Language environmental analysis (LENA) of three Cypriot Greek-speaking children

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Abstract

This is the first study that explores the quantity and quality of language input in Cypriot Greek-speaking families using highly specialised software. The purpose of this longitudinal case study was to record, analyse and evaluate the longitudinal changes in conversational turns, input and participant vocalisations in Cypriot Greek-speaking families using the computerised LENA (Language Environment Analysis) software. The study involved two typically developing children (TD) and a child with a Language Disorder (LD). TDs' performance and language input confirmed the norms of typically developing scores of the LENA system. In contrast, LD differed quantitatively and qualitatively from the mean number of CVC and CTC. The mean numbers of LD measured below the <25th percentile in any measurement and the quantity of language input. Recent research supports the findings of the present study.

Keywords: LENA, language input, vocalisation, prelinguistic, language disorder

Introduction

LENA system is a new tool combining a wearable audio recorder with automated vocal analysis software (LENA Research Foundation, 2014). LENA was developed to overcome the difficulties in obtaining data from young children and conducting detailed analyses of language samples. LENA system investigates various linguistic aspects (Greenwood, Thiemann-Bourque, Walker, Buzhardt, & Gilkerson, 2011; Sunsking et al., 2016).

Recently, Wang et al. (2020) reported a statistically reliable correlation between adults' words and children's language skills. Thus, the LENA system estimates of in-home language input since the 30-million-word gap project showed that parents were encouraged to increase the quality and quantity of their turns. Another milestone study by Gilkerson et al. (2018) recently demonstrated long-term associations between early language exposure and subsequent child language and IQ through late middle school through LENA and their naturalistic methodology. Thus, they have proved that turn-taking predicts crucial outcomes by age 14. The authors affected the clinical practice recommendations of the American Academy of Pediatrics.

Aim of the study

This study aims to record for the first time in Cypriot-Greek dialect and Greek language how much exposure is needed for language acquisition since a language is acquired through exposure. Also, are there any recorded differences among TDs and LD participants?

Method

This is a longitudinal study of three cases included in-home recordings where two Cypriot Greek-speaking families and their typically developing children (6 and 46 months old) (TDs) and a Cypriot Greek-child (81 months old) (LD) diagnosed with a language disorder participated in the study. TDs were born full-term without neurodevelopmental or hearing disorders. All participants were recruited through the Cyprus University of Technology University Rehab Clinic and their participation approved by the Research Ethics Board of the Clinic and the University.

LENA's hardware includes a digital language processor (DLP), a USB port for data transfer, and a display screen that is held in a t-shirt worn by the participant with a pocket on the front. The device records in 16-bit, and when it is full, the researcher can upload it to the software since a full day consists of 20 to 50K segments (VanDam et al., 2016). The software classifies each segment based on volume and suprasegmental speech features as one of seven categories: adult male/female, another child, essential child, TV, noise, silence and overlapping sounds. Other sounds, defined as "vegetative sounds" (burping, sneezing) or "fixed signals" (crying, laughing) measured and classified based on their prosodic features (intonation, duration) (Oller et al., 2010). The segments classified as "vocalizations" counted as CVC and adult speech as AWC. Vocalization turns produced within five seconds of an adult's production without interruption are classified as the contiguous, linguistic turn-taking CTC. LENA system generates an estimated expressive language standard score calculated on the quality of the child's productions called automatic vocalization assessment (AVA) and provides a comparison to typically developing peers.

The software requires recordings to be at least 10 hours long to complete a full analysis, including percentile rankings. The audio data (>150 hours overall) was processed and classified by the LENA Pro software into seven sound categories. The speech and turn-takings of the six months old TD was recorded and analysed based on recordings in two months that fulfilled the system's criteria for analysis. The analysis of 46 months old TD was based on four recordings for two months. Accordingly, the analysis for LD child was based on 46 hours of three recordings in two months. An SLP explained the proper wearing and use of the DLP to the parents asking parents to have the child wear the recorder in the unique LENA clothing. Parents received an instruction sheet and were asked to provide information on whether the recording day seemed to represent a typical day for the child.

Results

Auditory environment

Results for the auditory environment by the categories are divided into five categories: 1) TV and electronic sounds, 2) silence and background noise, 3) noise, 4) meaningful speech, and 5) distant speech. The TV and electronic sounds time for TDs ranged from 3 to 9 hours. The overall time for LD child was 4 hours respectively. The amount of exposure to meaningful speech was found 4 ½ to 8 hours for TDs, while the corresponding time for LD was only 4 hours. The time of the distant speech was measured between 7 ½ to 16 hours for TDs, while the distant speech time of LD was found 16 ½ hours. The noise was measured for all the participants for almost 1 hour. Finally, the silence and background time for TDs was measured long since, ranging from 21 to 27 hours overall.

Vocalizations and turns

The mean number of vocalizations of LD (46 months old) was 990 words classified at the 50o percentile, while the mean number of LD (6 months old) was 529 vocalizations classified at the 10o percentile of the LENA system. The performance of LD was measured at 313 words and classified at the 10o percentile of the norms. The adult words of TDs were classified at 75-90o and 70o percentile accordingly. Regarding the concern, the mean conversational turns were found at 270 (50o percentile) for six months old TD and 223 (10o percentile) for the other TD child. The LD child had only 85 turns classified at the 10o percentile of the system since the 50o percentile is measured at 200 turns.

Discussion

The purpose of this study was to present in detail data for the first time in Cypriot-Greek and Greek about the informal environment of TD and LD participants. The present study is part of a more extensive study involving more participants from both groups. We are particularly interested in revealing subtle communicative differences among TDs and LDs, especially in Cypriot-Greek dialect, so we can differentiate our clinical protocols in Speech-Language Pathology, providing the parents with the opportunity to be more "communicative" qualitatively and quantitatively. AWC, CT and CV variables of the LENA system proved reliable in many studies and linked the performance to possible LDs (Ganek & Eriks-Brophy, 2018; Thiemann-Bourque et al., 2014).

According to our results, the adult words that LD child received were few, only at the 10o percentile. The same stands for the turns since the mean number was calculated at 85 and the 10o percentile. Thus, there is a significant mean difference between the adult words that LD child received (6.800) and

the vocalizations that TDs received (16.000) from their parents. The results revealed a delay for the turns as well. The LD child received only a mean number of 85, while TDs ranged from 223 to 270 turns. In sum, the study also revealed the need for intensive counselling of the parents by changing clinical protocols in Speech Pathology, following other studies that revealed similar needs (Suskind et al., 2013).

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