ɪ-child speech. *Phonetica, 48,* 208–

ased on subsequent context. *Percep-*

ɪguage acquisition. Cambridge, MA:

8 A Comparison of Initial Consonant Acquisition in English and Quiché

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Recent work on phonological development has emphasized individual variation and downplayed the effect of phonological organization in children's language. Jakobson's (1941/1968) theory, in particular, has been criticized for failing to capture the differences between children acquiring the same language (Ferguson & Farwell, 1975; Macken & Ferguson, 1983; Menn, 1983) and different language (Macken, 1980). To the extent that some constancies may remain across children, they are usually attributed to "universal phonetic tendencies which result from the physiology of the human vocal tract and central nervous system" (Ferguson & Farwell, 1975, p. 437). In this paper, we present data from the phonological development of five Quiché Mayan children which demonstrates the effect of internal phonological organization on phonological development. This is done through a comparison of initial consonant acquisition in Quiché with known results from English. The results show consistent differences that cannot be accounted for by ease of articulation. We present a version of Jakobson's theory which retains a universalist perspective at an abstract level, but which allows for interlinguistic and intralinguistic variations. Our model has an advantage over previous interpretations of Jakobson's theory and current cognitive models in that it makes specific predictions about the course of children's phonological development.

QUICHÉ INITIAL CONSONANTS

Quiché is a Mayan language spoken by a half-million people in the western highland region of Guatemala. It has an initial consonant inventory shown in Table 8.1. The plain stops /p t k q/ are unaspirated before vowels and aspirated

TABLE 8.1
The Word-Initial Consonants of Adult Quiché

	Bilabial	Alveolar	Palatal	Velar	Uvular	Glottal
Plosives	p	t ts	tʃ	k	q	?
Ejectives	b'	t' ts'	tʃ'	k'	q'	
Fricatives		s	ʃ	x		
Nasals	m	n				
Liquids		r,l				
Glides	w		j			

elsewhere. The affricates /ts tʃ/ are also produced with noncontrastive aspiration. The apostrophe (') indicates glottalization for the voiceless obstruents. All of the glottalized sounds except /b'/ are ejectives in the dialect studied. The /b'/ is a voiced implosive in syllable-initial position and a voiced unreleased stop in syllable-final position. The /r/ is a voiced apicoalveolar trill in word-initial position and a voiced apicoalveolar flap intervocalically. /l/ is a voiced apicodental lateral continuant. /r l w j/ are devoiced in word-final position and before consonants. Quiché has five vowels: /a/, /e/, /i/, /o/, /u/ and two degrees of vowel length: long and short (see Norman, 1976, and Mondloch, 1978 for further discussion of Quiché phonology).

METHOD

Subjects and Data. The Quiché data were collected during a longitudinal field study by the first author (Pye, 1980). Five children, aged 1;7 to 3;0, were visited in their homes over a 9-month period, approximately every 2 weeks, for a 1-hour session. Table 8.2 provides details of the ages and vocabulary. Quiché was the predominant language in all the households, although a few Spanish words occasionally appear in the children's speech. The tapes were transcribed phonemically with the help of two native Quiché speakers. A more narrow phonetic transcription was used to capture the children's sounds that were outside the adult Quiché phonology.

TABLE 8.2
Names, Ages, Sample Sizes, and Criterions of Frequency for Five Quiché Children

		Number of	Criterion of Frequency		
Child	Age	Lexical Types	Marginal	Used	Frequent
A Tu:n	1;7	23	1	2,3	4+
A Li:n	2;0	85	2	3-5	6+
Al Tiya:n	2;1	52	1	2,3	4+
Al Cha:y	2;9	115	3,4	5-9	10+
A Carlos	3;0	68	2	3-5	6+

The first Quiché subject, A Tu:n, was an only son. We used his second language sample which contains 23 distinct words or lexical types. (Here we follow the terminology in Ingram (1981) where distinct words of the adult language are referred to as lexical types.) The second subject, A Li:n, was the oldest son of a neighboring family. He had a younger sister, but spent most of his time with his aunts (aged 7 and 12) and grandmother. A Li:n's language sample contains 85 lexical types. Al Tiya:n, our third subject, was the youngest daughter of a family of five children. She spent most of her time with an older sister (aged 4) and her mother. Al Tiya:n's language sample contains 52 monosyllabic lexical items. Al Cha:y was the youngest daughter of a family of four children. Her sample is based on 115 monosyllabic lexical types. Our fifth Quiché subject, A Carlos, was the first son in his family. Another baby, a girl, arrived during the study. A Carlos' family lived with his grandparents throughout most of the study, and he spent most of his time in the company of his 10-year-old cousin. A Carlos' sample contains 68 monosyllabic lexical items.

