Spontaneous Vocalization Change in Infants with Severe Impairments using visiBabble

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Abstract

Children with difficulty producing speech sounds can practice sounds in play, even prelinguistically. visiBabble is a prototype computer-based program that responds with customized animations to targeted types of infant vocalizations. The program automatically recognizes acoustic-phonetic characteristics of the vocalizations and can selectively respond to utterances with varying levels of complexity (e.g. multisyllable utterances). This poster reports syllable production changes of three children with physical and speech impairments, ages 1-4, in response to visiBabble reinforcement. Results include immediate effects of visiBabble reinforcement on infant vocalizations as well as longer-term effects of home visiBabble practice on spontaneous sound production.

Background

- The goal of visiBabble is to encourage children with significant delays or impairments in developing speech to produce vocalizations that are more speech-like. It does this by providing visual and auditory feedback for types of babbling that are associated with later language and cognitive development.
- The program is also designed to be a clinical tool that relies on acoustic-phonetic analysis of the child's vocalizations. As a child interacts with visiBabble, the program analyzes the child's utterances to determine relative acoustic complexity so that it can respond differentially to target and non-target types of utterances.
- The purpose of the visiBabble system is to increase the vocalizations of young children, and to increase the sophistication and variety of such vocalizations by differentially reinforcing syllabic and non-syllabic productions.

Procedures

Subjects

- Subjects were three children with neurological impairments at risk for being nonspeaking, mean age 29 months (range 17-50 months)
- All children had developmental ages below expectations for their chronological age. One child (HR) was within typical expectations for her expressive language milestones at 17 months, but at risk for being nonspeaking because of a cerebral palsy diagnosis
- Two children (HR and CS) already produced a variety of sounds in communicative contexts and had an intervention target of multisyllable utterances. The other child, JL, had difficulty producing vocal behaviors communicatively and the intervention target was producing any sound at the opportunities presented.

Subject Developmental and Descriptive Characteristics

Subjects	Gender	Chronological Age	Etiology	Developmental Age *	Motor Age	Cognitive Age	Receptive Language Age	Expressive Language Age	Speech Target
JL	F	22 mo.	developmental disability of unknown origin	4 mo.	2 mo.	6 mo.	8 mo.	4.5 mo.	any sound
HR	F	17 mo.	cerebral palsy	15 mo.	8 mo.	14 mo.	23.5 mo.	16.5 mo.	multisyllables
CS	F	50 mo.	vocal fold paralysis	27 mo.	25 mo.	25 mo.	42.5 mo.	26 mo.	multisyllables

* All age scores beyond Chronological are age equivalence scores on the Battelle Developmental Inventory

Equipment

- visiBabble was a computer program that responded to a child's vocalizations with animated reinforcements, based on acoustic recognition of target syllable types
- Visual reinforcement appropriate for the child's developmental age (e.g. fireworks, animation, uncovering puzzle pieces from a personal or age appropriate picture) was presented in response to all child vocalizations that matched the targeted sound type
- Partial reinforcement (e.g. producing single syllables in multisyllable mode) received a brief highlighting of reinforcer items but no animation or complete removal of item

Treatment & Data Collection

- Preliminary assessments were collected: Battelle Developmental Inventory, Sequenced Inventory of Communication Development, Communication and Symbolic Behavior Scales (CSBS). The CSBS was also administered after visiBabble intervention as a structured speech sample as well as communication measure.
- Parents videotaped samples of their child in a vocal interactive activity 1-3 times during the weeks before and after visiBabble intervention, to provide an independent sample of children's vocalizations and generalization of effects
- For visiBabble therapy, the visiBabble was set up on a laptop computer in the family's home and the family was trained how to use it. Family was encouraged to conduct one 8-minute visiBabble reinforcement session per day.
- Researchers visited the family once per week and videotaped a visiBabble session with 4 minutes of the reinforcement animations activated and with 4 minutes without reinforcement to see if child was responding differentially to the reinforcement
- The research goal was to see a change in the sounds in targeted categories after visiBabble intervention, using a quasi-experimental pre-post single subject design

Data Coding

- Children's speech samples during the CSBS as well as parent vocal samples before and after intervention were broadly transcribed for phonemes and words produced
- Utterances were differentially coded into categories of vocal production: vowel only, multiple vowels, long vowels, quasi-consonants, canonical syllables, multiple syllables with consonants, words, multiple words
- Videotapes of child during the visiBabble session were coded to see if child was attending or not attending to the screen

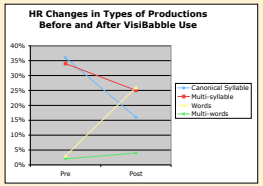
Results

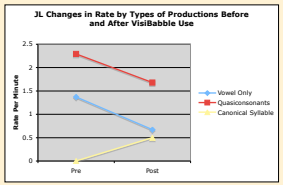
Treatment Implementation

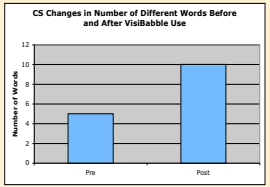
- Although each family was scheduled for 6 weeks of visiBabble intervention, actual intervention times could be longer because of vacations and other family delays. Average number of visiBabble weeks in the home was 10 (range 6-14), and the average number of family uses of visiBabble (recorded automatically by the computer) was 17 (range 10-28).
- There was variability in the average number of visiBabble sessions/week for the children. The child with the least vocalizations practiced the most intensively (JL averaged 5.7 family uses/week in 6 weeks); HR averaged 1.6/week in 10 weeks, and CS averaged 1.3/week in 14 weeks.
- Children varied in the percentage of the 8-minute sample in which they attended to the visiBabble screen. HR averaged 42% attention (range 25-68%), JL averaged 74% (range 44-95%, and CS averaged 80% (range 67-94%)

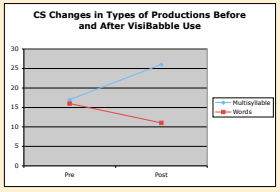
Treatment Outcomes

- In post treatment spontaneous vocal samples, HR increased in targeted complex productions (i.e., words and multiple words) and decreased in simpler productions (i.e., canonical babbling and multiple syllable babbling).
- In post treatment spontaneous vocal samples, JL increased in the variety of both consonants and vowels produced (target was any vocalization). JL also showed a post-treatment decrease in less complex vocalizations, like vowel only and quasi-consonants, and an increase in more complex canonical syllables.
- In post treatment spontaneous vocal samples, CS increased her number of multisyllable utterances, as targeted in intervention. CS decreased her overall number of words produced, but showed a greater number of different words in the post treatment sample.









Discussion

- All three subjects showed increases in the frequency and/or variety of vocalizations after 6-14 weeks of visiBabble intervention.
- All three subjects demonstrated increases in their vocal skill area targeted by visiBabble.
- Based on independent speech samples collected by parents before and after treatment, all subjects exhibited generalization of skills from visiBabble to nontreatment settings.
- Subjects with complex motor and neurological impairments showed change in frequency and variety of vocalizations even with co-occurring cognitive impairments.
- Based on the small n and quasi-experimental design, the study should be replicated to control for outside variables and include a larger number of subjects.

Clinical Implications

- visiBabble has the potential to be an effective strategy for targeting skill production in children with a variety of motor and cognitive skills if child's productions fall in the range between vowels and multisyllable words.
- visiBabble does not target specific sounds, but addresses the acoustic/articulatory variety and complexity of vocalizations children produce. Therefore, visiBabble should not be used in isolation, but should be combined with other forms of vocal and communicative treatment.

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