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The Importance of Early Vocalizations In Infants Born with Cleft Palate

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ABSTRACT (100-200 WORDS):

Research has proven that early vocalizations are a crucial component of normal language development in children. While there is a considerable body of research about the significance of early vocalizations in normal language acquisition, very little research exists about the presence and importance of early vocalizations in infants born with cleft palate. This paper provides

a review of studies that focus on early vocalizations in normally developing children. This is followed by a review of the research comparing the development of early vocalizations in children with cognitive impairments or hearing impairments. Finally, research that studied early vocalization development in infants born with cleft palate is reviewed and discussed. As a result of the review of research, further implications about remaining issues and future areas of research are discussed.

Introduction

Nearly 70 years ago, Jakobson proposed the theory that infant babbling was completely unrelated to a child's later language development (Oller, Wieman, Doyle, & Ross, 1975). Since the 1950s, speech-language pathologists, linguists, teachers, child psychologists and other professionals have dedicated their time, expertise, and careers to proving the inaccuracy of this belief. Prominent researchers such as Oller and Vihman, as well as others, have conducted their own studies and verified that infant babbling is a vital component of language acquisition. Oller (1975) states "...utterances are not 'random vocalizations'...there are many parallels between babbling and the development of speech." In addition, Boysson-Bardies and Vihman (1991) carried out a longitudinal study on infant babbling in which they found, "...the babbling repertoire and early words show that infant productions are the complex product of an interaction between articulatory tendencies and the influence of the phonetic structure of the linguistic environment..."

It has been proven that early infant vocalizations serve as precursors for language development. Because babbling is ruled by "general restrictions of the human phonological capacity," (Oller et al., 1975) this is the time babies learn how to produce speech sounds. Infants also learn about the production of syllables, consonants, vowels, etc. The knowledge they gain through the production of early vocalizations will impact various aspects of their language acquisition such as syntactic, semantic, and pragmatic development, all of which are foundations for communication.

Most of the studies that have been conducted on early vocalizations have highlighted children with normal anatomy and physiology. The focus of this review will

be on select studies about early vocalizations in children born with abnormal oral structures (i.e. cleft of the palate). By reviewing early vocalization development in children with cleft palate, possible reasons for babbling delay will be discussed. Implications for further research will be addressed with the development of good speech and language as the ultimate goal.

Normal Language Development

Language acquisition in normally developing infants is made of up four stages. These stages are phonation, gooing, expansion, and canonical babbling (Oller & Ellers, 1988). The phonation stage occurs between 0-2 months. The types of sounds produced here are 'comfort sounds' called quasi-resonant nuclei/quais-vowels that have normal speech-like phonation. These sounds are precursors to the production of vowels. The next stage is known as the gooing stage. This stage occurs around 2-3 months and is in response to changes in the anatomical relationships of the child's speech production mechanism. In this stage, the production of phonetic sequences involves quasi-resonant sounds of the phonation stage, as well as articulated sounds in the back of the vocal cavity. Articulations may be precursors of consonants, but are not well formed. The third stage is called the expansion stage, which usually takes places at 4-6 months. The production of labial trills and vibrants (raspberries), squeals, growls, yells, etc, will start to appear. The productions of vowel-like sounds emerge as well (Oller & Ellers, 1988).

Canonical babbling is the final- and most important stage of early vocalization, which begins between 7-10 months. This stage marks the start of controlled production of well-formed syllables (Oller & Ellers, 1988). Canonical syllables are reduplicated (e.g.

bababa) and variegated (e.g. danana) strings of consonant-vowel (CV) syllables which are unlike earlier stages of vocalizations because they resemble adult speech (Chapman, Hardin-Jones, Schulte, & Halter, 2001). In addition, the onset of canonical babbling is often praised by parents and professionals because of its relationship to the development of later speech and language (Chapman et al., 2001).

Oller (1988) created four different properties of canonical babbling. First, canonical syllables must exhibit at least one fully resonant nucleus (i.e., vowel of identifiable quality. High nasalized vowels are excluded by the resonance requirement. This is because if an infant produces a vowel with excessive nasality, that vowel production is not considered to be of 'identifiable quality.' Highly nasalized vowels are not a part of normal sound production in the English language). Second, the syllable must exhibit one nonglottal margin (i.e., consonant production other than glottal stop or glottal fricative that either precedes or follows a resonant nucleus). Third, the duration of syllable and formant transitions (changes in resonance associated with the movement of the articulators from one speech sound to another) must fit within the range of mature syllable production. When an infant reaches the canonical babbling stage, they are on the verge of producing their first word. It is expected that they would produce mature syllables at this point in development. Finally, the vocalization must exhibit normal phonation and pitch range. This means the quality of the infant's phonation and pitch should be perceived as adequate when compared to other infants and no other identifiable abnormal features should be noted (i.e. breathy or strained vocal quality).

