	☐ [Checked=1]	☐ [Checked=1]	☐ [Checked=1]	☐ [Checked=1]

		/ʃ/	/ʒ/	/θ/	/ð/	/f/	/v/	/h/	/m/	/n/	/ŋ/	/w/	/j/	Other
9)	Continued from question 8: Which of the following does the child misarticulate greater than 50% of the time in any position in words and is inappropriate for chronological age?	☐ [Checked=1]	☐ [Checked=1]	☐ [Checked=1]	☐ [Checked=1]	☐ [Checked=1]	☐ [Checked=1]	☐ [Checked=1]	☐ [Checked=1]	☐ [Checked=1]	☐ [Checked=1]	☐ [Checked=1]	☐ [Checked=1]	☐ [Checked=1]

10) If other speech sound production errors are occurring, please describe below.

(1000 characters remaining)

*11) Speech sound errors are primarily:

- Distortions (articulation) [Value=1]
- Phonological processes [Value=2]
- Combination of both articulation and phonological processes [Value=3]
- Apraxia [Value=4]
- Dysarthria [Value=5]

12) If phonological processes are evident, which are most occurring?

- Fronting (e.g. gate -> date) [Checked=1]
- Backing (e.g. bat -> gat) [Checked=1]
- Stopping (e.g. sun -> tun) [Checked=1]
- Devoicing (e.g. dad -> tat) [Checked=1]
- Voicing (e.g. kite -> gide) [Checked=1]
- Cluster Reduction (e.g. black -> back) [Checked=1]
- Final Consonant Deletion (e.g. dog -> do) [Checked=1]
- Gliding (e.g. red --> wed) [Checked=1]
- No phonological processes [Checked=1]
- Other [Checked=1]

13) If other phonological processes are occurring, please describe below.

(1000 characters remaining)

*14) This student's speech sound production problem:

- Is related to a vision problem (e.g., both have the same origin, such as cerebral palsy) [Value=1]
- Is probably related to a vision problem [Value=2]
- Is probably not related to a vision problem [Value=3]
- I do not know whether this child's speech problem is related to a vision problem [Value=4]

*15) This student's speech sound production skill is:

- Expected for age level [Value=1]
- Expected given the child's primary diagnostic conditions (e.g., cerebral palsy) [Value=2]
- Unexpected for age level [Value=3]
- Unexpected for the child's primary diagnostic conditions (e.g., cerebral palsy) [Value=4]
- I do not know the relationship between the child's primary diagnostic conditions and the speech sound production problem [Value=5]

16) This student has been diagnosed with:

- Mild language delay/disorder [Checked=1]
- Moderate language delay/disorder [Checked=1]
- Severe language delay/disorder [Checked=1]
- Mild Cognitive impairment [Checked=1]
- Moderate Cognitive impairment [Checked=1]
- Severe Cognitive impairment [Checked=1]
- A genetic disorder (any syndrome, sequence) [Checked=1]
- Cerebral palsy, prematurity, low birth weight, other birth-related issues [Checked=1]
- Encephalitis, meningitis, other illness of the brain [Checked=1]
- Brain injury after the age of 2 [Checked=1]
- Autism [Checked=1]
- Injury to or disease of the eye or visual mechanism [Checked=1]

- [ ] Metabolic or growth/development disorder [Checked=1]
- [ ] I am not sure [Checked=1]
- [ ] No other diagnoses [Checked=1]
- [ ] Other (please specify) [Checked=1]

17) If the student has other primary diagnosis (e.g., Down Syndrome, Fragile X) or if you would like to provide other relevant information to explain your responses for this student, Use the space below. (Optional)

(1000 characters remaining)

Optional section questions 18-26:

It would be very helpful to know more about the student's speech history. Please report on previous speech therapy and development for the following questions if possible.

*18) I have sufficient history with this student and would like to report about previous therapy.

- ○ Yes [Value=1]
- ○ No [Value=2]

Question Logic
If [Yes] is selected, then skip to question [#19]
If [No] is selected, then skip to survey [#162556], question [#1]

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Reference list:

/b/ (e.g. boy) /p/ (e.g. pan) /g/ (e.g. game) /k/ (e.g. cat, kite) /d/ (e.g. dog) /t/ (e.g. tiger)

/tʃ/ (e.g. child) /dʒ/ (e.g. jump) /r/ (e.g. run) /l/ (e.g. light) /z/ (e.g. zoo) /s/ (e.g. sun)

/ʃ/ (e.g. shoe) /ʒ/ (e.g. measure) /θ/ (e.g. think) /ð/ (the) /f/ (e.g. fast) /v/ (e.g. vehicle)

/h/ (e.g. height) /m/ (e.g. man) /n/ (e.g. nine) /ŋ/ (e.g. ring) /w/ (e.g. water) /j/ (e.g. yellow)

19) Which of the following FORMER speech sound goals are no longer in error?