Analysis. The resulting samples were subjected to a phonetic analysis described in Ingram (1981), which requires sounds to occur at a minimum frequency before being considered part of the child's phonetic inventory. This results in a conservative estimate of the child's phonology, but eliminates many of the arbitrary decisions about the category to which a particular segment belongs.

The sounds that a child uses are divided into three categories—Marginal, Used, or Frequent. These three categories are determined by comparing the frequency in which a sound occurs against a Criterion of Frequency (CF). The CF for any sample is determined by dividing the sample size by 25. This is done with the arbitrary assumption that a sound, if acquired, should occur at least once in every 25 words. For example, a sample size of 100 lexical types would have a CF of 4. This measure means that an "acquired" sound should occur in at least four words. Marginal sounds are ones which do not meet the CF, but occur at least one-half the CF. In this example, this would be sounds which occur 2 or 3 times. Used sounds are ones which meet the CF. Frequent sounds are ones that occur twice the CF, or in this example, at least 8 times. (See Ingram, 1981, for a discussion of the rationale for this methodology, and Ingram, 1983, for a discussion of its adaptation for crosslinguistic use.)

RESULTS AND DISCUSSION

Table 8.3 presents the Marginal, Used, and Frequent initial consonants for each of the five Quiché subjects. Marginal sounds are enclosed in parentheses, while Frequent sounds are marked with an asterisk for each time the sound doubles the CF. Used sounds are given without any notation. If the inventories are combined by taking those sounds appearing in the samples of at least four subjects, the result is the composite shown at the right of Table 8.3.

TABLE 8.3
Phonetic Inventories of Five Quiché Children

Quiché Consonants		Children					
		A Tu:n	A Li:n	Al Tiya:n	Al Cha:y	A Carlos	Composite
Nasals	/m/		m		m	(m)	(m)
	/n/	n	n**	n*	n	n	n
Stops	/p/	(p)	p	p	p*	(p)	p
	/t/		t	t*	t	t*	t
	/ts/					(ts)	
	/tʃ/	tʃ	tʃ*	tʃ	tʃ*	tʃ*	tʃ*
	/k/	(k)	k*	k*	k	k	k
	/q/		q				
Glottal Stops	/?/	?**	?**	?***	?*	?*	?*
	/b'/		(b')	(b')		(b')	(b')
	/t'/						
	/ts'/						
	/tʃ'/						
	/k'/					k'	
	/q'/						
Fricatives							
	/s/					s*	
	/ʃ/				ʃ*	(ʃ)	
	/x/		x*	x*	x	x*	x*
Liquid	/l/	l*	l**	l***	l***	l	l*
	/r/						
Glides	/w/	w*	w*	w**	w*	w	w*
	/j/		(j)				

The initial consonant inventories show a remarkable consistency, given their origin in samples of the children's spontaneous speech. There also seem to be well-defined cross-sectional trends in the acquisition orders, especially among the fricatives. There are a few anomalies, e.g., A Li:n's early [q] and [j] and A Carlos' marginal [p]. Overall, these data indicate that this analytic procedure produces a reasonable picture of the children's phonetic inventories. The composite appears to be the basic starter set of initial consonants for Quiché children.

Ingram (1981), using a comparable procedure for English, found a basic inventory for English-speaking children shown in Table 8.4. The subjects were

TABLE 8.4
Average Initial Consonant Inventory for Children Acquiring English[a]

	Labial	Alveolar	Velar	Glottal
Voiceless Stops	p	t	k	
Voiced Stops	b	d	(g)	
Nasals	(m)	n		
Fricatives	(f)	(s)		h
Glides	w			

[a]Based on Ingram (1981)

15 normally developing children between the ages of 1;5 and 2;2. Their lexicons contained between 30 and 333 lexical types.

