CHILDREN WITH CHRONIC OTITIS MEDIA: THE RELATIONSHIP BETWEEN BABBLING AND ONSET OF MEANINGFUL SPEECH

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ABSTRACT

Otitis media (i.e., middle ear effusion) results in a mild-to-moderate hearing loss that places children at risk for difficulties in phonetic development. This prospective longitudinal study examined prelinguistic skills of five children with chronic otitis media (COM) in relation to their onset of meaningful speech. Thirty minute language samples were collected every two weeks and phonetically transcribed (total = 51 samples). Results showed an inverse relationship between the nature of children's babbling inventories and the age of onset of meaningful speech. Four out of the five children had prelinguistic repertoires of commonly occurring sounds and acquired meaningful speech between 12-17 months of age. The fifth child had a restricted babbling inventory and a later onset of meaningful speech (21 months). Results suggest that descriptions of young children's babbling inventories may provide valuable diagnostic measures for the early identification of children with COM who are at risk for delays in lexical development.

1. INTRODUCTION

Recently, diary and case studies have investigated the relationship between prelinguistic phonetic inventories and the development of early words in children with COM [2, 14]. In this paper, we will elaborate on previous research by examining associations between babbling repertoires and onset of meaningful speech in a group of young children diagnosed with COM between birth and 6 months of age. Section 2 contains an introduction to this area of research and the specific research questions to be addressed. Section 3 includes participant descriptions along with data collection and analysis procedures. In Section 4, results and clinical implications are provided.

2. BACKGROUND

2.1. Significance of the problem. Otitis media is one of the most common childhood diseases, affecting 79-91% of children during their first two years of life [10] and accounting for approximately $3.5 billion annually in direct and indirect costs [18]. Episodes of otitis media are accompanied by a fluctuating conductive hearing loss that occurs during critical periods of development and places children at risk for speech and language difficulties [1, 4, 6, 15, 16]. Since smaller prelinguistic speech sournd repertoires are associated with slow vocabulary development in some children [9, 12], it is hypothesized that reduced phonetic inventories will interfere with early lexical development in children with COM. Despite this potential association, few studies have examined prelinguistic sound repertoires of children with COM in relation to their onset of meaningful speech. Donahue [2] completed a diary study of a young child with COM between the ages of 9-22 months. According to Donahue, children with COM may compensate for fluctuating auditory input by using various strategies to assist in their lexical development and these differences may account for some of the individual variation in language learning within this population. In a case study, Robb et al. [14] described the phonetic and lexical development of a child with COM between 11-21 months of age. Analyses of monthly language samples revealed that this child's vocalizations showed a lack of phonetic complexity and a reduced phonetic repertoire at the onset of meaningful speech. According to Robb et al., the child with COM had delayed sound productions that resembled speech patterns of hearing-impaired children.

Since many children experience COM before they produce their first words, it is necessary to investigate relationships between prelinguistic speech sound repertoires and early vocabulary development. This line of research will not only further our understanding of the role of fluctuating auditory input on early speech and language development, but it may enable us to identify the children with COM who are most at risk for early language delays.

2.2. Research questions. The current study employed a prospective longitudinal design to investigate relationships between early babbling inventories and lexical development in five children with COM. The following questions were addressed: (1) What is the nature of babbling inventories of children with COM?, and (2) Is there a relationship between the nature of babbling inventories and the age of onset of meaningful speech in children with COM?

3. METHOD

3.1. Participants.

3.1.1. Recruitment procedures and participant descriptions. Participants in this study were part of a larger ongoing project of the effects of COM on children's development. Participants were recruited for the current project from a University-based daycare in Central Pennsylvania. Five children (3 females, 2 males) participated in this study from a group of 8 children with COM. Children were selected if they had reached meaningful speech, defined as the production of at least 10 identifiable word types [17] during a 30-minute language sample.

Each participant was monolingual with English as their native language. With the exception of middle ear disease, medical history was insignificant for factors that had the potential to interfere with speech or language development, such as sensorineural hearing loss and prematurity. Children were

from middle-class, dual-earner families. Based on medical history and demographic characteristics, participants in the current study were at low risk for developmental difficulties.

