The development of English and Japanese phonology in a bilingual child aged 1 year 3 months to 1 year 8 months

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Abstract

Language used by a child between the ages of 1;3 and 1;8 was recorded while she was being brought up in a bilingual English-Japanese home environment. The words used by the child were phonologically analysed to determine whether there was any evidence for a structural theory or a frequency theory of phonological development. Evidence was found to support and to contradict each of these types of theory. It was found that either a) the child chose to attempt only words which contained a high proportion of phonemes she knew she could utter or b) the frequency of the parents' phonemes was modified from the frquency of standard adult speech when the parent was talking to the child. Little evidence of phonological interference between the two languages was observed during the course of this study.

Acknowledgements

Numerous people have contributed, sometimes wittingly, often unwittingly, to this study. Members of the Education Department at Massey University, Professor C.G.N. Hill and Dr John Kirkland especially, guided the research, raised relevant questions and supplied answers along the way. Dr Geraldine McDonald and Dr Richard Benton of the New Zealand Council for Educational Research provided encouragement and insight to enable the study to proceed. Thanks must also go to Mr Akira Matsuo of the Japanese Department at Massey University for help in researching Japanese background material. Thanks are also due to Dr Noel Watts of the Modern Languages Department at Massey University for frequently answering my questions about processes of language learning. And most thanks of all must go to the child, Chihaya, without whom this study could never have begun and who made the whole exercise so enjoyable. Finally I would like to thank my wife for providing the Japanese component of the language input and compiling vocabulary lists in Japanese and for being a constant source of encouragement throughout the study.

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Part One Review of literature

Introduction

There has been a considerable amount of interest, research and writing in child language over the past ten to twenty years. Some reasons for this recent upsurge in interest in the field may be

1) the development of psycholinguistics,
2) concern for helping language retarded and language deficient individuals,
3) renewed interest in the origins of language,
4) implications which the development of first language may have for the learning of second languages.

There have been basically two approaches to obtaining data for the study of language spoken by children.

1) large samples which may be statistically generalisable to a bigger population but which may not be fine enough to pick up small details,
2) small samples, sometimes referred to as diary studies. These may lack generalisability but often provide an in-depth study which can indicate fruitful directions for further research.

The focus of bilingual study has been mainly on the relationship between bilingualism and formal education in the school situation. However, a child is often in a position to become bilingual before entering school, but there have been very few studies made of infant bilingualism.

The study of English-Japanese bilingualism is especially rich in contrasts because of the innumerable differences between the two languages and cultures. There are still many misunderstandings between western cultures and Japan, and bilingual studies can be of some help in explaining these misunderstandings.

The review of literature covers the three main areas of this study, that is, language input, phonological development and bilingualism.

Language input

Importance of language input in explaining language development.

Until the 1970s, linguists tended to focus their attention on the output component of child language rather than closely studying what exactly parents said to the child. This may possibly be explained by the fact that Chomsky (1965) described language as "rule-governed creativity" and that the child is equipped with a language acquisition device (LAD) with which he cracks the linguistic code he hears about him. Chomsky also described the data that the child analyses to deduce the rules of a language as being "degenerate" in the sense that adult speech is full of false starts, omissions, regressions and ungrammatical utterances. This has been criticised by Halliday (1974p 15) who claims that the everyday speech surrounding a small child is "fluent, highly structured and closely related to the non-verbal context of situation."

The publication of Snow and Ferguson's "Talking to Children, Language Input and Acquisition" (1977) has aroused interest in the study of Baby Talk (BT), the register of adults talking to children. According to Snow and Ferguson, the register of Baby Talk is quite different to standard adult speech and that Baby Talk has a fundamental role to play in the speech development of the child. Brown (1977 p 13) suggests that mothers' speech is "fine tuned to the child's psycholinguistic development." Possibly, in works of this kind, may be discerned a trend towards comparing what the adult says to the child with what the child himself actually says.

Some universal features of Baby Talk.

Studies in the register of Baby Talk suggest that there may be over a hundred linguistic features which distinguish Baby Talk from adult speech. Garnica (1977) mentions the following characteristics as examples readily identifiable as Baby Talk.

1) significantly higher fundamental frequency
2) greater range of pitch
3) rising terminal intonation
4) whispering
5) longer duration between separable words (eg push in)
6) use of reduplicative words (eg bye-bye, car-car)

Brown (1977) suggests that these are devices not invented by the child, that they originate from the mother and can be found in all languages to a greater or lesser extent. It would appear that Baby Talk exists for mothers to control or gain attention, to improve intelligibility, to mark utterances as those directed specifically at the child. It is to ensure communication and thus also casts the mother in the role of language teacher.

Adults may modify their speech phonologically, lexically or grammatically when speaking to children. From the point of view of this study, phonological and lexical modifications from adult speech to Baby Talk were of main interest and examples of these are detailed as follows.

Some sound changes and lexical modifications from adult speech to Baby Talk in English.

Adults tend to use many initial stop consonants (especially voiced ones) when speaking to children. There are for example, many words which begin with /b/ in a child's environment; baby, bottle, bike.

Concessions may be made in the area of reducing more complex phonemic structures to simpler ones such as from "goodbye" to "byebye". Ferguson (1977) proposes the metamorphosis from the adult "stomach" to the Baby Talk lexical item of "tummy" as being explainable by the following substitution.

st - t
^ - ^
m - m
ach - y

Some sound changes and lexical modifications from adult speech to Baby Talk in Japanese.

In Japanese, as in English, the simplification of phonemic shapes is common. An example is the substitution of /s/ by /tʃ/, from the adult "san" to the Baby Talk lexical morpheme "chan".

A notable feature of Japanese is the large number of reduplicative words which exist in adult speech. These are often descriptive, eg /tʃiratʃira/ (flickering). Reduplication is as common in Japanese Baby Talk as in English and is phonologically often marked by a lengthening of the medial consonant as in /pop:o/ (birdie).

Chew (1969) and Fischer (1970) both report that Japanese parents often use first person pronouns when addressing young children. A boy is called "boku", the common adult male word for "I" used between equals. Girls are addressed as "atashi". This is continued until the child begins to refer to himself or herself with the correct pronoun. It may be seen as an attempt to reduce the complexity of the Japanese pronominal system in which selection of the appropriate pronoun is governed by the relationship between the speakers with regard to age, sex and status.

Implications.

Recent research into the register of Baby Talk seems to question Chomsky's assertion that the child's linguistic environment can be described as "degenerate". It may well be that responsibility for the child's early language development lies with the mother to a greater extent than Chomsky's theory would attempt to persuade.

A question which follows on is, "How can a mother help her child to learn language?" Brown (1977p 26) suggests that the best way is to "believe that your child can understand more than he or she can say, and seek above all to communicate. To understand and be understood... if you concentrate on communicating, everything else will follow."

Phonological development

Theories of phonological development.

Attempts to explain the sequence of phonological development may be classified under four broad categories, behaviourist theories, structuralist theories, the theory of natural phonology and prosodic theory.

In behaviourist theories, features such as frequency of input and ease of perception are considered to be the major factors influencing the child's phonological development. A notable behaviourist study is that of Olmsted (1971).

Structuralist theories developed from the ideas of Jakobson (1941) who argued that the child acquires phonemes in pairs which contrast maximally with one another. In terms of the universal syllabic pattern of consonant + vowel (CV), this may explain why the first syllable

acquired by a child might be /bɑ/ or /pɑ/ because the bilabial consonants /b/ and /p/ contrast maximally with the back vowel /ɑ/.

Stampe (1971) proposed the theory of natural phonology which describes phonological development as being essentially a process of suppressing and limiting the infinitely variable number of sounds which a child is capable of uttering. A system is then built up by the child who orders and classifies the remaining sounds.

Prosodic theory as suggested by Waterson (1971), a follower in the Firthian school, states that initially the child relies on prosodic patterning of the input and that later segmental phonological development does not seem to follow according to any natural laws, but may be rather more dependent on frequency of input.

None of these theories in it's pure form is wholly compatible with any of the others. Studies of child phonology carried out in the 1940s and 1950s tended to support a structural view but Leopold (1949) cautions that "Jakobson's theory, as applied to our case, seems to be too rigid, but our observations so far do not invalidate it in it's essential features." Subsequent studies, (eg Olmsted, 1971) have proved that Jakobson's laws are not as simple, regular or as symmetrical as at first had made them appear so attractive. Olmsted (1971 p 242) postulated that,

"1 The phones of the language are modelled for the child in about the same proportions as they occur in ordinary speech.

