DOCUMENT RESUME

ED 060 936 PS 005 426

TITLE	Aspects of the Acquisition of English Phonology.
INSTITUTION	Stanford Univ., Calif. Committee on Linguistics.
SPONS AGENCY	National Science Foundation, Washington, D.C.
PUB DATE	Nov 70
NOTE	19p.; NSF Grant GS-2320, Progress Report July 1, 1968-November 1, 1970
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Child Language; *Consonants; *Early Childhood; English; *Language Development; Language Research; Linguistics; Oral English; Perceptual Development; *Phonology; Research Methodology
IDENTIFIERS	Shvachkin (N Kh)

ABSTRACT

Progress in an extensive, linguistically oriented program of research on child language development is reported. The ultimate purpose of the research is to contribute to a general theory of human language behavior; more immediate goals are the increased understanding of language development processes and improved characterizations of particular languages. The first stage of research, the project "Aspects of the Acquisition of English Phonology," has four principal areas of study: (1) production of initial English consonants; (2) recognition of initial English consonants; (3) phonotactics, in particular the production and recognition of certain English consonant clusters. The state of each of the principal areas and plans in each area during the remainder of the grant period are presented. Substantive results reported concern (1) modal order of acquisition, (2) Shvachkin research method, and (3) value of multiple approach. By-products of the research include the following: (1) new interdisciplinary focus to child language research at Stanford; (2) new means of information exchange on child language research; (3) new publication of working papers; and (4) child language data archive. Future research will concentrate on other parts of English phonology using the same multiple approach and the extension of the study to the phonology of other languages. (DB)

ASPECTS OF THE ACQUISITION OF ENGLISH PHONOLOGY (NSF Grant GS 2320)

Progress Report July 1, 1968 - November 1, 1970

November, 1970

Committee on Linguistics
Stanford University
Stanford, California

In March 1967 the Committee on Linguistics at Stanford University announced its intention to carry out an extensive, linguistically-oriented program of research on child language development. The ultimate purpose of the research would be to contribute to a general theory of human language behavior, and more immediate goals would be the increased understanding of language development processes and improved characterizations of particular languages. The research was to make use of existing biographical studies of children from various language groups and was to include both experimental studies and the observation of behavior in naturalistic settings.

As the first stage of the research, the project "Aspects of the Acquisition of English Phonology," funded by NSF Grant GS 2320, was initiated. This project investigates the development of the recognition and production of English speech sounds, in particular the acquisition of word-initial consonants and consonant clusters by children between the ages of six months and five years.

The project began in summer 1968 but went slowly at first because several of the expected research staff became unavailable at just about the time the project was finally approved and funded. The delay resulted in a request for extension and a reorganization of staff to utilize more part-time and summer work by Stanford graduate students in Linguistics. As of November 1, 1970 all the preliminary studies have been completed, the experimental techniques have been refined, and the final studies are in progress and will be completed by June 30, 1971.

The main issues on which the project has focussed are: (1) what is acquired, i.e., what consonants and oppositions between consonants appear

in the children's discrimination and production behavior, and (2) the order of acquisition, i.e., the chronological order of the appearance of these consonants and consonant oppositions. These two issues have been studied within the framework of the linguistic point of view of Jakobson (Jakobson 1941/1968, Jakobson and Halle 1956) but also with regard to alternative theoretical positions such as those of Mowrer 1954, Olmsted 1966, and recent theories of phonology such as Chomsky and Halle 1968 and Stampe 1969.

Four principal areas of study were proposed:

(1) Production of initial English consonants

(2) Recognition of initial English consonants

(3) Phonotactics, in particular the production and recognition of certain English consonant clusters

*(4) Imitation of synthetic speech material.

The state of each of the principal areas of investigation as of November 1, 1970 and the plans in each area for studies during the remainder of the grant period are reported below, with a summary of the results of the project as a whole. A separate, more detailed report is available for each of the completed studies described below.

1. Production of Initial English Consonants:

This area of study was to include a collation of reports from diary sources, and a developmental study of nine subjects spread over the age range 1;6-5;0. These subjects were to be studied for eighteen months.

*This area was dropped because of the reduced funding level of the final grant.

The diary study is still in progress, and will be completed in March, 1971 (see below "Biographical Study of First Words"). Two preliminary studies were carried out to determine the effectiveness of cross-sectional techniques. One of these, on spontaneous production, was completed (see below); the other, on imitation of nonsense materials, was not carried to completion. Both led the investigators to strong recommendations for longitudinal studies of a small number of children in naturalistic settings.