These data allow a comparison with the results found for the five Quiché subjects. Both English and Quiché-speaking children show an early three-place voiceless stop series. Both have an early dental nasal and bilabial glide. Since Quiché lacks a voiced stop series, it is not too surprising that it does not appear in the children's speech. Quiché does have two Baby Talk items which begin with a /d/ and which the children acquire early, e.g., A Tu:n by 1;10. The Quiché children, however, tended to delete /d/ from Spanish words or substitute an /l/ in its place. Macken (1980) found that initial voiced stops were acquired later in Spanish due to their frequent alternation with spirant allophones. The Spanish subjects, however, substituted a spirant rather than /l/ for the voiced stops in their productions.

The fricative series is one point where the Quiché and English-speaking children look very different. Although the Quiché children did acquire an early /h/, it only occurs in word-final position where it was produced in opposition to the /ʔ/ and /x/. The Quiché children experienced a good deal of difficulty producing /s/, most often substituting /ʃ/ in its place. Al Cha:y produced ten lexical types with /s/ word initially. /ʃ/ was substituted for initial /s/ in seven of them, with /s/ deleted in one, and /s/ correct in two. A Li:n produced four lexical types with initial /s/. The substitutes were /ʃ/ in one and /tʃ/ in another. /s/ was produced correctly in the other two.

Another surprise of the early Quiché phonology is the affricate /tʃ/. Its presence may be a reflection of its heavy use in several Quiché Baby Talk items (e.g., /tʃiʃ/ 'yuck', /tʃuʃ/ 'sit'). A Li:n produced seven of nine lexical types correctly with initial /tʃ/. The two others lost the /tʃ/ due to the process of initial syllable deletion. Al Cha:y produced eight of ten lexical types correctly with initial /tʃ/. One was lost in initial syllable deletion, and the other was deleted. Al Tiya:n produced five of six lexical types correctly, losing one /tʃ/ in initial syllable deletion. It is interesting that the affricate appears in the children's speech before the homorganic fricative /ʃ/.

Finally, the early /l/ in Quiché marks a real difference with English. Al Tiya:n correctly produced all five lexical types with an initial /l/, Al Cha:y correctly produced nine of eleven lexical types, substituting /d/ for /l/ in a Spanish loan and /p/ for /l/ in a Quiché word. A Li:n correctly produced all six of his lexical types beginning with /l/.

John Locke (1983) has proposed another method for comparing phonological acquisition cross-linguistically. His method is based on a division of sounds between repertoire sounds, a "collection of readily available articulations" (p. 83), and nonrepertoire sounds which are the result of articulatory development under environmental pressure. Locke's repertoire sounds include all but one of the sounds in Ingram's basic inventory for English (/m,n,p,t,k,b,d,g,f,h,w,j/). Locke's sound classification reflects a low level phonological universal, but

misses important phonetic and structural details. For example, he does not provide evidence that is independent of the children's production data to substantiate the claim that /f/ is a more readily available articulation than /v/. It is impossible to tell from the data that Locke provides whether any of the repertoire sounds being acquired in languages as diverse as Japanese, Russian and Swedish have any phonetic features in common. His method of comparison also overemphasizes the mere presence of repertoire sounds at the expense of details of the variation among the repertoire sounds and the significance of nonrepertoire sounds (such as the early Italian /tʃ/, Russian /z/, and Swedish /v/). Even by Locke's standards, however, the composite Quiché phonology remains peculiar. Only five (/n,p,t,k,w/) of its nine acquired sounds are repertoire while four (/tʃ,ʔ,x,l/) are not. Thus, the Quiché data would seem to be counterevidence to Locke's early repetoire hypothesis.

The systematic differences between the Quiché and English data challenge other theories of phonological acquisition as well. Current models of phonological development emphasize individual strategies based on "preferences for certain sounds, sound classes, or features . . ." (Ferguson & Farwell, 1975, p. 436; see also Kiparsky & Menn, 1977, p. 75; Locke, 1983). Such preferences are supposed to derive from a combination of articulatory and input factors. Menn (1983, p. 22) cites a combination of "external" factors "such as the frequency and salience of the sound in the speech of others" and "internal" factors such as "the probability of accidentally hitting on an acceptable way to produce it and the salience of the sound in one's own speech." The models emphasize individual strategies in order to explain the observed variation between children acquiring the same language and rely upon articulatory factors to explain the many aspects of phonological acquisition that children have in common. None of these models has attempted to operationalize these factors by measuring the frequency of the sounds in adult speech or the degrees of freedom of children's articulatory organs. Menn (1983, p. 23), for example, subscribes to the view that the probability of producing sounds correctly is physiologically governed.