2 The more discriminable phones have a selective advantage with respect to potential for success and resistance to error over the less discriminable ones."

In the light of recent studies into language input to children, Olmsted's first postulate may be questionable. Possibly a hybrid type of theory such as the one proposed by Waterson may be the most satisfactory way of dealing with the data on child phonology until such time as the picture becomes clearer.

Studies of phonological development in children.

These may be classified into two groups - longitudinal case studies of a small number of children and studies of a larger sample of children often conducted over only a short period.

Early investigations into the development of child phonology seem to have been of little use because the observers rarely had linguistic training of any sort. Leopold (1948) in a comprehensive review of literature on child language notes that of the many authors of works on child language "few are linguistic scholars and it takes the best techniques of a linguistic scholar to guard against misinterpretations." Many of the early studies (Darwin, 1840, Holden 1877, Preyer, 1882, Stern, 1907) dealt with the acquisition of vocabulary and the counting of the number of words a child was able to use at certain ages which is not a productive investigation for serious research seeking universals in child language. Leopold also observed that "most of these studies neglect exact phonetic transcription, although the first two years of speaking cannot be studied adequately without it."

A small number of careful studies were carried out between 1930 and 1950, notably those of Gregoire (1937), Leopold (1939-49) and Velten (1943). At that time, Jakobson's new theory of phonological acquistion indicated a promising avenue along which the research on child phonology might be developed. Not a great many studies subsequently sprang forth, possibly due to the fact that some linguistic training was necessary for accurate observation to be made and linguistics was in those days still a rather young discipline.

Even today, the general scarcity of data on child language development is still widely lamented. Only in 1974 did the first issue of a journal devoted exclusively to the study of child language first appear. The weaknesses inherent in the case study method are well known yet it is from these case studies of Leopold's and others that that the most useful data on child language has so far been generated.

Some of the more recent studies which have been imaginatively designed and produced interesting results have been those of Weir (1962) who tape-recorded the pre-sleep soliloquies of her 2 year old son, and Smith (1973) who studied the phonological development of his son from the age of 2 years to 4 years and produced a set of rules governing the child's phonology over that period. A number of investigators are currently interested in formulating rules which describe children's phonological development (eg Ingram, 1974, 1975) but the rules prove difficult to write because exceptions are quickly found (eg Menn, 1975).

Early studies in child phonological development can sometimes be distinguished from recent studies by the use of the tape recorder in the latter. In the longitudinal case study, the use of a tape recorder may not be necessary since the trained observer will be able to transcribe the language as it is uttered. In view of the vast amount of data that a sampling study generates, a tape recorder becomes a rather more necessary piece of equipment. Olmsted (1971) mentions some early sampling studies worthy of examination, easpecially Wellman et al (1931) which was an attempt to classify the error types of 204 children between the ages of 2 and 6 years old. Templin (1957) studied 408 children aged between 3 and 8 years old to determine whether phones have an increasing order of difficulty. Olmsted (1971) studied 100 children aged between 15 to 54 months and his research illustrates the problems which these extensive studies entail in terms of transcription and computerisation of data.

The fact that data collected so far gives rise to a number of conflicting theories on child phonological development indicates that more data still needs to be collected, from many languages and cultures.

Bilingualism

Definition of bilingualism.

Bilingualism is now so widespread throughout the world that it is logical to view it not as a phenomenon but as a characteristic of language use. Bilingualism is an individual thing and the extent and performance of individual bilingualism can be quite precisely mapped in terms of who uses what languages, to whom, when and to what extent. When it comes to describing the features of a bilingual community though, it is more difficult to make precise statements.

A study of bilingualism must begin from a description of the community. Mackey (1962) has stated that "a self-sufficient bilingual community has no reason to remain bilingual since a closed community where everyone is fluent in two languages, one could get along just as well with one language. As long as different monolingual communities continue to exist however, there is likelihood of contact between them and this contact results in bilingualism." Individuals may react to a dual language environment by becoming bilingual.

The terms coordinate bilingualism and compound bilingualism were in the 1960s considered to be useful measures of the extent to which an individual could be considered to be bilingual. A coordinate bilingual was generally considered to be an individual who could use each language system independently of the other with no instances of language interference occurring. A compound bilingual on the other hand, could not always keep the two languages separate and language interference would occur. By this definition, there are very few truly coordinate bilinguals in the world since language interference, however slight, occurs in the language used by even fluent bilinguals. The terms coordinate and compound appear to represent the two extremes with the vast majority of bilinguals falling somewhere in between.

Mackey (1962) suggests two aspects which can be used to chart the condition of bilingualism.
"Degree: Phonological-Graphic, Grammatical, Lexical, Semantic, Stylistic. Function: (External) Home, Community, Education, Mass-media, Correspondence. (Internal) Counting, Reckoning, Praying, Cursing, Dreaming, Note-taking..." Mackey sees two approaches to studying the language performance of a bilingual. One is the alternation between languages, the other is the interference between the languages spoken.

Haugen (1956) suggests two approaches to describing bilingualism. One way is to start with the description of the phenomena of interference and to analyse these by referring to the linguistic structures of the languages in contact. The other way is to begin with a contrastive analysis of the languages in contact, to pinpoint their differences, then to predict what types of interference could be expected to result because failure to learn the differences results in interference. Interference may be phonological, lexical, grammatical or semantic.

Studies of infant bilingualism.

Studies in bilingualism are few enough but the literature available infant bilingualism is extremely meager. It is a reflection of this that, even now, the most often quoted study is still that of Leopold, "A Bilingual Child" (1939-49) which was a study of his daughter Hildegarde's simultaneous development of English and German.

Three factors contributing to this scarcity of enquiry are also common to the study of child language in general, these being, linguistic competence of the observer, interest in the problem and the patience required to carry out the project. Add to this the need for a bilingual situation to exist during infancy and the chances of such studies being carried out shrinks to very long odds.

Vildomec (1963) describes three European studies by Ronjat (1913), Pavlovitch (1920) and Leopold (1939-49). Ronjat proposed a method for maintaining a stable bilingual situation which he described as "one person - one language. The child soon became aware of his bilingualism and parallel development occurred in phonetics, morphology and syntax."

The problem with Ronjat's method is that each speaker will, by habit, be involved with certain activities which he or she will talk about to the child and thus bias the child's language development in certain areas of vocabulary.

Leopold's extensive study begins from birth and continues to the age of two with daily diary entries and thereafter with notes of salient events until the child was aged 15 years. The notes are full and accompanied by four volumes of discussion. Leopold notes that Hildegarde began to separate her languages from each other according to the person she was conversing with soon after her second birthday.

The consensus of previous investigations into infant bilingualism is that bilingualism does not harm speech development. Leopold strongly supports bilingualism, claiming that, "bilingualism helps break down the intimate association between form and content. A bilingual child will pay more attention to things referred to, situations and actions described and ideas expressed than to phonetic forms pronounced..I attribute this attitude of detachment from words confidently to bilingualism."

English-Japanese bilingualism.

Some useful guidance was obtained from works which did not specifically focus on infant English-Japanese bilingualism but which were related to the topic. Examples of this type were Nagara (1972) "Japanese Pidgin English in Hawaii; A Bilingual Description" which was useful as an account of actual Japanese-English bilingual description and as a source for references on Japanese-English bilingualism. Taylor (1976) describes Ervin-Tripp's study of Japanese women in California as an account of the problems of lexical interference. Both of these studies are of an older age group than infants.

Nakazima (1962) made a comparative study of the phonological development of Japanese infants and American infants up to the age of one year. The American infants were raised in a bilingual environment although Nakazima suggested that these American infants were slower than the

Japanese children in speech development around the age of one year because they had to learn two languages.

There are a few informal diary accounts of Japanese children growing up in English speaking countries and becoming bilingual and while such studies as these (eg Takagaki, 1976) provide interesting anecdotal descriptions, few are based on any statistical data.