Study Completed: Initial Consonant Production (Spontaneous)
June-September, 1969
Caroline Stoel

Purpose: An attempt to get an overview of the development of consonant production.

Method: 18 children -- 1;6-4;3. No restrictions on birth order. Each child was visited once. Words which children were expected to know were elicited by use of pictures and toys. If the child would not spontaneously produce a certain word, an attempt was made to elicit an imitation. Each initial consonant, if possible was elicited in at least two different lexical items. The tapes were analyzed according to whether each production of the child was a "correct" sound in terms of adult English, a phonetic variant of that sound, or the substitution of another English phoneme.

Results: Results were inconclusive as to the over-all ordering of correct consonant production, but the following findings were of particular interest:

(1) Stops were acquired early and were stable except for the feature of voicing.

(2) /h/ was acquired early, varying in some children with [ʔ].

(3) There was a great deal of variation in the acquisition of fricatives, the production of /s š θ ð/ varying from one item to the next in many subjects.

(4) Semivowels were not produced by the youngest children, but when they appeared they were correctly pronounced.

(5) Liquids /l/ and /r/ were not found in spontaneous speech of the younger children; semivowels were often substituted for liquids. After 39 months, the production of liquids was always correct.

Suggestions for future studies:

(1) Longitudinal studies of small numbers of children using two investigators would seem to be more promising for general investigation of initial consonants. Several visits and considerable work with each child are required in order to determine the full consonant inventory because of differing lexicons, phonetics and speech styles of the children. A second investigator is required in order to have both effective elicitation and adequate tape recordings along with phonetic and semantic/situational notes.

(2) Single-visit, larger-sample studies would seem to be suitable only for the investigation of a small sector of the phonology, e.g., initial fricatives. The relevant repertory can be determined on a single visit and even simple presence/absence data can yield interesting generalizations.

Study in Progress: Children's Production of Initial Consonants
July, 1970-June, 1971
Carol Molony
Carol Farwell

Purpose: Profiting from the suggestion for a longitudinal study above, this is a developmental study of initial consonant production beginning with children at about one year of age when each is beginning to say his first words. Consonants are being studied according to their occurrence in words which are recognized as an attempt at some adult word, although some initial consonants of established idiosyncratic words will also be studied.

Method: 7 subjects; 4 girls, 3 boys. No restrictions on birth order. Parents native speakers of English. Each subject is visited once a week for a half-hour recording session. Two investigators are present at most sessions. Interviews are informal and investigators depend heavily on parents to know what words a child might say and how best to induce him to say them. Spontaneous productions are preferred but imitations are also analyzed. As the children approach the end of the study, at ages 1;6 to 1;9, it may be possible for the interviewers to structure each session so that specific sounds can be elicited.

Proposed Study: A Biographic Study of Children's First Words
September, 1970-March, 1971
Carol Farwell

Purpose: This study is a diary survey of children's first words which are identifiable as attempts at adult productions, in order to co-ordinate diary findings with the experimental results of the project. The focus of the study is on the consonants used in first words as well as certain properties of the shape of such words, such as reduplication.

In order to be most useful to the current research project, the study is focussed on English-speaking children and is limited to those diary studies which are highly explicit about the earliest vocabulary.

2. Recognition of Initial English Consonants

This area of study was to include children in the age range of six months to three years, six months, so that maximum data could be collected. The younger children were to be studied for perceptual differences by using the Bridger method of measuring physiological correlates of attention.* The older children were to be studied by using the method employed by Shvachkin (1948) in which children are tested on the discrimination of two initial consonants. In the Shvachkin method different toys are named with different nonsense syllables, e.g., 'bik' and 'mik', and the child is considered to have acquired a given opposition when he is able to make correct choices between pairs of names on being given one of them.

Study Completed: Feasibility of Duplicating Shvachkin's Study of Russian Sound Acquisition on American-English Speaking Children
April-May, 1970
Natalie Brostoff
Olga K. Garnica

Purpose: This study was carried out to explore methods and procedures for a replication of Shvachkin's study with English-speaking children and to determine its feasibility. Shvachkin's report omitted description of many procedural details and left many methodological questions open for future experimenters trying to replicate his study.

*The Bridger method study was dropped because of the reduced funding level of the final grant.

Method: Two children, 1;4 and 1;7 were studied for several sessions in their homes. A variety of objects and methods were tried out to get the child to play the sort of game reported by Shvachkin.