Ignoring external factors (since they are not specified very clearly in any of the current models), one would expect children acquiring different languages to exhibit similar ranges of physiologically governed sounds. The differences between the early sounds of children learning Quiché and English, especially the early Quiché [tʃ] and [l] contradict this. There is the possibility that the Quiché [tʃ] and [l] are phonetically distinct from their English counterparts and therefore easier to articulate. The only distinction that we are aware of is the tongue placement for the [l]. A physiological model would have to show that the apicodental placement in Quiché was easier to produce than the apicoalveolar placement of the English [l]. It seems that children can produce a wider range of sounds than those that are frequent in English. Locke (p. 46) cites Crelin (personal communication to Locke, October 5, 1981) who states that "as far as the vocal

tract anatomy is concerned an infant can make all three of the above sounds [b, d, f] when he can make the d-like sound." Some other factor must limit children to the sounds which are prevalent in the language they are acquiring.

We believe this factor is the pressure that the adult phonological system exerts on children's phonological development. Children must be specially adapted to search out the phonological contrasts which predominate in a language and attempt to capture those. MacKain and Stern (1985, p. 30) argue that infants must have a strategy that involves "the discovery of those contrasts that convey differences in meaning." Children are, after all, attempting to produce meaningful forms. They are not attempting to hit an identical phonetic target every time they utter a word with the same sound. The way around such a humanly impossible task is to establish phonological categories of sounds and be content hitting targets that are within those categories.

Children must monitor the speech of others for forms with detectable meanings. Once these are found the forms can be stored by reference to their meanings. At this point, the children's lexical system can perform some type of abstraction process in order to subtract all of the variability from the various phonetic renditions given for the same meaning. Some meaningful signals may also be subtracted during this phase, such as plural /-s/ or past tense /-ed/. Such a process could not be carried out without also comparing the forms with different meanings since this vastly simplifies the search for meaningful contrasts. A child's phonological system results from a convergence of these two procedures, one across lexical types and one within each lexical type. The adult phonological system exerts its influence during a child's search across the different lexical types since the more frequent phonological contrasts should be the easiest to find.

Substitution patterns provide the clearest evidence of the effect of an adult system on children's phonological development. Physiologically based models only predict that children will select a substitution at random from similar sounds that are already in their articulatory repertoire (cf. Menn 1983, p. 21). They can not explain why so many children consistently display the same substitution patterns such as fronting, gliding, stopping, and so forth (cf. Ingram, 1974). Natural phonology is an improvement over physiological models in that it at least attempts to explain wide-spread substitution patterns (cf. Stampe, 1969). However, it predicts that all children will exhibit the same substitution patterns regardless of the language they are acquiring. A phonological model predicts that children will make use of the maximal oppositions in the language they are acquiring. This has the corollary that children acquiring the same language should exhibit the same patterns of substitution, whereas children acquiring different languages may show different patterns of substitution for the same sounds.

Some evidence already exists that children acquiring languages other than English will make different types of substitutions. Macken (citing Stoel, 1974)

states that "in Spanish, [ð] frequently patterns with the liquids and is substituted for by [l] and in some cases [r]" (Macken, 1980, p. 149). The use of [l] for [ð] may also be common among children acquiring Greek (Hinofotis, 1976; Drachman & Malkouti-Drachman, 1973). Among children acquiring English, the usual substitute for [ð] is [d] or [t] (Macken, 1980).

The Quiché children produced substitution patterns that were very different from those produced by children learning English. The early appearance of [l] in the Quiché children's speech is underlined by its use as a substitute for /r/. This was the most frequent substitution for all the Quiché children. By comparison, English-speaking children frequently change /l/ to [j] and /r/ to [w], while French children prefer to delete an initial /l/ (Ingram, 1979, p. 135). Again, [j] and [w] were present in the Quiché children's speech and presumably available as substitutes. There is even a case in Al Tiya:n's speech of an [l] being used for /j/; /krajon/ "crayon" was produced as /lon/.