Part Two Purposes and procedures of study

Purposes of study

The purposes of this study are

1) to provide phonological, lexical and semantic data on a single case study of English and Japanese language development for comparison with other similar studies,
2) to attempt to show the importance of taking into account the input component of language development, that is, the speech adults use when talking to children, and to relate this to the speech of the child,
3) to determine the nature of any phonological, lexical or semantic interference between the two languages,
4) to determine the age at which the child understands that she is in a dual language environment,
5) to consider the problems and decisions faced by parents who are raising children bilingually,
6) to determine whether any language learning strategies employed by the child are generalisable to second language learning.

Problems

Although enthusiasm has been expressed calling for more studies on child language (Leopold, 1948), few have been forthcoming. The reasons for this may possibly be

1) the considerable investment of time and patience necessary for observation,
2) lack of linguistic training on the part of the observer; familiarisation with even a basic phonetic script such as the International Phonetic Alphabet (IPA) is a necessity to begin with,
3) connected with 2) above is the problem that children's phonemes often differ markedly when compared with the adult model - the observer is faced with the problem of devising some symbol for describing the child's sounds where they differ from any standard adult norm,

4) lack of interest in the problem by potentially able observers.

Even fewer studies in infant bilingualism are available; in addition to the reasons given above, the following may contribute,

1) there are are fewer situations where a truly bilingual home environment exists,
2) bilingualism is personal and results may not always generalise very effectively,
3) there is the difficulty of measuring the extent of bilingualism within the home environment; that is of recording who speaks what language, when,,to whom and for what purpose.

Procedure and plan of study

This study involved three main areas.

1) Language input which describes the language adults use when speaking to children,
2) Words uttered by children, especially the phonological components of those words, when the child was in it's second year of life,
3) Comparison between two phonological systems developing in the child during it's second year of life.

This was a case study of a first born child, a girl, who was aged 1 year 3 months (hereafter 1;3) at the beginning of the study and aged 1 year 8 months (hereafter 1;8) at the conclusion of the study.

The study was carried out by the subject's father who noted down the words used spontaneously by the child over a six month period from July 1977 to December 1977. Words were determined to be spontaneous if they were observed to have been uttered by the child with no prompting by others about her three times or more during one month of observation. This eliminated words which parents and others modelled and which the child repeated.

Words uttered by the child spontaneously were noted down by the observer in International Phonetic Alphabet (hereafter IPA) symbols which are listed under "Transcription Symbols". A tape recorder was used for some time at the beginning of the study but it was found to be difficult to capture the words uttered in her natural environment without the tape recorder being noticed by the child and being rather cumbersome for the observer to carry around. Words were therefore noted down on paper and the child was apparently not aware of this recording process throughout the duration of the study. Words were not used frequently enough by the child to cause them to be missed out during the recording process which can be a problem in recording the fluent speech of an older child by this method. Halliday (1973) in his observations of a two year old using language encountered similar problems with the use of a tape recorder and opted for the pencil and notebook method. Leopold (1939) conducted his exhaustive study of child language entirely by the use of pencil and notebook. Weir (1962) found that the use of a tape recorder was helpful in recording the pre-sleep soliloquies of her son Anthony aged two and a half years.

The convention used throughout this study of expressing ages in years;months (eg 1;3) is that proposed by D. Crystal in the Journal of Child Language, Vol 1, 1974.

The recording of data covers the child's linguistic development from the age of 1;3 to 1;8. Only single word utterances were recorded. Evidence of two word utterances and early grammar appeared from about the age of 1;9, consequently, grammatical analysis was not undertaken in this study.

The problem facing the parents of the child studied was a common one facing many bilingual homes - the decision of which language was to become the home language. A number of possiblities were considered as follows;

1) that the home language would be Japanese,
2) that the home language would be English,
3) that the child would be spoken to by the mother in Japanese and in English by the father,
4) that the child would be spoken to by the mother and father in whichever language they wished to,
5) that constraints designed to provide the child with equal exposure to both languages would be imposed, eg using English in mornings and Japanese in the afternoons and alternating this pattern weekly.

Since both parents could speak both languages, and they considered it desirable to maintain a bilingual home environment, the first two possibilities were eliminated.

The third possibility had the disadvantage that activities which the mother was engaged in during the period of study were mainly connected with household routines and the father's activities were in general outside the house thus potentially causing a semantic bias in the languages learned. It also had the disadvantage that when both adults were speaking to each other or to the child it seemed a little unnatural to rigidly adhere to two native languages being spoken at once. This method was also eliminated.

The danger with free use of either language at any time was that, for the purposes of this study, it would be impossible to say whether either language was being used more than any other. A second potential danger lies in the area of languages interfering with each other. In the situation where two people know one another very well, as in a husband-wife relationship, there is a danger of the two languages being used interchangeably with each other. For example a sentence may be started off in Language A and be ended using Language B. It was observed that this happened from time to time in the situation under study. For these two reasons, the fourth possibility was eliminated.

The fifth possibility of imposing somewhat artificial constraints on the use of language was therefore adopted. Throughout the study, this method was employed although it was found to be difficult to keep it up beyond the study after which the free use of either language was adopted. For the purposes of this study though, the method of both parents using English in the mornings and Japanese in the afternoon noons was employed. The pattern was reversed every week so that language bias in certain activities could be avoided.

Even then, this did not provide exactly equal exposure in both languages for the child since visitors to the house, though few, usually spoke English. Grandparents spoke only English and English was the only language used on radio and television. Places visited outside the home were almost always places where English was the language used for communication.

The parents used either English or Japanese when conversing between themselves, following a similar pattern to the procedure adopted for communicating with the child. Throughout the study, intrusions from one language to another were kept to a minimum.

The English spoken by the father was close to the Received Pronunciation (RP) of British English with the slightly broader vowels of New Zealand English. The father's speech was not, however, an accentuated variety of New Zealand English. The variety of English spoken by the mother tended to contain phonological intrusions from Japanese. Notable examples were the substitution of the Japanese /ɑ/ for the English /æ/ and /ə:/, Japanese /u/ for the English /ʊ/, Japanese /o:/ for the English diphthong /əʊ/, the Japanese /o/ for the English /f/, /v/ for /b/, and the Japanese alveolar flap /r/ for the English /l/ and /r/.

The Japanese spoken by the mother was standard Japanese of the variety heard in the Tokyo area. The Japanese spoken by the father contained intrusions from English, notably the occasional substitution of the English /r/ for the Japanese alveolar flap /ɾ/ and the use of the English /f/ for the Japanese bilabial /ɸ/.

Definition of terms

Bilingualism.

See page 9.

Adult Speech.

This is abbreviated to AS in some tables. As used in this study, Adult Speech means the English, Japanese and common words used by the parents when speaking to the child or between themselves.

Child language.

This is the term used to cover language used by children, as proposed by Leopold (1948).

Linguistic interference.

An instance of deviation from the norms of the languages in contact which occurs in the speech of bilinguals as a result of their familiarity with more than one language. Interference may be phonological, lexical, semantic or grammatical.

Loanword.

When a word is taken directly into another language, that word becomes a loanword. An example is aisu kurimu (ice cream) in Japanese.

Common language.

A number of words (eg pen, brush) are used both in English and Japanese. Most of these are loanwords which Japanese has taken from English. There are differences in phonology and so these words are classified as words common to both languages. A few other words, (eg meaning in English sheep, swing, want) were used by the child but seemed to be her own phonological creations, not based on adult English or Japanese words. These words were also classified under the category of common.

Transcription Symbols

Since there are only 26 letters in the English alphabet and more than 40 basic sounds, it follows that normal orthography would be inadequate for transcribing the phonological output of either the adult or the child. Considerable ambiguity would result. The Japanese language is a phonetically spelled language and presents fewer problems than English in this respect. International Phonetic Alphabet (IPA) symbols, basically those of Gimson (1970) were chosen as the transcription notation for both languages.

A further problem remained in that a child's phonemes are less likely to be as well formed or conforming to the adult model. Considerable deviation was observed to occur and sounds produced were not always directly identifiable as belonging to the English or Japanese phonemic inventories.

Symbols used are listed as follows for English and Japanese.