Results: The investigators concluded that great flexibility in experimental tasks might be required to accommodate the preferences of each child. Some specific suggestions were made, but a larger pilot study was recommended to settle on exact procedures. In general, Shvachkin's approach was seen as a feasible method of research.

Study Completed: The Development of the Perception of Phonemic Differences in Initial Consonants by English-Speaking Children: A Pilot Study
Summer, 1970
Olga K. Garnica
Marlys Macken

Purpose: This study was conceived as a further testing of specific methods in carrying out a Shvachkin experiment. It was also hoped that an overview of the gross ordering of consonantal acquisition might be obtained so that the consonant pairs tested in the main experiment could be chosen on a principled basis. The Shvachkin study was concerned only with Russian consonants, and the differences in phonological inventories of Russian and English require modification of the classification and choice of representative consonants.

Method: Twelve subjects, age 1;9 to 3;5 were seen twice a week for half-hour play sessions. The children were introduced to painted, variously shaped blocks with faces and names such as "Mr. Bik." After training sessions in which the objects' names were repeated many times, the children were asked to pick one of the objects and to do something with it in the array of other props which were used such as a doll house, a car, a slide, etc.

After training, at least twelve test trials were made during which the experimenter gave no aid to subjects in choosing the objects named in each request. A child was told immediately, however, if he had made the wrong choice and was given the other object with which to continue the action. A statistical analysis was used to indicate whether the choice of correct objects was above chance levels.

Results: Although the experiment was not extensive enough to arrive at comprehensive, detailed statements about ordering, the subjects seemed to be learning to distinguish consonants in about the same order, and the classes of consonants which Shvachkin used seemed applicable with only minor modification for the investigation of English.

The methodology for a Shvachkin kind of study was perfected and it has been made explicit enough in the investigator's report that other researchers interested in replicating Shvachkin's experiment or using his method for other research can readily do so. A whole series of details such as number of trials, naming of objects, and types of acceptable responses had to be worked out either because they were not reported by Shvachkin or because his procedures were not applicable in the American setting.

Study in Progress: The Development of the Perception of Phonemic Differences in Initial Consonants by English-Speaking Children
Olga K. Garnica
Marlys Macken
Carolyn Johnson

Purpose: This is the full Shvachkin replication for which the preliminary studies were carried out. In it children's acquisition of discrimination of initial consonants and consonant classes will be followed for about six

months in order to obtain a more definitive ordering of acquisition for English.

Method: Eight children; 4 about 1;6, 4 about 1;9. All children have at least one older sibling. Each child is seen three times a week. Methods perfected during the summer are used. As of November 1, 1970, this project is in the process of subject pre-testing.

3. Phonotactics

In this area of study, children under three years of age were to be tested over a period of nine months using a technique suggested by Messer (1967) in which children are asked to imitate nonsense syllables containing both "possible" and "impossible" initial and final clusters. Only a few of the conceivable combinations of English consonants are found in English words ("possible in English," PE) while many other such combinations sound odd to English speakers ("impossible in English," IE). As techniques for the study of production and recognition of initial English consonants were developed in the project, plans were made to use the same methods to study the acquisition of initial consonant clusters. An examination of diary studies was also undertaken for information on the order of initial consonant cluster production by English-speaking children.

Study Completed: Phonotactic Rules for Initial Voiced Stop + w, l, or r
October-December, 1969
Naomi Baron

Purpose: The purpose of this study was to follow up Messer's findings in depth by restricting the phonological variety of the stimuli. The

clusters to be investigated were restricted to a small number in which the variety of clusters would be in terms of a single parameter, place of articulation (features "anterior" and "coronal" in Chomsky and Halle, 1968). It was hoped to establish the existence of a single phonological rule blocking all of the impossible English clusters in the following set:

bw (IE)	dw (PE)	gw (IE)
bl (PE)	dl (IE)	gl (PE)
br (PE)	dr (PE)	gr (PE)

Test items consisted of twelve PE-IE pairs of nonsense syllables and twelve IE-IE pairs, all differing only in the initial consonant cluster. Four warm-up items were taken directly from Messer's study.

Method: Six subjects, 4 years old (7 more subjects were added later). All subjects from a monolingual English background. All subjects were judged to have intelligible articulation. Two identical stuffed animals were presented to the child, each named with one member of the pairs of nonsense syllables explained above. The child was asked to indicate by pointing which of the animals had a "better" name, defined as a name he might give one of his pets. After a session with the warm-up syllables, seven additional subjects were added, three 3;9-4;5 and four 9;0-10;3.