The fricatives are strikingly different in the speech of Quiché and English-speaking children. The /tʃ/ was always present as [tʃ] in the Quiché children's speech (with the minor exceptions noted earlier). But /tʃ/ is frequently replaced by a stop (e.g., Smith, 1973) or by another fricative (Ingram, Christensen, Veach, & Webster, 1980) in the speech of children learning English. Both English- and French-speaking children frequently substitute [s] for /ʃ/ (Ingram, 1979; Ingram et al., 1980) while Quiché children may go either way. Al Tiya:n changed /ʃ/ to [s] while A Li:n and Al Cha:y changed /s/ to [ʃ] (a Yucatec Mayan child 3;8 also changed /s/ to [ʃ], Straight, 1976). Again, we would emphasize the fact that English-type substitutions are possible for Quiché children, but typically they chose not to make them. There is some evidence that syllabic processes may have played a role in some of these substitutions, more often determining when a substitution took place rather than what was substituted. We also examined the data for evidence of consonant assimilation and cooccurrence restrictions, but did not find any evidence for these processes.

Given this evidence, we conclude that children exposed to different types of linguistic input, proceed along substantially different paths of phonological development. Ease of articulation seems to play only a partial role in determining the overall developmental route. Individual strategies seem similarly restricted when viewed from a cross-linguistic perspective. We believe the results are best explained by reference to the children's emerging phonological system. Here the emphasis is on system to underline the point that children are not acquiring isolated phonetic segments, but rather a set of systematically related phonological categories. The notion of phonemic opposition plays such a central role in the adult system that it is difficult to see how children could be successful language learners without it. It would also be difficult to construct a learning theory which would rely solely on positive evidence to establish the role of phonemic opposition in the phonology. However, children have to work out the particular system of phonemic oppositions that is relevant to the language they are learning.

Ingram (1983) discusses this notion in relation to Jakobson's theory of phonological development, showing that Jakobson makes certain allowances for the role of the adult surface forms of words. Accordingly, we suggest revising Jakobson by restricting the notion "maximal opposition" to hold just within the particular language the child is acquiring. Children acquiring different languages should exhibit common patterns of phonological development to the extent that the sounds within those languages enter corresponding sets of relationships. One would no longer expect children to follow a single, universal sequence in acquiring the sounds of their language. Their development would, however, remain unified at the more abstract level of maximal opposition within the language.

The early Quiché [tʃ], for example, is quite counter-Jakobsonian under previous interpretations. Jakobson explicitly predicts that affricates will be produced first as homorganic fricatives (1941/1968, p. 55). However, by placing priority on the maximal oppositions within Quiché we would predict the early appearance of [tʃ]. We preserve Jakobson's essential insight regarding the importance of phonemic contrasts by stipulating that the contrasts must be relative to the particular language being acquired. Since /tʃ/ provides a maximal opposition to the other Quiché consonants, children learning Quiché acquire it early.

One can gain a rough measure of the importance of various oppositions within different languages by determining the frequencies with which the different sounds occur. There are certain reservations about the frequency data which need to be explored. First, the average frequency with which a sound appears is fairly uninformative. In English, for example, /z/ is the eleventh most frequent consonant overall, but twenty-fifth most frequent in word-initial position, while /r/ is the fourth most frequent overall, but sixteenth in word-initial position (Mines, Hanson, & Shoup, 1978). We can expect a large difference between word-initial and word-final consonants in children's speech. Second, we need to make allowance for the fact that children's phonology is a reflection of their lexical organization, not just the frequency with which a sound occurs in adult conversations. There is ample room for individual differences to arise from the child's selection of which words or which part of words need to be subjected to phonological analysis (Ferguson & Farwell, 1975; Menn, 1978; Schwartz & Leonard, 1982). The phonological distinctions are most likely worked out from the child's lexicon, not the immediate speech. Thus, the relative frequency of sounds across lexical types, not tokens, is the measure we seek.