Vowels	English		Japanese	
Front	i	feet	i	ichi
	ɪ	fit		
	e	bet	e	megane
	æ	bat		
Back	ɑ	far	ɑ	akai
	o	shot	o	oku
	ɔ	sort		
	ʊ	should		
	u	boot	u	uchi
Mid	ə:	bird		
	ə	about		
		but		
Diphthongs	eɪ	hay		
	aɪ	eye		
	ɔɪ	boy		
	əʊ	go		
	ɑʊ	how		
	ɪə	ear		
	eə	hair		
	ʊə	poor		

Consonants	Bilabial	Labiodental	Dental	Alveodental	Alveolar	Alveopalatal	Prepalatal	Palatal	Prevelar	Velar	Glottal
English											
Stop vl	p				t					k	
Stop vd	b				d					g	
Affricate vl								tʃ			
Affricate vd								dʒ			
Fricative vl		f	θ		s			ʃ			h
Fricative vd		v	ð		z			ʒ			
Nasal	m				n					n	
Lateral					l			r			
Glide	w							y			
Japanese											
Stop vl	p				t					k	
Stop vd	b				d					g	
Affricate vl				ts		tʃ					
Affricate vd				dz		dʒ					
Fricative vl	ɸ				s		ʃ			ç	h
Fricative vd					z		ʒ				
Nasal	m			n						n	
Flap					r						
Glide									y	w	

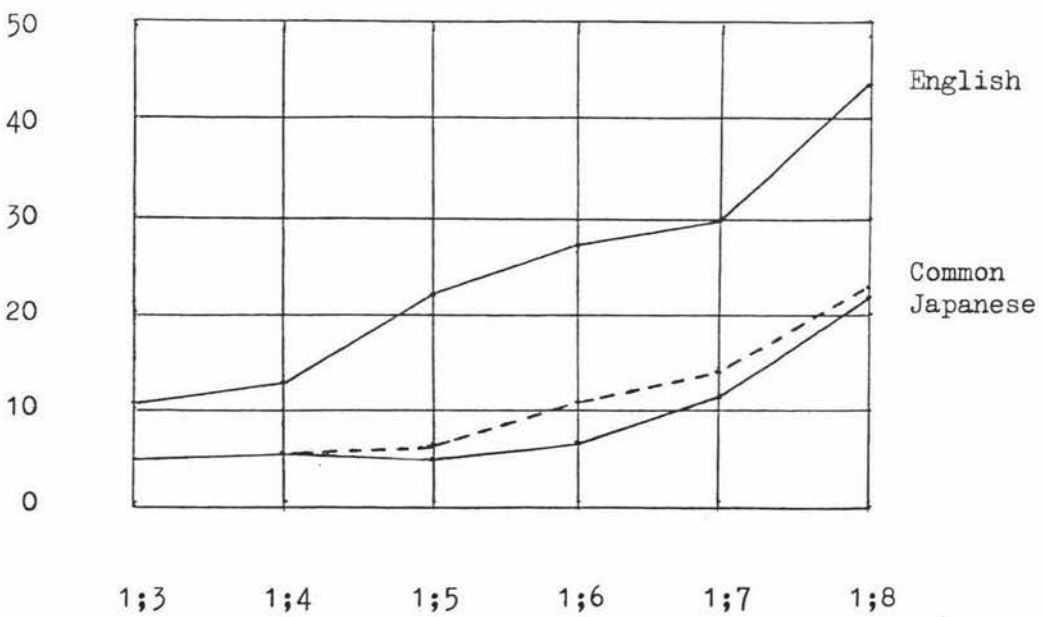
vl voiceless
vd voiced

Part Three Results

Vocabulary development

The study commenced when the child was 1 year 3 months old. At that time she was spontaneously using 11 English words, 5 Japanese words and 5 words which were classified in the common category (see page 19). This study was continued until the child was 1 year 8 months old when she was using 43 English words, 22 Japanese words and 23 words classified as common. This covered the period from when the child had just begun to use language to the point where there was a sudden increase in active vocabulary. In this study the words will be considered first as complete units, followed by an analysis of the component phonemes.

Table 1 Vocabulary development of child aged 1;3 to 1;8



Tables 2, 3 and 4 list the words used spontaneously by the child over the observed period which ran from July 1977 to December 1977. Observational procedures were as described on p 14 - 18.

Table 2

English word development in the child from the age of 1 year 3 months to 1 year 8 months

		1;3	1;4	1;5	1;6	1;7	1;8
baby	beɪbi	dæ də	dæ də	dæ də	dæ də bʌbə	dæ də bebɪʃ	bebɪʃ
bath	bɑ:θ						bɑ
bear	bɛə				bɛə	bɛə	bɛə
bee	bi:						bi:
bike	baɪk				bɑ	bɑ	bɑ
bird	bə:d	bə:ʃ	bə:z	bə:	bə:	bə:	
blanket	blæŋk ət			bɑ	bɑ	bɑ	bɑ
bone	bəʊn						bəun
book	bʊk	bʊ	bʊ	bʊ	bʊ	bʊ	bʊ
bottle	botəl				bo	bo	bo
broken	brəʊkən						bəu
chair	tʃɛə						tʃe
daddy	dæ di		dæ da:	dæ da:	dæ də	dæ də	dæ də
doll	dol	do	do	do	do	do	do
down	dɑʊn	dɑʊ	dɑʊ	dɑʊ	dɑʊ	dɑʊ	dɑʊ
duck	dʌk			dʌ	dʌ	dʌ	dʌ
fish	fɪʃ				wɪʃ	fɪʃ	fɪʃ
flower	flɑʊwə						wɑ
girl	gə:l				gə:	gə:	gə:
gone	gon		gon	go	go	go	go
grandma	græ mɑ					mæ mə	mæmə
grandpa	græmpɑ					bɑ	
hallo	hæ ləʊ	hæ əʊ		həʊ			hæ əu
horse	hɔ:s						ɔ:
hot	hot	ə:	ɑ:	ɑ:	ɑ:	ɑ:	ɑ:
key	ki:			gi:	gi:		
light	laɪt			daɪ	daɪ	daɪ	daɪ
man	mæn			mɑ	mɑ mæ	mæ	mæ
more	mɔ:		mɔ:wə	mɔ:ə	mɔ:ə	mɔə	mɔə
nap	næ p			nə mæ	mæ	mæ	
no	nəʊ					nəʊ	nəʊ nɔ:
off	of						oʃ
peas	pi:z						pi:s
plane	pleɪn			bɑ	bɑ	bɑ	bɑ
pusspuss	pʊspʊs	pʊʃpʊʃ	pʊʃpʊʃ	pʊʃpʊʃ	pʊʃpʊʃ	pʊʃpʊʃ	pʊʃpʊʃ
rabbit	ræ bət					bæ	bæ
rain	reɪn						we:
rhubarb	ru:bɑ:b						bɑ
rice	raɪs						waɪ
ride	raɪd						wɑ
round	rɑund						wɑ
shoes	ʃu:z	ʃu:z	ʃu:z	ʃu:z	ʃu:z	ʃu:z	ʃu:z
tea	ti						tʃi
10 Little Indians						te	
up	ʌp		ʌ	ʌ	ʌ	ʌ	ʌpu
water	wɔtə						wɔ:
whats this		wəʃɪʃ					
wowwow	wəʊwəʊ	wəʊwəʊ	wəʊwəʊ	wəʊwəʊ	wəʊwəʊ	wəʊwəʊ	wəʊwəʊ

Table 3

Japanese word development in the child from the age of 1 year 3 months to 1 year 8 months

Japanese (English)	1;3	1;4	1;5	1;6	1;7	1;8
anyo (leg)						anyo
arigato (thankyou)	a	a	a	a	a	a
bara (rose)						ba
boshi (hat)		bo:	bo:	bo:	bo:	bo:
dozo (please)						do:dʒo
hae (fly)						haɪ
ichigo (strawberry)						i:
kame (turtle)						ka
kasa (umbrella)						ka
makura (pillow)						ma
mama (food)	mama	mama				
me (eye)				me	me	me
megane (glasses)						me
mimi (ear)					mimi	mimi
Momotaro (PN)					momo	momo
niau (meow)					nyau	nyau
nori (seaweed)						nowi
ohayo (good morning)	a					
oni (devil)					ə	ə
paipai (milk)	paɪpaɪ	paɪpaɪ	paɪpaɪ	paɪpaɪ	paɪpaɪ	paɪpaɪ
paipai (breast)	paɪpaɪ	paɪpaɪ	paɪpaɪ	paɪpaɪ		
pan (bread)				pampan	paba	paba
Seishi (PN)		seɪʃ	seɪʃ	seɪʃi	seɪʃi	seɪʃ
te (hand)					te	te
Yaya (Own name)						yaya

