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AN ONTOGENETIC STUDY OF INFANT SPEECH PERCEPTION


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GENERAL GOALS

This paper presents the main lines of a project that will assess the development of speech perception and production during the first two years of life. The project will primarily focus on the evolution the infant's speech perception during the language acquisition process. The studies will complement the investigations of infant speech production that were made in previous projects carried out by the Institute of Linguistics of the University of Stockholm (Roug, Landberg, & Lundberg, 1989).

The evolution of the infant's perceptual space for speech will be investigated from two perspectives. One perspective concerns the infant's basic auditory abilities: what kind of speech sounds does the infant discriminate and how the infant's ability to discriminate along different acoustic dimensions changes in the course of language acquisition. The other concerns the infant's capacity to establish equivalence classes for speech sounds, i.e., the ability to ignore communicative irrelevant acoustic differences among sounds in order to become a linguistically competent listener.

One of the goals of this project is to gather both perceptual and productional data to provide an empirical basis for the discussion of theories that account for invariance in speech perception by reference to speech articulation gestures. Although the gross aspects of the initial phase of language acquisition seem to be similar across infants, infants clearly have idiosyncrasies regarding the infant's preferences for places of articulation and, later, words. The project will attempt following the individual development strategies of both speech perception and speech production as this may uncover the relationship between perception and production of speech, in particular, the relative timing of their development.

Another goal of the project is to provide empirical evidence for the discussion of the two traditionally competing hypothesis: (a) The infant's speech capabilities are the result of a phylogenetic specialization for speech vs (b) the infant's speech development is accounted for by functional specialization of general auditory mechanisms.

Finally, the project's perceptual experiments will be coordinated with those of studies that are being carried out in Universities abroad, as to provide comparable cross language data on infant speech perception development.

METHODS

The methodology for this project was chosen to enable the parallel follow up of the infant's perceptual and productional development.

The production data will be registered immediately before or after the perception experiments, whenever possible. Both video and audio recordings will be made under the same standard situations in which data was collected for the project "From babbling to language I" (Från joller till språk I) and that are described in Roug & al. (1989).

The perception experiments will be conducted using behavioral techniques. The infant is initially exposed to a reference stimulus (or a reference set of stimuli). Once a stable behavior has been attained after this exposure period, the target stimuli are pre-

For a detailed version of the project see Lacerda, Aurelius, Landberg and Roug-Hellichius (1989).
sented. The infant's response to the new stimuli is inferred from changes in the infant's behavior.

**PRODUCTION DATA**

Video and audio recordings for the production data are planned to be done in connection with the perception experiments. The recording sessions will be 15 minutes long, just before and after the perception experiment. The perception test itself will also be video recorded for posterior analysis. There will be three standard recording situations. The mother will be encouraged to stimulate the infant's speech production during the recordings.

**Infants that do not sit without help**

For newborns and small infants that are not yet able to sit by themselves, the recordings will be made under two standard situations. In one, the infant will be laying on a table being changed by the mother. In the other, the infant will sit on the mother's knees, face to face with the mother.

**Infants that can sit by themselves**

When the infant can sit without help, a new recording situation will be created in which the infant will be given a set of standard toys to play with.

**Methodological problems**

The infant's speech production material will be separately transcribed by at least two phonetically trained transcribers. Their phonetic transcriptions will be then be described in terms of phonetic parameters and only the transcriptions matching in at least 80% of those parameters will be considered for future analysis.

**Perception experiments**

The perception experiments will be carried out with two different behavioral techniques depending on the infants age.

**Infants below about 6 months of age**

For infants in this age group the experiments will be conducted with the high amplitude sucking technique (HAS).

First the high amplitude criterion is defined for the infant to be tested. This is done by letting the infant suck a blind nipple for a short while. The criterion for high amplitude sucking is then defined so that a certain percentage of the infant's spontaneous suckings will be above the criterion.

After this the satiation phase starts. A stimulus (or set of stimuli) is presented when the infant's sucking amplitude is high. A limitation of the maximum frequency of stimulus repetition is included. Except for this limitation, the stimulus presentation is controlled by the infant.

After a while the infant gets tired of listening to the same stimulus and decreases the frequency of the high amplitude sucks. At that point a new stimulus is presented. If the infant can discriminate this from the preceding one the sucking frequency may increase again.

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‡ The schedule of these recordings may have to be readjusted if it turns out to be too straining for the young infants.
Infants above about 6 months of age

Infants that are more than 6 months old will be tested using a visual reinforcement head turn (HT) technique. The infant hears first a reference stimulus (or set of stimuli) that is periodically repeated. After an initial period of curiosity, the infant ignores the presence of the stimulus and becomes instead interested in a silent toy that is held in front of the baby. At this stage the reference stimulus is substituted by a new stimulus and a toy that draws the infant’s attention is presented laterally at the same time. The infant looks in the direction of the new toy. After a while the toy is removed, the presentation of the original reference stimulus continues and the infant becomes again interested in the toy that is in front of him.

After some repetitions of this procedure, the infant expects to see the second toy whenever the reference stimulus is substituted by another sound. The infant anticipates the appearance of the second toy and looks toward the place where the toy can be seen when he detects the type of changes in the stimuli that were associated with the appearance of toy. If the infant’s head turn occurs after a correct detection, the toy is displayed and therefore the infant’s behavior reinforced. If the infant makes an incorrect head turn, the toy is not shown. The measurement of the head turns and their relation to the presented stimuli indicates the type of discriminations or classifications that the infant is able to make.

Methodological problems

There are a number of difficulties with these experiments. First the amount of data that can be obtained by session is rather limited. Second the experiments demand that the infant is willing to cooperate, does not fall asleep, starts crying or gets distracted during the experiment. Third the interpretation of the infant’s behavioral responses demands special control of possible experimenter’s bias. Fourth the number of experimental sessions per infant (roughly 30 in two years) demands a high motivation from the parents.

Experiment schedule

The time interval between the experiments will be adjusted to the infant’s developmental stage. Newborns will be studied every other week, starting at their first week of life, until they reach the reduplicated consonant babbling stage. After that milestone the infants will be tested once a month.

STIMULI

The stimuli for the experiments will consist of synthetic V, CV, VC and CVCV stimuli. These stimuli will be used to study how the discrimination and the establishment of equivalence classes evolve during the first two years of life. The CVCV stimuli will be used to investigate the infant’s representation of the Swedish word accents: Accent I (acute) and accent II (grave).

The stimuli that will be used in the perception tests with the infants will be first calibrated in labelling tests run with adult native speakers of Swedish.

SUBJECTS

The subjects will be full term infants born, after a normal gestational period, at the Karolinska Hospital, in Stockholm. The future parents will be contacted by the doctor or nurse in charge of the routine check ups during pregnancy.
References