Unfortunately, the relative frequency of sounds in children's word types is not readily available from published sources. We made an estimate based on data reported by Moe, Hopkins, and Rush (1982). This provided us with the 500 most frequently used words of 329 children aged 5;10 to 8;4 living in north-central Indiana. We then counted the frequency with which the different consonants occurred in initial position in this lexicon. This second estimate again affects the relative frequencies of the initial consonants. The Mines et al. study (1978) gives /ð/ as the most frequently occurring word-initial consonant, while by our estimate it is fourteenth across word types.

Using this set of procedures, we examined the frequency of the sounds which are common to both Quiché and English in the speech of four Quiché children and the children reported on by Prather, Hedrick, and Kern (1975). For the Quiché subjects, we counted the frequency of the initial consonants in the adult word types the children attempted, not the sounds the children actually produced or the sounds in the adult input. We used the data from Moe et al. (1982) to establish the frequencies of the initial consonants in the speech of children learning English. The results appear in Table 8.5.

It is surprising how close the frequency of the sounds the children attempted is to the order in which they acquired those sounds. The Spearman rank-order correlation between the frequency and acquisition orders in Quiché is .76 ($p < .01$, one-tailed), and in English .55 ($p < .05$, one-tailed). The most frequent sounds in both Quiché and English are the sounds which appeared the earliest in the children's speech. The /tʃ/ and /l/ which appeared earlier in Quiché than in English are also much more frequent in Quiché than in English. Equally, the /s/ and /d/ are more frequent in English and appeared earlier in the speech of children learning English. However, there are also certain discrepancies: /r/ occurs with greater frequency in both Quiché and English than its late acquisition would warrant while /n/ and /d/ occur comparatively infrequently in English. The full list of frequency data for all the initial consonants in Quiché and English is also very similar to the children's acquisition orders in the respective languages. In Quiché, for example, the plain stops are much more frequent than their glottalized counterparts, while the back sounds (/tʃ/, /k/ and /x/) are more frequent than the labials and dentals. In English, the labial voiced stop is more frequent than its voiceless counterpart, but /k/ is much more frequent than /g/. The voiceless fricatives are also more frequent than their voiced counterparts with the exception of /ð/.

It might be the case that similarities between the children's phonological acquisition orders and frequency orders are the result of selection constraints operating on the children's lexicons. Some children actively avoid attempting to produce words that have sounds not under their control (Ferguson & Farwell,

TABLE 8.5
Frequency and Acquisition Rank Orders for Initial Consonants Common to Quiché and English

	Sounds												
Language	/tʃ/	/w/	/k/	/p/	/t/	/l/	/n/	/s/	/m/	/r/	/ʃ/	/j/	/d/
Quiche[a]													
frequency	1	2	3	4	5	6	7.5	7.5	9.5	9.5	11	12	13
acquisition	2.5	2.5	5.5	5.5	7.5	2.5	2.5	10	7.5	12.5	9	11	12.5
English[b]													
frequency	13	1	3	6	4	7.5	9.5	2	5	9.5	12	11	7.5
acquisition	12.5	6	4.5	2.5	4.5	10.5	1	7	2.5	10.5	12.5	8.5	8.5

[a] rho = .77, $p < .01$ (one-tailed)
[b] rho = .55, $p < .05$ (one-tailed)

1975; Ingram, 1974; Kiparsky & Menn, 1977). This does not present a problem for our analysis since the sounds we chose all occur within the children's productions. Moreover, such selection constraints may only apply to children's early lexicons (Schwartz & Leonard, 1982), while most of the children reported on here have productive vocabularies with more than 50 lexical types. Avoidance phenomena such as this might provide additional evidence for a phonological model if convincing data could be found showing that children acquiring different languages avoided words with different types of sounds. However, in order to be truly convincing such a demonstration would have to show that the children were actively avoiding certain sounds rather than simply responding to the frequency of the sounds in the input (cf. Macken, 1980).

It is necessary to emphasize that frequency data can only provide a rough guide to phonological organization in children since children are developing a set of relations between segments, not the segments per se. The discrepancy we noted earlier involving /r/ may be due to this difference. /r/ may play a less important phonological role in Quiché and English than its frequency suggests. Children do not have the luxury of working out these relations in a single environment at a time, although there is plenty of evidence that some children prefer to concentrate more on the beginnings or ends of words (Branigan, 1976; Menn, 1978). It is all too easy to envision a child working out a pattern of oppositions initially in word-final position and then applying the result to word-initial position, or showing a continuous feedback effect between both positions.