Table 4

Common word development in the child from the age of 1 year 3 months to 1 year 8 months

English Japanese	1;3	1;4	1;5	1;6	1;7	1;8
ball boru	bo	bo	bo	bo	bo	bo
banana banana						nɑnɑ
beer biiru						bi
biscuit bisuketo		bɪʃ	bɪʃ	bɪʃ	bɪʃ	bɪʃ
boots butsu			bu:ʃ	bu:	bu:	bu:
brush burash	bəʃ				bʌ	bʌ
byebye baibai	baɪbaɪ	baɪbaɪ	baɪbaɪ	baɪbaɪ	baɪbaɪ	baɪbaɪ
car ka			gɑ	gɑ	gʌ	kɛ:
cheese chiizu						tʃi:
door doa					dɔə	dɔə
ice cream aisu kurimu						aɪs
juice jusu					ʤu:	ʤu:
matches machi						mæ
milk miruku		mu		mə	mə	mə
mummy mama				mɑmə	mɑmə	mɑmə
orange orenji						owə
peanuts pinatsu				popo		
pen pen	be	pe	be	pen		
pool puru						pu:
radio rajio						we:
sheep hitsuji						ɱe:
slippers surippa	sɪʃ	sɪʃ	sɪʃ			
swing buranko						dɑdɑ
switch suwichi				wɪʃ	wɪʃ	wɪʃ
tapa recorder tepu rekoda					bæ	
tv terebi					te	tʃi:
want hoshi				ə	ə	ə

Word classes

A fundamental question which should be asked when analysing the words of young children concerns the criteria for word selection on the part of the child. If selection were based purely on word frequency, then some grammatical functor words[1] could reasonably be expected to appear early on in the child's speech development. West (1965) showed that the 10 most frequently occurring English words were grammatical functors. The English words spoken by the child in this study were not the most frequently occurring in West's list and this seems to indicate that words were not learned according to the frequency in which they occur in adult speech.

Table 5 shows that nouns were overwhelmingly the most numerous class of words used by the child during the study. This would seem to suggest that the child was interested in attaching names to objects. Nouns appeared early in all three languages, English, Japanese and common, dominating the child's speech throughout the period of study. Nouns are generally recognised as constituting the major class of words in early child speech and this data would seem to be unexceptionable in this respect. All three languages showed a steady increase in noun acquisition and only in English was there any use made of verbs.

Table 5

Word class analysis of child's English, Japanese and common lexical items from 1;3 to 1;8

	1;3			1;4			1;5			1;6			1;7			1;8		
	E	J	C	E	J	C	E	J	C	E	J	C	E	J	C	E	J	C
Noun	8	1	6	8	5	6	15	4	7	20	4	7	25	11	14	32	20	21
Verb	1			3			3			3		1	2			6		
Adjective	1			1			1			1			1			1		
Adverb				1			1			1			1			1		
Interjection	2	2	2		1	1	1	1	1		1	1	1	1	1	2	2	1

1. Functor words include grammatical words such as auxiliary verbs, conjunctions, articles, etc. and mark grammatical structures. They may be distinguished from contentive words, eg nouns, adjectives, which make reference to people, objects, actions and qualities.

Semantic groups

Word classes are not able to indicate just what it is that the child is interested in naming. It could logically be expected that the child would be interested in attaching names to objects that he or she comes into contact with in the everyday environment rather than immediately starting out to learn the names of abstract qualities or objects he has never had any contact with. In short, it may be expected that the child would learn the names of toys, food, animals people and so on. A semantic analysis is set out in Table 6 which tends to corroborate this view.

Table 6

Semantic analysis of the child's English, Japanese and Common lexical items from the age of 1 year 3 months to 1 year 8 months

	1;3			1;4			1;5			1;6			1;7			1;8		
	E	J	C	E	J	C	E	J	C	E	J	C	E	J	C	E	J	C
Food		1			2	2		1	1		2	3	2	2	3	5	4	8
Toys	2		2	2		2	2		2	3		2	8	2	3	5	2	5
Animals	3			3			4			5			3	1	1	7	3	1
People	2			2	1		3	1		4	1	1	6	2	1	5	2	1
Body					1			1			2			3			4	
Clothes	1		2	1	1	2	2	1	3	2	1	1	3	1	2	1	1	1
Indoor			1				3						1		3	6	3	4
Outdoor							1		1				1		1	3	1	1
Social	1	2	2		1	1	1	1	1				1	1	2	2	2	2
Action	1			2			4						4			7		
Miscel.	2			3			1						1			1		

English names tended to dominate the child's speech which was not surprising in view of the fact that the child was being raised in an English speaking culture. Certain semantic groups however were not monopolised by English. Since the mother tended to have greater contact with the child at meal times, and much of the food was Japanese,

eg nori (seaweed), and so the child used more Japanese food names than English food names. The naming of parts of the body was also a reflection of the fact that the mother spent more time handling the child, washing, dressing, caring for it with the result that the child was using 4 Japanese names for parts of the body by 1;8 but none in English. Names given to toys, animals and people tended to be reflective of the New Zealand culture and were thus mainly in English.

English provided all the words associated with action of any sort (broken, down, gone, off, ride, round, up). It is not clear whether this was due to English being a language whose basic nature is more "active" than Japanese or whether it was due to English being accelarated in development.

Speakers of Japanese treat social relationships seriously and a large number of set phrases exist in Japanese which are used at all times by everybody, eg ohayo gozaimasu (good morning). English on the other hand tends to have a greater number of variant forms or styles. "Good morning sir", "Morning", " Nice day" or "Hi" could all be used in the English situation whereas only "Ohayo gozaimasu" would be used in Japanese. Possibly this concern for social relationships and the formulaic manner in which it is handled may account for the fact that an equal number of words were being used by the child for social interaction in English and Japanese by the age of 1;8, despite the overall accelarated development of English.

Word mortality

The phenomenon of word mortality was observed to some extent. One cause of word mortality immediately apparent is the changing pronunciation of certain words such as /dædə/ — /bebIʃ/ (baby) or /mɔ:wə/ — /mɔə/ (more).

Other words seem to have dropped out of usage because the object was removed from the child's environment or because the child lost interest in the object. Examples of these include /gi:/ (key), /sIʃ/ (slippers).

There are other examples of word mortality which are less easily explained. /wəʃIʃ/ was used by the child at the age of 1;3 a few times when she seemed to be asking the name of something, but was dropped from her vocabulary after a few days. /mɑmɑ/ (Japanese child talk for food) was used at 1;3 and 1;4 but not used thereafter. Perhaps she had begun to use more specialised words for different kinds of food and thus had less need for a general term. /ɑ/ (Japanese ohayo or "Good morning") and /popo/ (the child's word for peanuts) both disappeared from the child's vocabulary during the study, but did reappear in expanded phonological form after termination of the study.

Phonemic shapes of words

Fundamental differences were observed between the child's phonemic word shapes and those of the adult models. Table 7 shows that the child's phonemic word shapes were not true replicas of the adult words but that she tended to favour a consonant + vowel (CV) pattern. This was a tendency which was even more marked in the case of English. Most notable was the child's tendency to reduce English CVC type words to a CV phonemic pattern by frequently omitting the final consonant.

This trend of the child patterning her words on a CV formula could also be observed in the acquisition of common words. The adult model in this case was partly English and partly Japanese resulting in a spread of adult patterns peculiar to neither of those languages. Table 8 therefore sets out only the child's phonemic patterns of common words.