- [ ] /b/ [Checked=1]
- [ ] /p/ [Checked=1]
- [ ] /g/ [Checked=1]
- [ ] /k/ [Checked=1]
- [ ] /d/ [Checked=1]
- [ ] /t/ [Checked=1]
- [ ] /tʃ/ [Checked=1]
- [ ] /dʒ/ [Checked=1]
- [ ] /r/ [Checked=1]
- [ ] /l/ [Checked=1]
- [ ] /z/ [Checked=1]
- [ ] /s/ [Checked=1]

20) Continued from question 19:

- [ ] /ʃ/ [Checked=1]
- [ ] /ʒ/ [Checked=1]
- [ ] /θ/ [Checked=1]
- [ ] /ð/ [Checked=1]
- [ ] /f/ [Checked=1]
- [ ] /v/ [Checked=1]
- [ ] /h/ [Checked=1]
- [ ] /m/ [Checked=1]
- [ ] /n/ [Checked=1]
- [ ] /ŋ/ [Checked=1]
- [ ] /w/ [Checked=1]
- [ ] /j/ [Checked=1]
- [ ] Other (please specify) [Checked=1]

Other:

21) Which of the following phonological processes are no longer in error?

- [ ] Fronting (e.g. gate -> date) [Checked=1]
- [ ] Backing (e.g. bat -> gat) [Checked=1]
- [ ] Stopping (e.g. sun -> tun) [Checked=1]
- [ ] Devoicing (e.g. dad -> tat) [Checked=1]
- [ ] Voicing (e.g. kite -> glde) [Checked=1]
- [ ] Cluster Reduction (e.g. black -> back) [Checked=1]
- [ ] Final Consonant Deletion (e.g. dog -> do) [Checked=1]
- [ ] No phonological processes [Checked=1]
- [ ] Other (please specify) [Checked=1]

22) In my work with this student, the most effective speech intervention techniques have been: (skip if you do not have familiarity or do not have success to report).

(1000 characters remaining)

*23) Progress:

- This student has made adequate yearly progress in speech improvement, given age and other conditions. [Value=1]
- This student makes some yearly progress in speech improvement, given age and other conditions. [Value=2]
- This student does not make yearly progress in speech improvement, given age and other conditions. [Value=3]
- I do not know whether this student makes yearly progress in speech improvement. [Value=4]

24) Please mark all areas where you have evidence of improvement (your work with the child, prior SLPs' work, other evidence):

- Fronting (e.g. gate -> date) [Checked=1]
- Backing (e.g. bat -> gat) [Checked=1]
- Stopping (e.g. sun -> tun) [Checked=1]
- Devoicing (e.g. dad -> tat) [Checked=1]
- Voicing (e.g. kite -> gide) [Checked=1]
- Cluster Reduction (e.g. black -> back) [Checked=1]
- Final Consonant Deletion (e.g. dog -> do) [Checked=1]
- No phonological processes [Checked=1]
- Other (please specify) [Checked=1]

25) Please describe the most effective speech sound intervention techniques that you used with this student.

(1000 characters remaining)

*26) The total amount of time that you provided speech sound production therapy for this student was:

- less than one school year - under 9 months [Value=1]
- one full school year [Value=2]
- more than one full school year, but less than two [Value=3]
- two full school years [Value=4]
- more than two full school years, but less than three [Value=5]
- three full school years [Value=6]
- more than three full school years, but less than four [Value=7]
- four or more school years [Value=8]

Question Logic
If [less than one school year - under 9 months...] is selected, then skip to survey [#162556], question [#1]
If [one full school year] is selected, then skip to survey [#162556], question [#1]
If [more than one full school year, but less than two...] is selected, then skip to survey [#162556], question [#1]
If [two full school years] is selected, then skip to survey [#162556], question [#1]
If [more than two full school years, but less than thr...] is selected, then skip to survey [#162556], question [#1]
If [three full school years] is selected, then skip to survey [#162556], question [#1]
If [more than three full school years, but less than f...] is selected, then skip to survey [#162556], question [#1]
If [four or more school years] is selected, then skip to survey [#162556], question [#1]

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Speech Sound Development in Children with Vision Impairments

Thank you!