Oller found the canonical babbling stage to be most crucial in language acquisition. Canonical babbling is the "onset of repetitive production of well-formed

syllables..." (Oller & Eilers, 1988). This is the final stage of babbling before the emergence of first words. This explains why the production of canonical babbling sounds similar to later speech and language. These four properties are supposed to categorize the milestones of the canonical babbling stage in an infant's normally developing vocalizations.

There are different factors that play a role in the development of early vocalizations. Many studies have proven that vocalizations in normally developing infants are "dependent upon the contingency between the response and the rewarding stimuli" (Wiergerink, Harris, Simeonsson, & Pearson, 1974). In addition, social reinforcement seems to have a consistent influence over the production of infant vocalizations (Weisburg, 1963).

Also, caregivers play a role in the expansion of early vocalizations. Jones and Moss (1971) discovered that an infant with a "highly stimulating mother is receiving information about the environment that is not available to an infant with a more passive mother." This is especially true if a mother's reaction is influenced by the infant's behavior. If an infant vocalizes more in the presence of his or her mother, the mother will continue with her attempts to elicit a vocalization from the infant, thus providing a highly stimulating environment. However, early vocalization development remains unaffected by prematurity, low SES, and bilingualism (Oller, Eilers, Urbano, & Cobo-Lewis, 1997).

When infants produce early vocalizations, they are starting to recognize and pay attention to words (Boysson-Bardies & Vihman, 1991). The development of early vocalizations is an infant's first exposure to knowledge about their phonetic system. The

development of sounds will dictate their first words. When an infant realizes the sounds they produce attract attention from caregivers, they use these sounds to communicate their wants and needs. Eventually, an infant learns the words in their linguistic environment based on exposure to their native language. This exposure will lead to later lexicon and further linguistic development.

Early vocalizations are a time when an infant's "perceptual capacities are developing...and phonetic discrimination becomes more dependent upon the phonemic organization of the language of their environment" (Boysson-Bardies & Vihman, 1991). This means the native language an infant is exposed to will determine their phonetic inventory. For example, if an infant is raised in an English-speaking home, the infant will innately learn the phonetic characteristics of that language because that is the environment they are being exposed to and those are the sounds that are being reinforced by caregivers. As an infant approaches the canonical babbling stage, the early vocalizations begin to sound more like words of the native language. Caregivers encourage and promote infants to continue to make these sounds through positive reinforcement and stimulating interaction.

Special Populations

If early vocalizations are necessary for language acquisition, a negative result may occur when a child is limited in his or her ability to produce them. Adverse effects may arise for children of other populations, such those who are deaf or hard of hearing. As described previously, interaction with the caregiver is important to the development of

speech and language. This would suggest that difficulties with this interaction may impede babbling and the subsequent development of the child.

Oller and Eilers (1988) demonstrated the importance auditory exposure plays in the development of an infant's phonetic inventory. A longitudinal study was conducted where they observed twenty-one infants with normal hearing and nine infants who were deaf. For the twenty-one normally hearing infants, they recorded vocalizations once a month for the first two years of life. These samples were half an hour in length and consisted of 50-75 non-vegetative utterances. The nine deaf infants were recorded three times a month, or two times a week, and the length of utterances as well as duration of the sample varied session to session. They tried to create recording conditions similar to those of the hearing infants (high-fidelity equipment, quiet room, parent and experimenter eliciting vocalizations with quiet toys, etc).

They initially found that both groups create "many precanonical vocalizations that are substantially alike." However, infants exhibiting moderate to severe hearing loss were significantly delayed in the onset of canonical babbling. All of the infants who were deaf were fitted with hearing aids during the period of vocal sampling and were involved in speech stimulation programs. They hypothesized that infants who were deaf manifest a different pattern for the onset of canonical babbling. If this is true, these infants may exhibit more normal canonical vocalizations at a later age. Their study proved auditory exposure does play an important role in the development of an infant's phonetic inventory.