Table 7

Comparison between adult word shapes and child word shapes when child was aged from 1 year 3 months to 1 year 8 months

	1;3		1;4		1;5		1;6		1;7		1;8	
	E	J	E	J	E	J	E	J	E	J	E	J
	AS C	AS C	AS C	AS C	AS C	AS C	A S C	AS C	AS C	AS C	AS C	AS C
Monosyllabic												
V	1	2		1	2	1	2	1	2	2	2	3
CV	3			1	3 14	1	3 17	1 2	5 21	2 4	6 29	3 9
CVC	5 2			1	11 1	1	14 2	1	14 2	1	19 3	1 1
VC							1				2 1	
CCV										1 1	1	1 1
CCVC	1				1		1		1		1	
CVCC												
Disyllabic												
VCV										1	1	1
CVV	2				1		1				2	
CVCV	4 2	1 1	4	3	4 3	1 2	3 4	4 3	3 4	4 5	5 3	10 7
VCCV												1 1
CCVCV									1		2	
CVCVC	1						1		2 1		3 1	
CCVCVC											1	
CVCCVC	2 1		1		1 1		1 1	1	1 1		1 1	
CCVCCV									1			
CCVCCVC					1		1		1		1	
Polysyllabic												
VC VCV		1										1
CVCVCV												2
VCVCVCV		1										1
CVCVCVCV												1
multi									1			

Table 8

Common word shapes of child 1;3 to 1;8

	1;3	1;4	1;5	1;6	1;7	1;8
Monosyllabic						
V				1	1	1
CV	2	3	3	4	9	14
CVC	2	2	3	3	2	2
VC						1
Disyllabic						
VCV						1
CVCV	1	1	1	3	2	4

The child seemed to demonstrate a marked preference for two basic word shapes, the monosyllable CV and the disyllable CVCV. To what extent these patterns were used by the child in shaping her English, Japanese and common words can be seen in Table 9. In all three languages, CV and CVCV forms occur so frequently as to imply that this may have been a strategy of the child whereby she used the basic CV structure to model her own words on.

While it would seem that the child showed a preference for CV monosyllables, this was not the case with monosyllables of adult speech in English where CVC is the most frequently occurring shape among the words attempted by the child. The child reduced the CVC adult words down to a CV form - generally by omitting the final consonant. eg adult speech /dol/ - child /do/. In the case of Japanese, which is based on a CV pattern, there seemed to be a closer correspondence between the adult model and the child's performance. The child appeared to find it easier to imitate the CV structure of Japanese than to reproduce the more common CVC English monosyllables.

Table 9

Percentage of CV and CVCV syllables in English, Japanese and common vocabulary of child 1;3 to 1;8

	1;3	1;4	1;5	1;6	1;7	1;8
English	45	62	74	78	80	74
Japanese	34	67	60	71	75	72
Common	60	67	67	64	78	81

A case could be argued here for evidence of phonological interference from Japanese in the form of the CV shape of syllables. But it seems unlikely, firstly because English was the more dominant language of the child throughout the study and it seems improbable that the less dominant language would intrude so extensively. Secondly, evidence from other studies (Jakobson and Halle, 1956) suggest that the use of this CV or CVCV formula is a strategy of children beginning to learn their first language and therefore need not be considered as an instance of language interference.

The child's preference for the CV form became even more accentuated in the disyllables. Here it was the dominant form of the parent model and the child's utterance in all 3 languages. Some reduplication was noted /pʊʃpʊʃ/ (pusspuss), /wəʊwəʊ/ (wowwow), /baɪbaɪ/ (byebye). The remaining disyllables were CVCV constructions of non-alike syllables.

In the case of Japanese, the structure of the language makes the occurrence of disyllabic CVCV forms almost a certainty. This is not the case in English. Not all English disyllables conform to the CVCV pattern. They may be CVCCV for example or any of a number of other combinations (see Table 7). Yet in this sample most of the child's disyllables were found to be CVCV in form. It was shown that this was unlikely to be phonological interference from Japanese. It may be conjectured that words which are used to young children may have been tailored to the phonological preferences and capabilities of children. This proposal may be extended to argue that the Japanese language may be better suited to learning by young children because of It's being based on the CV form.

Phonological interference

Since this was a study of a bilingual child, it was of considerable interest to watch for instances of phonological interference between English and Japanese. There has already been discussion on the possibility of phonological interference from Japanese to English in the section on phonemic shapes of words and the result was found to be negative.

In general very little phonological interference between the two languages was observed except for one or two isolated instances at the age of 1;8 when the child used the Japanese /ɸ/ instead of the English/f/ in /fiʃ/. Whether or not this was actually a token of phonological interference or not is debatable for it may equally well be argued that this was merely an infantile deviant form of /f/ which could have occurred in the speech of a monolingual child.

Evidence of phonological interference may have been difficult to pick out because of the reduced nature of the child's phonological performance when compared with adult models.

It has been suggested that children begin to separate two languages around the age of 2 years (Leopold, 1939-49) but it may well be that the child is capable of phonologically discriminating between two or

more languages earlier than the age of 2 years. If so, this would account for the lack of instances of phonological interference in the speech of this child between the ages of 1;3 to 1;8.

Development of phonemes

Tables 10 and 12 provide a general picture of the vowel and consonant phonemes occurring in the words used by the parents which the child attempted and those which occurred in the words of the child. These tables do not however, show where the phonemes were being used, specifically, whether they were occurring in initial, medial or final positions; information on this can be obtained from the Appendix. Since English was slightly accelarated in development, English phonemes appeared before Japanese phonemes.

Table 10

Analysis of the child's English and Japanese vowel development from the age of 1 year 3 months to 1 year 8 months

	1;3				1;4				1;5				1;6				1;7				1;8			
	E		J		E		J		E		J		E		J		E		J		E		J	
	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C
i	1		1				3		3	1	3		3	1	3	1	3	1	7	4	5	3	9	4
ɪ	1	1											1	1			3	2			1	1		
e															1	1	1	2	2	2		3	5	3
æ	1	2			1	2			5	3			4	4			7	6			5	4		
ɑ			5	4		2	4	2		5	2	1		5	3	3	2	5	5	3	3	10	14	8
o	3	1	3		3	2	2	1	3	2	2	1	4	3	2	1	4	3	7	3	5	4	11	7
ɔ					1	1			1	1			1	1			1	1			3	4		
ʊ	3	3			3	3			3	3			3	3			3	3			3	4		
u	1	1			1	1			1	1			1	1			1	1			2	1	1	
ə:	1	1			1	1			1	1			2	2			2	2			1	1		
ə						2		1	1	3			2	4			3	4		1	6	4		2
ʌ					1	1			2	2			2	3			2	2			3	2		
eɪ	1				1		1	1	2		1	1	2		1	1	2		1	1	3		1	1
aɪ							4	4	1	1	4	4	2	1	4	4	1	1	2	2	4	2	4	4
ɔɪ																								
əʊ	3	3			2	2			3	3			2	2			3	3			6	6		
aʊ	1	1			1	1			1	1			1	1			1	1	1	1	3	1	1	1
ɪə																	1							
eə													1	1			1	1			2	1		
ʊə																								

In the development of both English and Japanese vowels, the following general trends could be observed. (see Table 11)

1) The child tended to use fewer front vowels than the adult in the case of both English and Japanese.
2) The child tended to use more mid vowels than the adult, especially in English. Mid vowels are not used in adult Japanese speech.
3) The child tended to use more back vowels than the adult in English.
4) The child was able to use all Japanese back vowels by the end of the study which may be explained by the fact that the Japanese back vowels /ɑ,o,u/ are more clearly differentiated and thus possibly easier for the child to be able to perceive than the English back vowels /ɑ,o,ɔ,ʊ,u/.

Table 11

Place of English and Japanese vowel articulation compared in adult speech and child from the age of 1 year 3 months to 1 year 8 months

	1;3				1;4				1;5				1;6				1;7				1;8			
	E		J		E		J		E		J		E		J		E		J		E		J	
	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C
front	3	3	1		3	2	3		8	4	3		8	6	4	2	14	11	9	6	11	11	14	7
mid	1	4			2	4			4	6			6	9			7	8		1	10	7		2
back	7	5	8	4	8	9	6	3	9	12	4	2	9	12	5	4	11	13	12	6	16	33	26	15
diphthong	5	4			4	3	5	5	7	5	5	5	8	5	5	5	9	6	4	4	19	10	6	6

Diphthongs do not strictly occur in Japanese which because it is a syllable timed language, tends to separate double vowels, eg /e-i/, instead of the English practice of diphthonbgisation, /ei/. The difference is however, a fine one and it was found to be very difficult to determine whether the young child was separating the vowels or using diphthongs. Diphthongs are therefore grouped together although it must be remembered that in the Japanese adult model, in reality, two vowels were sounded. The most frequently occurring diphthongs /aɪ,əʊ,ɑ / include initial components which are high frequency vowel phonemes in the child's speech such as /ɑ,ə/.