Given the differences in the organization of the adult phonologies of Quiché and English (as partially reflected in relative frequencies of appearance), we can start to see why children learning these languages might begin differently. Children learning English face the task of sorting out the voiced-voiceless distinction. They may apply this distinction the way adults do and produce an initial voiced or voiceless series of stops. Until the opposition is controlled, they may equally have an initial /b/, /d/, /k/ series (Menn, 1978, p. 14). Quiché lacks a voiced-voiceless opposition so children learning it may initially oppose some other category to the voiceless stops, most likely the continuous category (since the Quiché children show an early /w/, /l/, /x/ series). Quiché children appear to incorporate /tʃ/ directly into their stop series, whereas English-speaking children treat it as an affricate and merge it with a stop or fricative. Nasals seem to operate independently of the other dimensions in both languages, although the children seem to prefer a dental nasal. Finally, place appears to play an important role in the children's phonologies. All the Quiché children substituted a homorganic stop for their glottalized counterparts.

REFINING THE PHONOLOGICAL MODEL

We have sketched a phonological model to account for the differences between the phonological development of children learning Quiché and English. The

obvious strengths of the model are that it focuses attention on children's attempts to resolve which contrasts are phonemic in the adult language. It predicts the presence of some organization in children's phonologies rather than a random assortment of isolated articulations. The model also predicts that children will attempt to build phonemic contrasts on the basis of maximal opposition within the language. It follows that children learning the same language should follow roughly similar paths of phonological development. However, children learning different languages should show similarities in their phonological development only to the extent that segments in the languages possess similar sets of oppositions. This model explains why children learning the same language exhibit similar substitution patterns while children learning different languages may produce very different substitutions for the same sounds.

The model is compatible with evidence commonly cited in favor of *cognitive* explanations of phonological development. First, there is the variation between children acquiring the same phonological systems. The extent of variation is partly a reflection of the methods used to document children's phonologies. Thus, the "phone trees" of Ferguson & Farwell (1975) exaggerate the amount of phonetic variation by grouping together all the sounds a child might have used to produce a set of words. Children who happen to produce the same word once or twice with different sounds would have different phone trees. Still, some variation exists in the way children acquire the sounds of a particular language. Cognitive models explain this variation by assuming that children may discover different aspects of the adult phonological system at different stages of development. There is no reason to deny the role of discovery in a phonological model or any reason to think that all the children acquiring some language would discover its set of oppositions in exactly the same sequence. We predict, instead, that there will be limits to the amount of variation that children display. These limits are set by the status of the oppositions in the adult language.

Children's selectivity about the words they chose to produce is also cited as evidence for the cognitive model. The evidence typically comes from observed asymmetries in the number of words in a child's lexicon beginning with particular sounds. Menn (1978), for example, refers to the case of Jacob who avoided words beginning with /p/ and /g/. Macken (1980, p. 162) showed that Jacob's selectivity could be explained by the uneven distribution of English words beginning with these sounds, the number of syllables in the words, and their syntactic role (noun or verb). Schwartz & Leonard (1982) found that selectivity may not be just an artifact of the frequency of the sounds in the language, but that it was limited to a time when children produced fewer than 50 words. It does not seem to be a factor in children's comprehension (Leonard & Schwartz, 1985). A phonological model could tolerate some selectivity in the initial period of development since children would need to accumulate some number of words before they could begin phonological analysis. During this initial period, children would collect a set of word-based articulations, forming what Menn (1983) calls

in "output lexicon." At or about the fiftieth word children would begin the process of extracting phonological contrasts, depending on the child's nature and the sample of lexical articulations collected.

This initial period would also explain the existence of what Moskowitz (1970) labeled "phonological idioms." These are lexical exceptions to rules that otherwise operate across the board in a child's lexicon. The most famous example is Hildegard Leopold's early and accurate production of "pretty." For many months, this was her only word that contained a consonant cluster. When she eventually incorporated the word into her system, she produced it as [bIdi]. In our version of Jakobson's model lexical exceptions would be just that—lexical exceptions. These would be lexical articulations that a child had not yet incorporated into a system of phonological oppositions. They should be highly idiosyncratic in nature and could remain in production for variable lengths of time. The existence of lexical exceptions makes it all the more necessary to base analyses of children's phonologies on sound productions that occur in several lexical types rather than in an isolated example.