3.1.2. Defining chronic otitis media. Children were screened weekly by a nurse practitioner using pneumatic otoscopy and tympanometry to detect middle ear disease. Participants were classified as having COM when they were diagnosed at least 20% of the time with otitis media between the ages of birth to 6 months. This percentage is equivalent to a child having ear infections approximately 2½ months a year, and is similar to other definitions of COM [3, 19, 20].

3.1.3. Language information at 12 months. At 12 months of age, a family interview was conducted in each child's home. As part of the home visit, mothers used the *Language Development Survey* (LDS) [11] to report the number of words their children independently produced. In addition, a 20-minute mother-father-child play interaction was videotaped and orthographically transcribed using the *Systematic Analysis of Language Transcriptions* (SALT) [8].

3.2. Language samples. Thirty minute language samples were collected at 2-week intervals for each child, resulting in a total of 51 samples between the ages of 9-23 months (see Table 1 for more information on the language samples). During the language samples, children wore an apron equipped with a very small microphone (Countryman EMW lavalier microphone with flat frequency response) connected to an FM transmitter (TELEX WT-55 transmitter linked to ENG-1 receiver for interface with the video signal). Many toys were available to the children during this interaction. Items had been selected so that each phoneme of the English language was represented at least five times, providing children with a maximum opportunity to use all of the sounds during each language sample. For example, a toy chicken was included to give children the chance to say the [tʃ] sound, red and orange stacking rings were used for the [r] and [dʒ] sound, respectively, and while playing with a car, children could make the car go "zoom" for the [z] sound.

Child	Number of samples	Age range sampled
P1	12	16-21 months
P2	7	15-21 months
P3	14	14-23 months
P7	10	12-16 months
P8	8	9-12 months

Table 1. Language samples collected for each child.

During the first 15 minutes of the language samples, the examiner and the child incorporated the toys into routine scripts which followed this sequence: free play, bath-time for a doll which included washing and dressing the baby, snack-time for the doll where the child could feed the baby, snack-time for the child where the child could have an animal cracker and apple juice, and bed-time for doll where the child could put the baby to bed. These activities were followed by a 15-minute modified hide-and-go-seek game where the child and examiner hid and searched for various toys around the room.

3.3. Data analysis.

3.3.1. Phonetic inventories. Results of this study are based on independent analyses. Children's productions during the language samples were transcribed using the symbols of the International Phonetic Alphabet (IPA) [7]. Productions were then grouped into two phonetic repertoires for each child: a babbling inventory which included all of the sounds in babbled speech, and a meaningful-word inventory which included all the sounds used in real words. In order for a sound to be included in a child's inventory, it had to be produced at least twice within the 30-minute sample. The age of onset of meaningful speech was also determined when the child produced at least 10 meaningful words during the sample [17].

3.3.2. Lexical information. Information on children's lexical development at 12 months of age came from two sources. First, the LDS provided a description of the number and type of spontaneously produced words for each child. Second, measures such as the child's total number of words and the child's number of different words were determined from the twenty-minute mother-father-child language sample collected in the home.

4.1 RESULTS

4.1.1 Babbling inventories. Four of the five children (P1, P3 P7, P8) showed babbling inventories which consisted of many commonly occurring consonantal sounds in young children [p,b,t,d,k,g,m,n,w,j] [13]. However, the remaining child, P2, had a more restricted prelinguistic repertoire (see Table 2). For example, at 15 months of age, P2's babbling inventory was limited to two phones, the voiced velar [g] and the glottal [ʔ]. This repertoire was delayed in comparison to previous studies which showed that typically developing children use 6 phones at 15-months of age [5, 13]. The number of phones in P2's babbling inventory was similar at 15-month old child with COM who had delays in prelinguistic speech sound development [14].

At 17 months of age, P2 increased his babbling repertoire to 5 phones [b,d,g,ʔ,m]. The size of P2's repertoire continued to resemble that of the 17-month-old child with COM in Robb et al. (n=4 phones) [14], although the diversity of P2's inventory was more limited. Specifically, P2's repertoire consisted of stops and one nasal, while Robb et al.'s child used a stop, nasal, and two fricatives [s,h]. Findings continued to identify delays in P2's prelinguistic speech sound development.