The neutral vowel/ə/ does not occur in Japanese yet it appeared when the child attempted Japanese words on 2 occasions. Whether this was an instance of phonological interference or not is difficult to determine. It was felt that this was simply a feature of the speech immaturity of the child to centralise vowels which was also observed in the case of English.

The child demonstrated a preference for using back vowels in English, as well as in Japanese. The front and central vowels did not enjoy such frequent use. This is as much evidence as can be found in this study to support Jakobson's irreversible law of solidarity since the study began at a stage when the child had the initial onset stage of phonological acquisition. Even so, the gaps in the child's phonemic inventory indicate that that it is very likely that developmental constraints are operating which prevent an even pattern of acquisition.

Table 12

Analysis of the child's English and Japanese consonant development from the age of 1 year 3 months to 1 year 8 months

	1;3				1;4				1;5				1;6				1;7				1;8			
	E		J		E		J		E		J		E		J		E		J		E		J	
	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C
p	2	2			3	2	4	4	5	2	4	4	5	2	5	6	6	2	3	3	5	4	3	3
b	4	2			4	2	1	1	5	4	1	1	8	9	1	1	9	11	1	2	14	4	2	3
t	2		1		1		1		3		1		4		1		8	1	3	1	7		3	1
d	3	4			5	6			6	8			6	8			7	8			7	6	1	1
k	1				1				3				5				4				5		3	2
g			1		1	1	1		1	2	1		2	3	1		4	2	1		3	2	3	
tʃ																		1			1	2	1	
dʒ																			1	1				1
ʤ																						1		
f													1				1	1			3	1		
v																								
θ																					1			
ð																								
s	4				2		1	1	2		1	1	2		1	1	2		2	1	4	1	2	1
z	2	1			2	2	2	1	1	1			1	1			2	1			2	1	1	
ʃ	1	6			1	3			1	2	2	1	2	4	2	1	2	5	2	1	2	5	2	1
ʒ																								
h	2	1			1				2	1			1				1				3	1	1	1
(J)r			1				1				1				1				2				5	
l	2				1				5				6				8				7			
(E)r																	3				7			
m			2	2	1	1	2	2	2	3			2	4	1	2	4	5	5	5	3	4	8	7
n	1		2	1	2	1			5	1			5			1	9	1	2	1	9	2	4	3
ŋ									1				1		1		1		2		1		2	
w	3	3			2	3			2	2			2	3			2	2			4	8		1
y																			1	1			4	4

Table 13

Manner of English and Japanese consonant articulation compared in adult speech and child from the age of 1 year 3 months to 1 year 8 months

	1;3				1;4				1;5				1;6				1;7				1;8			
	E		J		E		J		E		J		E		J		E		J		E		J	
	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C
Stop	12	8	2		15	11	7	5	23	16	7	5	30	22	8	7	38	24	8	6	41	26	15	10
Affricate																		1	1	1	1	2	1	1
Fricative	9	8			6	5	3	2	6	5	3	2	7	5	3	2	8	7	4	2	15	10	6	3
Lateral	1				1				5				6				11				14			
Flap			1				1				1				1				2				5	
Nasal	1		2	2	3	2	2	2	8	4			8	4	2	3	14	6	9	6	13	6	14	10
Glide	3	3			2	2			2	2			2	3			2	2	1	1	4	8	4	5

The most frequently occurring consonants were stops both in English and Japanese. The frontal bilabial stops /b,p/ were not only the most frequently occurring of this group both in adult and child speech but these also most often appeared at the beginning of a word (see Appendix). Next in order of frequency were the mid position or alveolar stops /t,d/. Those stops articulated at the back were the last to appear and the least frequently used of all the stop series.

The next most frequently uttered group of consonants were fricatives in English but nasals in Japanese. Nasals were third most frequently occurring consonant group in English while fricatives were third most frequently occurring consonant group in Japanese. This apparent reversal is possibly a reflection of the fact that English has a greater number of fricatives than Japanese. Again, a progressive increase in the use of these consonant groups was observed over the period of study.

Laterals, /l,r/, and the Japanese alveolar flap /r/ were present in the words uttered by the parents but not observed in the speech of the child who would either omit these consonants from her own productions, eg adult speech /ru:ba:b/ - child speech /ba/, or substitute some other consonant, eg adult speech /laɪt/ - child speech /daɪ/, or adult speech /reɪdio/ - child speech /we:/.

Glides were present first in English at 1;3 and in Japanese at 1;7. This may be indication of the fact that the child's general language development in Japanese was about 4 months behind that of English (see also Tables 2 and 3).

Affricates were late to appear and little used by the child; nor were they frequently used in the adult words which the child attempted to produce. This may be attributed to the fact that affricates constitute only a very small proportion of normal adult speech (in English about 1%, see Table 16).

Table 14

Place of English and Japanese consonant articulation compared in adult speech and child from the age of 1 year 3 months to 1 year 8 months

	1;3				1;4				1;5				1;6				1;7				1;8			
	E		J		E		J		E		J		E		J		E		J		E		J	
	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C	AS	C
Bilabial	10	8	2	2	10	8	7	7	14	11	5	5	17	18	7	9	21	20	9	10	26	30	13	13
Labiodental													1				1	1			3	2		
Dental																					1			
Alveolar	12	4	1	1	13	9	3	1	22	10	3	1	24	9	3	3	39	11	9	3	43	10	16	6
Palatal	2	6			1	3	2	1	1	3	2	1	2	4	2		2	6	3	2	3	7	3	1
Velar	1		1		2	1			5	2	1		8	3	2		9	2	4	1	9	2	12	7
Glottal	2	1			1				2	1			1				1				3	1	1	1

Two regions of the mouth appear to account for most of the articulation by the adult and by the child in both English and in Japanese, the bilabial and the alveolar regions. (see Table 14) Whereas the child's bilabial consonants occur in approximately the same frequencies as the adults in both languages throughout the study, the adult words contain a greater proportion of alveolar sounds than the child produces. Consonants which are articulated from the back of the mouth, those which are palatal, velar or glottal, occur to no significant extent in the adults' words or in the child's utterances in either English or Japanese.

There may be a kind of phonological compromise operating. Bilabial consonants are possibly easily perceived by the child since the oral signal is reinforced by a readily observed visual demonstration. The child could for example, see how the lips close to form a /b/ or a /p/. This may have helped the child to develop bilabial sounds earlier than others.

However, not all words are composed of bilabial sounds. More alveolar consonants occurred in the adult words attempted by the child than bilabials. But whereas the child used as many bilabial sounds as occurred in the adult words, she was only able to use about one third as many alveolar consonants as occurred in the words used by adults. Alveolar consonants, while occurring more frequently than bilabial consonants, seem to have constituted a greater problem for the child. It could be argued that there were structural constraints arguing against the concept of frequency as a dominant factor in the development of child phonology, thus lending some support to the basic idea of Jakobson's hypothesis. Edwards (1974) has hypothesised that the order of acquisition tends to be uniform but that details vary greatly.

It may be significant that the regions of the mouth used were the same both for English and Japanese and that the pattern of relative success with bilabial and alveolar consonants were similar in both languages. It was noted that the order of consonant acquisition differed slightly between Japanese and English (the second most frequently occurring groups of consonants were fricatives in English

but nasals in Japanese. This may have been due to the difference in frequency of occurrence between the two languages which introduces the final section of this discussion.

Frequency of phoneme occurrence

In general there was a high correlation between the phonemes used by the child and those used by the adult. Since the child's phonemic inventory was not as complete as the adults' English or Japanese phonemic inventories, this may suggest that the child was attempting adult words which contained a high content of phonemes which the child was capable of producing. It may also indicate that the adults exposing the child to words which they felt she was capable of uttering. This section will investigate the evidence for these possibilities.

Adult words attempted by the child may not contain phonemes in the same proportions as they occur in ordinary speech. An inspection of Tables 15 and 16 show this to be so for English. A comparison was not carried out in Japanese due to the unavailability of normative data.

Vowels did not occur in the adult words attempted by the child in the same frequencies, nor in the same ranking as vowels in "ordinary" speech. (see Table 15) The phoneme frequencies for "ordinary" speech were taken from a study of Southern English carried out by D. B. Fry cited in Gimson (1970). The most frequently occurring vowels of ordinary speech were not the first to appear in the words selected by the child and nor was there any similarity in the frequency ranking. The least frequently occurring vowels of ordinary speech were not found in any of the words attempted by the child.