A study done by Smith and Stoel-Gammon (1977) proposed that hearing infants and infants with moderate-to-profound hearing loss produce similar vocalizations during

their first year of life. They found that around six months of age, infants with impaired hearing shifted from producing dorsal (back) consonant sounds (e.g. /g/ and /k/) to more labial (front) consonant sounds (e.g. /p/ and /b/), as well as an increased tendency to avoid low back vowels (e.g. /a/). Hearing infants also presented with back-to-front shifting and low vowel avoidance tendencies, proving that both groups of infants produce similar types of vocalizations during the first year of life. However, the presence of otitis media (inflammation of the middle ear) in babies with conductive hearing loss showed delays in their development of early vocalizations. Also, infants who are deaf or hard of hearing do not receive auditory input from their own speech attempts or from their caregivers, which inhibits the amount of audition they are exposed to and ultimately delays their early vocalization development (Chapman et al., 2001).

Even though some similarities of early vocal development exist between infants with normal hearing and those who are deaf, infants who were classified as deaf consistently showed delay during the most crucial stage of vocalization development-canonical babbling. Their lack of exposure to auditory input impedes their development of early vocalizations.

Cleft Palate

Children born with cleft palate have congenital structural anomalies. The lack of an intact palate at birth prevents the child from being able to separate the oral cavity from the nasal cavity. Therefore, issues can arise with articulation, resonance, voice, hearing, and language (Kuehn & Moller, 2000). The research in this area is limited, but a handful of researchers are continually discovering more about the importance of early vocalizations in babies born with cleft palate.

Developing early sounds becomes a difficult task for infants with cleft palate. These difficulties are due to various reasons. In years past, palatal surgery was delayed until approximately 2 to 3 years of age (Kuehn & Moller, 2000). However, many prelinguistic and linguistic capabilities develop between birth and three years of age. With a delay in surgery the lack of an intact palate has the potential to disrupt development during this very crucial time. Therefore, some have argued that the age of palatal surgery should be as early as 4-6 months to avoid articulation and speech problems. It is impossible for an infant with cleft palate to build up intraoral air pressure because the oral and nasal cavities are incapable of being separated from each other. If attempted, air will escape from the oral cavity through the cleft into the nasal cavity. Many sounds in the English language require the build up of intraoral pressure, particularly stops, fricatives, and affricates. In fact, nasals are the only sounds that remain relatively unaffected by the coupling of the oral and nasal cavities. The coupling of these cavities creates a hypernasal quality of speech in children with cleft palate, along with the possibility of nasal air emission, which decreases the intelligibility of their speech. Given the limitations caused by the anatomy, it would be hard for children with clefts of the palate to produce a wide range of sounds made by infants with intact mechanisms. This is one reason a child with cleft palate may have difficulties in developing early vocalizations.

Another reason an infant with a cleft of the palate may be delayed in early vocalizations is due to their hearing capabilities. Often, infants with cleft palate are affected by the accumulation of fluid in the middle ear. Before palatal surgery, the muscle responsible for opening and closing the Eustachian tube (the tensor veli palatine

muscle) does not contract properly. This causes a build up of negative air pressure, which leads to fluid in the middle ear. In addition to middle ear fluid, a conductive hearing loss will affect the baby's ability to perceive sound, whether it's feedback from caregivers or from their own sound productions (Chapman et al., 2001).

Chapman (2001) examined the effect of clefting on early vocal development by comparing babbling samples from infants with and without clefts of the palate, focusing primarily on the canonical babbling stage. Forty-five (30 with unrepaired cleft palates to 15 with normal palates) 9-month old infants were studied. The participants were recorded in their homes as they interacted with their primary caregivers. The caregivers were instructed to play with their babies as they normally would. A total of 4,783 utterances were recorded from the 45 babies. The audio samples were then transcribed independently using the International Phonetic Alphabet (IPA). These utterances were compared for canonical babbling ratios, the percentage of babies who had reached the canonical babbling stage, utterance types, consonant productions, and vocal frequency.

Analyses of the data revealed that the babies with cleft were delayed in the onset of canonical babbling, with 57% of the infants with cleft palate having reached the canonical babbling stage compared to 93% of the noncleft babies. The infants with cleft palate that produced vowels utterances or any utterance which contained a glottal or laryngeal place of articulation were not considered to be using a canonical syllable. The babbling of infants with cleft palate had the same rhythm and beat as the babbling of noncleft infants, however, the consonant productions varied greatly.