No model that attempts to account for all of the intricacies of phonological development is wholly without difficulties, including our own. First, the matter of maximal opposition within a language needs clarification. Jakobson's original proposal has the merit that a single universal hierarchy of features explained the phonological development of all children. Children did not have to deduce the hierarchy from the languages they were acquiring. By restricting the application of maximal oppositions to individual languages we face the problem of specifying how children make use of phonetic information to uncover phonological features. We are, in effect, redefining the term maximal opposition from the universal reference frame that Jakobson envisioned to a scale that is relative to a child's emerging lexicon. Within this framework the frequency and distribution of phonological oppositions play a larger role than Jakobson realized. Thus, the /t/-/tʃ/ opposition is very different in Quiché and English despite the fact that the sounds are very similar. At this point we can not say whether the difference is only a matter of frequency or whether the opposition is more *marked* in some fashion in English. We need a rigorous definition of maximal oppositions that specifies the relative strengths of different features within any language.

A second problem is common to all versions of Jakobson's model, the problem of relating surface phonetics to the underlying set of oppositions in children's language. For example, it is not clear why a child learning Quiché would produce an apicodental [l] while a child learning English would aim for an apicoalveolar. Would not either of these serve the same set of oppositions in Quiché and English? If children recover oppositions from their own lexicons then the answer to our question must lie in a careful specification of children's recovery procedures. The Quiché children may just be stuck with their apicodental articulation. This raises a further problem, however, of how children acquire such remarkably accurate articulations in the absence of a phonological system.

We might appeal to some type of Gestalt processing, but this is obviously an area that demands further research.

A related problem is the task of demonstrating that children are using phonological oppositions in their speech. In this paper we were only able to resort to evidence from the chilren's spontaneous productions. This produced two types of evidence: different initial sounds and different patterns of substitution. Other revealing sources of evidence might come from experimental paradigms such as Braine's (1974) in which a child is taught a nonce form that can take various forms, depending on the child's phonological system.

SUMMARY

In this paper we have shown that Quiché children have a pattern of phonological development that is substantially different from that of children learning English. The Quiché children's early /ʔ tʃ x l/ are particularly noteworthy. We claimed that such differences invalidate models which appeal to ease of articulation for an explanation of children's phonological development. We argue, instead, for a version of Jakobson's theory which makes the notion "maximal opposition" relative to the child's emerging lexicon. This model predicts that children will learn the same language in a fairly unified fashion, but that there may be large differences in the way children approach the phonologies of different languages. The model also predicts that children will quickly develop an organization in their phonologies. Sound substitutions provide some evidence that children acquiring different languages develop different phonological systems. The Quiché children produced substitutions that were very different from those produced by children learning English. They used [l] as a substitute for /r/, [ʃ] for /s/, and produced an accurate [tʃ] from the beginning. English-type substitutions were possible for the Quiché children, but they did not make them.

We attempted to operationalize the idea of maximal opposition within a language by measuring the frequency of initial consonants in children's vocabularies. We then compared this measure to the children's order of phonological acquisition and found a statistically significant correlation for both Quiché and English. The frequency of consonants across lexical types is an imperfect guide to children's phonological systems because it refers to isolated segments rather than oppositions. Some children may develop an opposition more fully before moving on to the next most frequent segment.

We emphasize that the model of phonological development we present is preliminary. However, it does have the advantage of focusing attention on the organization of children's phonologies. To quote Jakobson (1941/1968, p. 67), "the appearance of single sounds must not be treated in an isolated fashion without regard for their place in the sound system." A central aspect of searching for organization is the development of techniques such as those of Ingram (1981)

which provide a principled means for separating phonological systems from lexical exceptions. The Quiché results make clear the necessity of documenting how children cope with non-English phonologies. Jakobson's familiarity with the rich literature on the acquisition of Slavic phonologies may have been responsible for his initial insight into the problem of explaining children's acquisition. We trust that additional cross-linguistic work on this problem will be equally rewarding.

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