

Consonant inventory of Swedish speaking 24-month-olds: A cross-sectional study

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Abstract

This cross-sectional study examines the consonant inventory of Swedish speaking twenty-four-month olds. The results are compared with English speaking children at the same age. 15 audio files recorded from 13 children were transcribed using independent analysis. Individual inventories were constructed for both word-initial and word-final consonants for each subject. The results are to a high degree consistent with the findings in the study compared. Anterior consonants are more frequent in the subject's inventories than posterior ones in both initial and final word position. Word initial voiced plosives are more common in the inventories than voiceless with the reverse situation i.e. voiceless plosives are more frequent than voiced in word final position.

Introduction

A number of studies have investigated the phonological patterns, phonological acquisition and consonant inventories of English, Dutch and African-American speaking twenty-four-month-olds (Stoel-Gammon, 1985, McIntosh & Dodd, 2008, van Severen et al., 2012, Bland-Stewart, 2003). However there is a gap when it comes to Swedish speaking two-year-olds and their consonant inventory.

A way of defining a consonant inventory is as “the set of consonantal types that occur in a child's production of meaningful words at a particular

moment in development” (van Severen et al., 2012:164).

Speech development is grounded in both sociocultural and cognitive contexts (Strömqvist, 2011). There are many variables that affect the child's speech production such as the size of the child's oral cavity and larynx. Individual differences are overt during speech development but many similarities occur. An example of this is that hearing and deaf children up to about nine months almost have the same amount and type of babbling (Smith, 1982) indicating that early vocalization has a strong connection with the child's anatomy. Stoel-Gammon (1985) suggests that there is a definite continuity in children's phonological development, meaning that there is a high degree of overlap between the phonetic inventories of babbling and meaningful speech. In general the phonemes that appear in many of the world's languages are the phonemes first developed in children's speech. On the contrary language specific phonemes are the ones last developed (Bjar, 2011).

As an introduction to Swedish phonology Table 1 shows the development of consonants in the Swedish language. It is apparent that the language specific phonemes /ç/ and /ħ/ are the ones last to appear. When comparing the inventory of the English language, presented in Table 2, to the Swedish equivalent many similarities are evident. Plosives, laterals and nasals do not differ at all whereas fricatives and trills merely show slight differences.

Table 1. Summary of the Swedish consonants in order of developmental acquisition. Cited from Bjar (2011:119), modified to IPA standard.

<i>Plosives</i>	E	p b	t d	k g	L	
<i>Laterals</i>	A		l		A	
<i>Trills</i>	R			r R	T	
<i>Fricatives</i>	L		j h	f v	s ʃ ʂ	E
<i>Nasals</i>	Y	m	n	ŋ		

Table 2. An overview of the English consonant inventory without specification on age acquisition (Grunwell, 1981).

<i>Plosives</i>	p b	t d	k g	
<i>Laterals</i>		l		
<i>Trills</i>		r		
<i>Fricatives</i>	j h	f v	ʃ ʒ	tʃ dʒ θ ð
<i>Nasals</i>		m	n	ŋ
<i>Approximant</i>	w			

Transcription is a part of the process when analyzing speech. *Independent analysis* focuses on the pronunciation patterns of the child regardless of the adult model (Stoel-Gammon, 1991). Another option is the use of *relational analysis*, which considers the accuracy of the consonant production in relation to the adult target form. More specifically, only correctly produced consonants are used in the analysis (van Severen et al., 2012).

The present study aims to investigate the consonant inventory of Swedish speaking two-year-olds. The study by Stoel-Gammon (1985) exhibit the consonant inventory of American-English speaking children aged twenty-four-months. The consonants present in initial position were /b, t, d, k, g, m, n, h, w, f, s/ and in final position /p, t, k, n, r, s/.

The hypothesis in this study is that Swedish children show similar consonant inventory as English speaking twenty-four-month olds in both initial and final position. Expected findings are that the Swedish-speaking children are able to produce labial, dental and velar plosives as well as laterals and nasals, which is covariant with the results of Stoel-Gammon, (1985).

Method

Results from this study are to be compared with the results from Stoel-Gammon, (1985).

Data Collection

The audio files analyzed in the present study were originally recorded for another purpose at the department of linguistics at Stockholm University. They were recorded using a H2 handy recorder. The recordings have a varying length between 1.37-8.52 minutes and contain interactions between the child, their caregiver and the researcher in the laboratory at the department of linguistics. In the process of transcribing the audio files it became necessary to limit the length of some of the files. This measure was taken to ensure that each subject was given the approximate equal amount of utterances.

Subjects

In this study, recordings of 13 children were used (7 girls and 6 boys, mean age 24;0). Guardians of children born in April 2011 were contacted and their addresses were acquired from the Swedish IRS (Skatteverket). 600 letters of interest were sent out. 50 participants replied with consent and 35 of those participated in another study at the department of linguistics at Stockholm University. This study contains data from 13 of these 35 participants.