Results: In three-fourths of the warm-up items, the PE syllable was preferred, but never by as big a margin as Messer found. In the real test, younger subjects showed no preference for PE syllables, and the older subjects showed no statistically significant preference. The choice among IE-IE pairs was random, even for two subjects who were consistent in their preference of PE over IE. This last result might be evidence for the blocking of these impossible clusters by a single rule. Although

these results do not match Messer's findings, this is probably attributable to methodological factors:

(1) Syllables differing only by the initial consonant cluster may be too similar for good comparison. There is some support for this supposition in the children's reactions during the experiment.

(2) The best name for a funny-looking stuffed toy might be a funny-sounding name.

(3) Some experimental syllables may have been pronounced by the experimenter with intrusive vowels breaking up the clusters.

(4) /dl/ may be an acceptable variant of /gl/ in some dialects.

Study Proposal Completed: To Determine Order of Discrimination of Initial Consonant Clusters
May, 1970
Natalie Brostoff

This little study proposal explored the possibility of using the Shvachkin method in a consonant cluster study. In particular, it enumerated the consonant cluster pairs which would have to be tested to obtain an exhaustive ordering of initial consonant clusters, a total of 78 oppositions, and suggested alternative limitations for a feasible experiment.

Study Completed: Relative Acceptability of Test Syllables kwup:kyEp
July-August, 1970
Carol Farwell

Purpose: In the study proposal reported above, the need to study the opposition of clusters containing a stop plus a liquid or glide in a constant phonetic frame led to the apparent necessity of including either the impossible English /kwup/ or the impossible English /kyEp/ in such a study. This study tested English speakers in an attempt to find: (1) how far in psycho-physical space from English (see Greenberg and Jenkins, 1964) these two syllables seem to be, and (2) their acceptability relative to one another.

Method: Twenty subjects of high school age listened to tapes on which 12 nonsense syllables were paired exhaustively, and were asked to indicate which syllable would be the best new English word. Four college students were also tested with oral responses to get some idea about which syllables on the tape were being misheard.

Results: /kwup/ was rated next to lowest among the 12 syllables. /kyEp/ was rated high but it was probably consistently misheard as /kEp/. Because of these results, it was thought best to change the original cluster proposal, eliminating the possibility of this conflict. Neither syllable could be recommended for inclusion in the experiment.

Study Completed: Acquisition of Consonant Clusters in English
July-September, 1970
Afia Dil

A review of available diary studies of English-speaking children to see whether there are general substitutions or omissions made at different stages in the acquisition of consonant cluster production. The evidence suggests that the child does not produce initial consonant clusters until after the age of two, and that many clusters are still not produced by the third birthday. Final consonant clusters appear earlier in general, but those which do appear tend to be of the type /dz/ which appears in noun plurals. Many initial clusters are still not produced by the third birthday, and initial three-consonant clusters are among the last to be produced.

When substitutions are made in initial clusters, the sound substituted for a member of the cluster is usually one that is also substituted for

that sound when it occurs alone, such as /w/ for /r/. When such substitutions occur, the result may be a cluster, such as /fw/ for /fr/, which would be "impossible" in adult English.

Study Proposed: Production of Initial Consonant Clusters in English
November, 1970-May, 1971
Olga K. Garnica

Purpose: A study of the development of the ability to produce initial consonant clusters from the time the first such cluster is produced in an appropriate place as determined by approximation to an adult English word.

Method: Eight subjects, approximately 1;9 at the beginning of the study, to be visited in their homes. Because these children are older than those being studied for single initial consonants, the experimenter will attempt to elicit specific words known to be in children's vocabularies by using pictures. Several different words will be elicited for each consonant cluster. Words beginning with single consonants will also be elicited for comparison with cluster words. Data will be analyzed to determine whether any general statements can be made about the kinds of omissions and substitutions found. Instrumental analysis will be employed to answer certain specific questions about changes in production over time, e.g., voicing of stops.

Summary. It may be dangerous to offer conclusions when a project is unfinished and the most important part is still in progress, but some results and tentative conclusions can be reported: substantive results, by-products, and points for future research.

Substantive results.