The noncleft infants produced twice the number of different consonants as babies with cleft palate. Oral stops were absent in the samples, and the use of glottals and glides

occurred more frequently. The vocal frequency between infants with cleft palate and noncleft infants was comparable. The researchers found the amount of vocal frequency seen in babies with cleft palate to be 'encouraging' because the two groups shared equal opportunities for vocal experimentation and stimulation from caregivers.

In an earlier study by Chapman (1991) the consonant inventories of toddlers with cleft lip and palate were studied. Her study involved ten toddlers, five of whom had unrepaired cleft lip and palate, and five with no history of a cleft. All toddlers were between 12 and 14 months of age. In order to collect spontaneous vocalizations the toddlers were visited in their homes. Each sample was collected during informal play interaction with their mothers, and each sample was roughly one hour in length. The vocalization samples were transcribed by speech-language pathologists using the IPA.

The main focus of this study was to compare the consonant inventories of the toddlers with cleft lip and palate to those of the noncleft toddlers. The children with cleft lip and palate exhibited reduplication and variation of consonants, within the constraints of their sound production abilities given their limitations induced by the cleft palate (i.e. their inability to produce oral pressure and non-nasal vowels). It was also discovered that [h] was the most frequently used consonant by toddlers with cleft lip and palate, whereas [d] was the most popular consonant for noncleft toddlers. Toddlers with cleft lip and palate preferred nasals, glides, and glottal fricatives, while producing fewer multisyllabic constructions. The findings from this study demonstrated differences between the consonant inventories and multisyllabic productions of noncleft toddlers and toddlers with cleft lip and palate.

The infants in Chapman's (1991) study who had cleft lip and palate presented with smaller consonant inventories, which could be due to the development of compensatory strategies. Children with cleft palate develop compensatory strategies as a way to compensate for their oral deficits. By developing these strategies, children with cleft palate are attempting to vocalize and increase their intelligibility. A commonly seen compensatory strategy in babies with cleft palate would be the production of a glottal stop rather than an alveolar stop (e.g. /t/ or /d/). This specific strategy would be used because air pressure cannot be built up behind the tongue-alveolar ridge contact due to the cleft of the palate. The plosive sound is shifted back to the glottis, a place where the infant can adequately build up enough air pressure below the closed vocal folds to create a similar sounding speech sound (i.e. it sounds like an explosive release of air).

Compensatory strategies cause an infant's phonetic inventory to become drastically limited, maintaining the manner and voicing of the sound but altering the place of production, which in turn affects their babbling development. Chapman et al. (2001) did find that the babbling samples of infants with cleft contained more glottal and labial places of articulation, rather than alveolar and palatal. Interestingly, parents and caregivers may be reinforcing compensatory strategies without really knowing it. The compensatory vocalization attempts are preferred by caregivers, rather than correct placement of the sound which exhibits hypernasality and audible nasal air emission (Kuehn & Moller, 2000). Kuehn and Moller suggest educating parents about speech development and appropriate responses to early speech attempts by their children.

The age at which an infant with a cleft of the palate has surgery to close the cleft remains a controversial issue. Professionals concerned with adequate speech and

language development may argue for palatal surgery to be performed sooner rather than later, some even arguing it should happen between 4-6 months of age, prior to the onset of the most important stage of babbling.

Chapman (2004) researched the effects delayed surgery has on speech development by comparing presurgery and postsurgery speech of toddlers with clefts of the palate. Fifteen children were analyzed in this study. She collected spontaneous vocalization samples in the participant's homes while they interacted with their caregivers. These samples were collected presurgery (9 months of age), postsurgery (13 months of age) and once more at 39 months of age.

The results of this study indicated that the true canonical babbling ratios (TCBR) presurgery correlated with the mean length of utterance (MLU) at 39 months. This suggested babies with lower TCBR's presurgery had higher MLU's at 39 months of age and vice versa. However, the compensatory strategies learned presurgery still existed in some toddlers postsurgery.

Another issue that arises postsurgery is velopharyngeal insufficiency (VPI). VPI is a disorder where the soft palate (velum) and pharyngeal muscles do not close off the nasal cavity from the oral cavity, which creates a hypernasal quality of speech and the inability to generate oral pressure for plosives, fricatives, and affricates. It is a disorder commonly seen in children with cleft palate. Chapman (2004) found that children with clefts of the palate who used compensatory strategies and who had VPI were more likely to be delayed in their language and phonological skills. It was hypothesized that the child's language skills are impaired because of intelligibility issues. In other words, a child will reduce sentence length as an attempt to increase intelligibility. The results of

Chapman's (2004) study indicated that the early impact the structural deficit had was overshadowed by postsurgery variables and proved that children with an unrepaired cleft who had poor prespeech performance could significantly improve their speech development postsurgery.