At 18-months of age, P2 entered a transitional period where he began to combine some early words with babbling. The size of his consonantal inventory at 18 months was similar to inventories of typically developing children [15, 17] and some children with COM at this age [14]. At 21 months, P2 reached meaningful speech. The size of his consonantal inventory was slightly smaller than those reported of typically developing 21-month-old children (i.e., 7 sounds in comparison to 9 sounds, respectively) but it contained similar features (i.e., voicing, sonorant, coronal) [13]. Results suggest that as P2 reached onset of meaningful speech he showed phonetic inventories similar to typically developing children.

Age	Babbling inventory (n)	Word inventory (n)
15 mos.	g, ʔ (2)	(none) (0)
16 mos.	m, n, ʔ (3)	ʔ (1)
17 mos.	b, d, g, ʔ, m (4)	(none) (0)
18 mos.	b, d, g, ʔ, m, h, l (7)	d, l (2)
20 mos.	b, ʔ, m, n (4)	(none) (0)
21 mos.	m, n (2)	p, b, d, k, m, n, h* (7)

Table 2. Examples of phonetic inventories for P2.
* Age P2 reached meaning speech.

4.1.2. Babbling inventories and meaningful speech. For the four children that showed typical babbling inventories (P1, P3, P7, P8), meaningful speech was reached between the ages of 12-17 months (see Table 3). For two of these children, P1 and P7, meaningful speech was seen in the first language sample collected at 16 months and 12 months, respectively. As a result, onset of meaningful speech may have occurred prior to this time; however, this was difficult to determine since the speech production data was not collected before the first age sampled.

Results of the LDS showed that according to maternal report, P1, P3, P7, and P8 produced between 18-44 words independently in their home environment at 12 months of age. For three of these four children (P1, P3, P7), analyses of 12-month language samples with their parents indicated that they were using words functionally during parental interactions. That is, P1, P3, and P7 produced between 1-12 meaningful words, and 1-8 different words during free-play with their parents. Although P8's mother reported that she was producing words spontaneously at home (18 words at 12 months), results of her language sample showed that she did not use any meaningful words during the parent-child language sample. P8's limited verbal participation was likely attributed to her mother's report that she was tired during this interaction and hesitant to participate in front of the videocamera.

P2, the child with restricted prelinguistic inventories, reached meaningful speech at a later age than the other four children with COM (21 months). His mother also reported that he produced fewer spontaneous words than the other children at 12 months of age (6 words), and results of his language sample indicated that he was not using words to communicate during a play session with his parents.

Findings suggest that meaningful speech does not start until children have adequate phonetic inventories containing sounds that they can use in their first real words. For each of the children in this study, onset of meaningful speech was reached when their inventories contained age-appropriate sounds. Even for P2 who had delays in his early babbling repertoires, onset of meaningful speech occurred when his inventory size was age-appropriate.

Results also indicated that some children with COM may experience prelinguistic speech sound delays that place them at risk for later onset of meaningful speech. There appears to be an inverse relationship between babbling inventories and early lexical development. Children with restricted prelinguistic repertoires showed later onset of meaningful speech and smaller expressive vocabularies at 12 months of age. Whereas, children with larger and more complex babbling inventories (P1, P3, P7, P8) had earlier onset of meaningful speech and larger expressive vocabularies at 12 months of age.

Child	Total number of words*	Number of different words*	Language Development Survey*	Age of onset of meaningful speech
P1	6	4	44	16 months^
P2	0	0	6	21 months
P3	1	1	18	17 months
P7	12	8	14	12 months^
P8	0	0	18	12 months

Table 3. Lexical information and age of meaningful speech.
* Data collected at 12 months of age.
^ Earliest date of data collection.

5. CONCLUSION

Only recently have studies started to investigate aspects of prelingusitic communication in children with COM in relation to lexical development. Since many children experience middle ear disease well before the onset of their first true words, early phonetic patterns may reveal important developmental differences in children with COM. Findings from the current study provide preliminary evidence that children with COM who have restricted babbling inventories are at risk for early lexical delays when compared to children with COM who have typical prelinguistic repertoires. Although continued research is necessary with larger sample sizes, studies of language development past the one-word stage, and additional speech sound analyses, results suggest that babbling inventories may provide important clues to identifying those children with COM at risk for language delays.

ACKNOWLEDGMENTS

We are grateful to the children and their families for their participation in this study. We are also thankful to the speech-language pathology students that assisted in data collection and analysis. This research was supported by Grant HD37586 awarded to the second author and Grant HD31540 awarded to the third author from the National Institutes of Health, National Institute of Child Health and Human Development.

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