(1) Modal order of acquisition. The results so far seem to point to a regular order of the Guttman Scale sort in the acquisition of initial consonants and consonant oppositions, but with minor individual variations and with several systematic differences between the order in discrimination and the order in production. For example, nasals are acquired very early and the voicing opposition very late in both discrimination and production; l-r opposition is acquired fairly early in discrimination but quite late in production.

The results also suggest that consonants appear with varying amounts of phonetic substitution. For example, nasals or stops have little variation, liquids and semivowels limited patterns of interchange, and fricatives considerable variation.

The results suggest that it is in general possible to regard the development of consonants as the acquisition of distinctive features, but that in some cases it is preferable to regard it as the acquisition of whole segments (phonemes).

The results thus far suggest that the acquisition of initial consonant clusters is not related in a simple way either to the acquisition of singletons or to the adult phonotactic system. For example, the "impossible" cluster fw- may occur as substitute for fr-.

[By the end of the project it is expected that these conclusions will be both more comprehensive and more precise.]

(2) Shvachkin research method. The method of studying children's speech discrimination ability reported by Shvachkin has been made explic... and modified for more general use. Phonological systems are so complex and the number of elements to be treated is so large that some productive, standardized experimental techniques are needed for extensive use by researchers interested in child phonology development. When this revised Shvachkin technique is made known by publication it will be available for widespread use.

(3) Value of multiple approach. The project included the study of both recognition and production and the use of three research approaches (diary studies, experiments, naturalistic observations). This multiple approach has been successful in that the research staff developed a broader view of the problems and greater caution in drawing generalizations and relating findings to theories than would have happened with a single approach.

By-products. In carrying out a research project valuable results other than the substantive findings are often apparent, such as the development of particular experimental expertise on the part of the investigators. This initial child phonology project at Stanford has had several striking incidental results, including the following:

(1) New interdisciplinary focus to child language research at Stanford. Staff meetings of the project and various spin-off meetings became in effect seminars on child phonology, bringing together researchers on childhood aphasia, linguistics, and psychology. Examples of papers which grew out of the project or were affected strongly by it are Ingram 1970 and Moskowitz 1970a and 1970b as well as a number of term papers for courses in Linguistics and Psychology.

(2) New means of information exchange on child language research. In August 1969 members of the project staff conducted and participated in a Child Language Forum attended by 40-50 research workers from the San Francisco Bay Area, at which six investigators from other projects reported on their current research. Another such Forum is planned for March 1971 at which two of the speakers will report on the Stanford phonology project.

(3) New publication of working papers. Early in 1970 the first issue of Papers and Reports on Child Language Development appeared; it consisted entirely of items on child phonology and the project contributed a small amount to its cost. The third issue, to appear in February 1971, will also include papers on phonology and will contain reports from the project itself. As of November 1, 1970, PRCLD has a circulation of nearly 200. Bibliographical papers have been distributed separately to the same mailing list.

(4) Child language data archive. Most of the investivations of the project involve the recording of child language behavior, and the resulting tapes are stored in the form of master tapes, identified and accessible for subsequent research.

Future research. The project leads immediately in two directions. One is toward investigation of other parts of English phonology for which the same multiple approach seems promising, either smaller parts of the initial consonantism or such areas as consonants in other positions or vowel oppositions. The other is the extension of the study to the phonology of other languages. In the immediate continuation project of this first phase of the Stanford linguistic research program in child phonology development, support will be requested for studies along both these lines, specifically as follows:

(1) Acquisition of initial fricatives (f v θ ð s z ś ź and the non-English x ɣ). Studies of the acquisition of fricatives show that each fricative tends to be acquired separately, the amount of phonetic variation is considerable, and individual differences in order of acquisition tend to be greater than in other parts of the phonology. The use of two non-English spirants adds to the possibility of isolating distinctive features in the acquisition procedure.

(2) Acquisition of liquids and semivowels (r l w y, initial singletons and clusters). There have probably been more linguistically oriented studies of the development of /r/ than any other phoneme; the place of the semivowels was not covered by Jakobson or Shvachkin; and the relations of liquids and semivowels are important for phonological theory in general.

(3) Acquisition of intervocalic consonants in Spanish. Spanish consonants include several types not found in English, notably the two r sounds (r and rr), the palatal nasal ñ, and the spirantal values of b and g. The intervocalic position is the position of maximum contrast for Spanish consonants.

[In a subsequent phase of the project, support will be requested for studies of the development of stress placement and vowel reduction in English and tone in Cantonese, which will require modifications of the research approach used thus far.]

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