Transcriptions

The method chosen is *independent analysis*, with IPA as standard. Each audio file was transcribed twice by two separate transcribers to insure inter-rater-reliability.

Data analysis

Although the data obtained contained both meaningful speech and babbling, the utterances which could be related to an adult target word were included in the analysis. The consonants were categorized by position in the word: initial or final. Statistical significance was

calculated using independent one-sample *t*-test in IBM SPSS version 22.

Results

After analyzing the transcriptions inter-rater-reliability was 90.3 %. Tables 3 and 4 present analyses of initial and final consonants on group level. The tables include average inventory size (mean and range) and list the consonant phonemes occurring in at least 50 % of the subject's inventories. Both tables show that nasals are the phonemes most commonly acquired by Swedish twenty-four-month-olds closely followed by voiced plosives. In initial position /m, d, b/ is acquired in over 90 % of the inventories. The raw scores of the consonants in initial and final position were compared to the raw scores provided by Stoel-Gammon (1985). One-sample *t*-test shows that there is no statistical significance ($p=.398$, $\alpha=.05$) in number of phonemes acquired in initial position between English- and Swedish-speaking two-year-olds. However in final position there is statistical significance ($p=.010$, $\alpha=.05$).

Table 3. Initial position: inventory size and phonemes in 50 % of subjects.

Age (n)	Inventory size: Phonemes in inventories	
	Mean (Range)	of 50 % of subjects
24 (13)	8.7 (4-14)	m ^a d ^a b ^a n s g l t v

^a Indicates phoneme occurred in 90 % of the inventories.

Table 4. Final position: inventory size and phonemes in 50 % of subjects.

Age (n)	Inventory size: Phonemes in inventories	
	Mean (Range)	of 50 % of subjects
24 (13)	3.8 (1-9)	n l

Initial inventories are represented to a larger extent than final. Table 5 shows that anterior consonants are more frequent in the subject's inventories than posterior ones in both initial and final

word position /b, d, t, m, v/. Word initial voiced plosives /d, b/ are more common than voiceless /t, p/ with the reverse situation in final position, i.e. voiceless plosives occur more frequently in the final inventories than voiced ones.

Table 5. Manner of articulation for each phoneme analyzed and number of subjects with phoneme acquired in both initial (I) and final (F) word position.

Manner of articulation	Phone (Initial-Final)	Number of subjects
		with phone acquired Initial-Final
<i>Plosives</i>		
	d (I)	12-0
	b (I)	12-0
	g (I-F)	7-2
	t (I-F)	8-5
	k (I-F)	5-1
	p (I)	5-0
	t̥ (I-F)	1-1
	d̥ (I)	1-0
<i>Laterals</i>		
	l (I-F)	7-10
<i>Fricatives</i>		
	s (I-F)	7-4
	v (I-F)	9-1
	ç (F)	3-0
	h (I)	6-0
	j (I-F)	4-6
	f (I)	3-0
	ʃ (I)	1-0
<i>Nasals</i>		
	m (I-F)	12-5
	n (I-F)	11-11
	ŋ (I-F)	1-1
<i>Approximant</i>		
	ɹ (F)	1-0

Discussion

The results of the present study are to a high degree consistent with the findings from the study compared. The examination of the phonological acquisition of English speaking two-year-olds by Stoel-Gammon (1985) indicates that there are many similarities to Swedish speaking two-year-olds. According to Stoel-Gammon the consonantal acquisi-

tion for English speaking two-year-olds is as follows, in word initial position: /b, d, t, k, g, m, n, h, f, s, w/ and final word position: /t, p, k, n, r, s/. Differences are overt when examining initial and final word inventories closely. Surprisingly the nasal /m/ is the most common consonant used in initial position. An explanation to this might be that the audio files were not recorded to be used primarily for the present study and do not contain enough spontaneous speech. To a great extent the audio files contained naming of objects and the Swedish words /mæsa/ and /lampa/ are words frequently uttered.

The subject's caregiver, usually their mother, was present which made the children more inclined to utter /mama/. In spite of this, phonemes expected in initial position /d/ and /b/ were present in 90 % of the subjects. Worth mentioning is that there are almost no similarities in the final inventories. Speculations are that the purpose for which the audio files were recorded inhibits the subjects spontaneous speech and heightens the occurrence of specific target words such as /bil/. This could be an explanation to the high frequency of the anterior lateral /l/ in final position. The lack of final consonants in the target words might explain the low frequency of final consonantal phonemes overall.

One of the difficulties when transcribing is the bias to the adult target word. Using independent analysis lead to discussions about word segmentation: where does the word begin and end. Relational analysis might have been the solution to this problem. Nevertheless, independent analysis were chosen because of the age of the subjects and their inconsistency pattern between babbling and meaningful speech.

Although the results to a large extent are consistent with the findings from Stoel-Gammon (1985) the amount of data is too limited to make broader generalizations and hence, additional studies are required. Preferably an ex-

perimental study with audio files designed to fit the purpose containing more spontaneous speech.

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