There are varying differences between the phonological inventories of infants born with clefts of the palate when compared to unaffected infants. These differences can be attributed to the size, location, and type of cleft (O'Gara, Logemann, & Rademaker, 1994). These differences are dependent on whether the cleft is of just the lip, just the palate, both lip and palate, or just the soft palate only. The cleft could be unilateral (on one side of the oral structure) or bilateral (on both sides), large or small. All of these factors will vary from child to child.

In their study, O'Gara et al. (1994) evaluated babbling samples of twenty-three babies with unilateral cleft lip and palate. Eleven of these babies that had palatal surgery at 12 months or less were called the 'earlier closure group.' Twelve of the babies that had palatal surgery between 13-18 months were in the 'later closure group.' Vocalization samples were collected at various ages (5, 8, 11, 14, 18, 30, and 35 months) both presurgery and postsurgery. The sample was collected during play in a sound-treated booth by the speech pathologist. The sample was a minimum of one half hour in length. The parents were instructed on how to provide positive reinforcement for their child's speech. The parents were advised to stimulate and positively reinforce nasals, glides, and liquids in babies presurgery. After the palatal surgery occurred, parents were told to stimulate oral stops, fricatives, and affricates in both word attempts and play sounds.

Parents were also told not to reinforce glottal or pharyngeal stops or fricatives anytime presurgery or postsurgery.

The results from the analyses indicated that the 'earlier closure group' had a higher frequency of oral stops than the 'later closure group.' Other than the greater appearance of oral stops, no other measurements were of notable significance. O'Gara et al. (1994) concluded that palatal repair should occur as soon as possible in order to begin the normalization of speech and language skills, but ultimately this decision is dependent upon each individual child and the severity of the cleft.

Further Implications

Having reviewed normal language development, language development in infants in another population (hearing impaired), and early vocalization development in infants with cleft palate, implications for treatment and research can be discussed in regards to an infant with cleft palate.

Proper timing of palatal surgery is an issue that emerges again and again in literature focusing on infants with cleft palate. The continued development of longitudinal studies, such as Chapman (2004), which focus on vocalization development both presurgery and postsurgery, will provide additional data about the proper timing of surgery, on an individual basis. By studying the appropriate timing of palatal surgery, other issues could be addressed as well. Children with cleft palate often experience associated language disorders due to their speech problems (Chapman et al., 2001). If their speech problems are significantly reduced because of the timing of palatal surgery, related language problems may diminish as well.

As described in the review of literature, hearing issues are common in an infant with cleft palate. If hearing issues are addressed as early as possible, infants with cleft palate may have the capability to equalize the pressure in their ear by opening and closing their Eustachian tube, and may gain auditory exposure by perceiving sound from their caregivers and their own sound productions. Performing these actions will aid in their speech and language development, and may also prevent any cognitive issues that could arise from having a hearing deficit.

An evaluation of the velopharyngeal mechanism will help determine if the individual is exhibiting characteristics of VPI. Once an evaluation is done, options for treatment can be discussed. Depending on the patient and the severity of the problem, therapy may help resolve some of the issues. In other circumstances, physical management is a better suited option. In either case, identifying VPI as soon as possible will assist in the reduction of speech production problems.

Oller (1988) defined characteristics of canonical babbling. Two of his characteristics included: canonical syllables must exhibit at least one fully resonant nucleus (i.e., vowel of identifiable quality. High nasalized vowels are excluded by the resonance requirement) and the syllable must exhibit one nonglottal margin (i.e., consonant production other than glottal stop or glottal fricative that either precedes or follows a resonant nucleus). Both of these properties would exclude sounds that are often created by infants with clefts of the palate. These infants are developing normally, so to speak, but are unable to produce these sounds because of their structural anomaly. Canonical babbling samples of infants with cleft palate should be reevaluated after palatal surgery to give the infant an opportunity to demonstrate the proper sound.

Finally, educating the families of an infant with cleft palate should be a high priority of everyone involved in team care. O'Gara et al. (1994) was one of the only study reviewed in which the professionals informed parents of appropriate reinforcement for their child's sound productions. No one spends more time with the child than the parents, caregivers, and family members. Teaching these individuals proper strategies for assisting their infant in the development of satisfactory vocalizations and sound productions could make the difference between mediocre speech and language outcomes, and great speech and language outcomes.

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