Table 15

Frequency of occurrence of English vowels in "ordinary" speech measured by D.B. Fry compared with frequency of occurrence of English vowels in adult words attempted by the child from the age of 1 year 3 months to 1 year 8 months

	Fry	1;3	1;4	1;5	1;6	1;7	1;8
ə	10.74%			1.39	2.38	2.63	4.19
ɪ	8.33	2.32			1.19	2.63	0.69
e	2.97					0.88	
aɪ	1.83			1.39	1.19	0.88	2.79
ʌ	1.75		2.27	2.77	1.19	1.75	2.09
eɪ	1.71	2.32	2.27	2.77	2.38	1.75	2.09
i	1.65	2.32	4.54	4.17	3.57	2.63	3.49
əʊ	1.51	6.97	4.54	4.17	2.38	2.63	4.19
æ	1.45	2.32	2.27	6.94	4.76	6.14	3.49
o	1.37	6.97	6.82	4.17	4.76	3.51	3.49
ɔ	1.24		2.27	1.39	1.19	0.88	2.09
u	1.13	2.32	2.27	1.39	1.19	0.88	1.39
ʊ	0.86	6.97	6.82	4.17	3.57	2.63	2.09
ɑ	0.79					1.75	2.09
aʊ	0.61	2.32	2.27	1.39	1.19	0.88	2.09
ə:	0.52	2.32	2.27	1.39	2.38	1.75	0.69
ɛə	0.34				1.19	0.88	1.39
ɪə	0.21					0.88	
ɔɪ	0.14						
ʊə	0.06						

Table 16

Frequency of occurrence of English consonants in "ordinary" speech measured by D.B. Fry compared with the frequency of occurrence of English consonants in adult words attempted by the child from the age of 1 year 3 months to 1 year 8 months

	Fry	1;3	1;4	1;5	1;6	1;7	1;8
n	7.58%	2.32	4.54	6.94	5.95	7.89	6.29
t	6.42	4.65	2.27	4.17	4.76	7.02	4.89
d	5.14	6.98	11.36	8.33	7.14	6.14	4.89
s	4.81	9.30	4.54	2.77	2.38	1.75	2.80
l	3.66	4.65	2.27	6.94	7.14	7.02	4.89
ð	3.56						
r	3.51					1.75	4.89
m	3.22		2.27	2.77	2.38	3.51	2.10
k	3.09	2.32	2.27	4.17	5.95	3.51	3.50
w	2.81	6.98	4.54	2.77	2.38	1.75	2.80
z	2.46	4.65	4.54	1.39	1.19	1.75	1.40
v	2.00						
b	1.97	9.30	9.09	6.94	9.52	7.89	9.79
f	1.79				1.19	0.88	2.10
p	1.78	4.65	6.82	6.94	5.95	5.26	3.50
h	1.46	4.65	2.27	2.77	1.19	0.88	2.10
ŋ	1.15			1.39	1.19	0.88	0.70
g	1.05		2.27	1.39	2.38	3.51	2.10
ʃ	0.96	2.32	2.27	1.39	2.38	1.75	1.40
y	0.88						
dʒ	0.60						
tʃ	0.41						0.70
θ	0.37						0.70
ʒ	0.10						

A similar result was observed in the development of the consonants. Again, the most frequently occurring consonants of ordinary speech were neither the first to be acquired nor the most frequently used words selected by the child.

This may be an indication that frequency of phoneme occurrence does not play the decisive role in child phonological development at this stage. Constraints of some sort seemed to be operating, suggesting that the child was developing her phonology according to criteria other than phoneme frequency.

The fact that there was no correlation evident between the frequency of occurrence of phonemes in ordinary speech and those which occurred in the words attempted by the child suggests the following possible explanations.

1) The child chose not to attempt to produce words she knew she could not utter.

2) The words first offered to the child by the adults were intuitively chosen by the adults as words which could be easily uttered by the child given her limited phonemic inventory.

It may be that there is some relationship between these two postulates. Quite possibly, throughout the history of language, words which are likely to be used with children may have been streamlined and tailored to fit the phonemic capabilities of children.

Part Four Discussion and conclusions

During this study a child was observed as she acquired the phonology and the lexis of two languages, English and Japanese.

At the word level, the child appeared to select words more often from English due to her being raised in a monolingual English speaking society despite the fact that the parents often used Japanese when addressing her. It seems that society can exert considerable influence on a child in forming language, even when the child is well insulated from the society.

The naming process appeared to begin when the child encountered an object which aroused her curiosity. Most words learned during the study were the names of concrete objects in the immediate environment. The parents, perhaps because they wished to teach or because the child indicated that she wished to know, would supply a name for the object. The linguistic devices employed by the parents when teaching the child were noted but not specifically measured in this study. It may be an interesting cross-cultural investigation to compare differences in baby talk between English and Japanese.

The child seemed to apply an operation of reduction to the words she heard her parents saying. Allied with this seems to have been a predisposition on the part of the child for using the CV (consonant + vowel) configuration for monosyllables and the CVCV configuration for disyllables. Since Japanese is based on the CV syllable pattern, this predisposition of the child did not affect her performance in Japanese significantly. It did, however, cause her to shorten many English words, especially those with a CVC phonemic shape.

Very little evidence of phonological interference occurred between English and Japanese in the child's speech at any stage during the study. Possible instances of phonological interference could equally well have been no more than non-standard phonemes which might have occurred in the speech of a monolingual child. It was suggested that bilingual phonological discrimination may have been occurring at least as young as 1;3 which may well indicate that the child was aware that the linguistic data of the input was bilingual much earlier than the generally quoted figure of around two years.

The child tended to use certain phonemes earlier and more frequently than others. It was observed that in the case of vowels, it was the back vowels which developed earlier. In the case of consonants, it was the bilabial and alveolar consonants which developed earliest and were used most frequently by the child. This was true for both languages, thus providing some support for Jakobson's hypothesis that the order of phoneme acquisition is universal and determined by structural constraints.

The role of frequency was investigated and it was found that neither the adult words the child chose to attempt to produce, nor the words uttered by the child, as observed in English, occurred with the frequency of phonemes which occur in ordinary speech. Two explanations were offered which may be seen as weaker or stronger variants of the basic hypothesis. The weaker form of the theory suggests that the child chose not to attempt to produce words she could not utter. The stronger form suggests that the words which the parent first instinctively presented the child in language learning contained a high proportion of phonemes which the child had already learned. This seems to be supportive evidence for Brown (1977) who suggests that the mother's speech is "fine tuned" to the child.

The data gathered in this study does not fully support nor disprove a structural theory or a behavioural theory of phonological development. The child did seem in general to follow the broad outlines of Jakobson's theory. At the same time, while the results of this study disagree with Olmsted's hypothesis that the phones are modelled for a child in about the same proportions as in ordinary speech, the data does not contradict Olmsted when he suggests that the more discriminable phones enjoya selective advantage over the less discriminable ones. The evidence of this study suggests that the language input of the adult differs from ordinary adult speech in that it is fine tuned to the phonological capabilities of the child which are constantly developing. This is to suggest that the adult instinctively knows that the child favours certain phonemes and therefore the adult tries to use these phonemes wherever possible.

A problem which may face parents who are raising children bilingually is to decide on a home language policy. The arrangement whereby one language was spoken in the morning and the other in the afternoon, reversing this pattern on alternate weeks, was not continued beyond the study due to the somewhat artificial flavour of the method. In most circumstances, the choice of language to be used at any particular time in a bilingual home will be by tacit or unconscious agreement. This implies that it is very likely to vary according to circumstances. In this case the parents should guard against speaking in mixtures of both languages. The effect of speaking mixtures of languages has not been determined on the language development of children raised in bilingual homes. A study comparing various bilingual home language policies could be instructive for providing guidance for parents on raising their children bilingually. The parents would do well to be aware of exactly what the effect of their linguistic behaviour is at any given time.

Some child language researchers have been interested in comparing how the child learns his first language with the way in which an older learner gains competency in his second language. The child in this study was observed to enjoy repetition. On several occasions, she was

observed to repeat a word 3 or 4 times then wander away and appear to become interested in another object. But then she would suddenly repeat her new word another 3 or 4 times. After 5 minutes or so, she would again repeat the new word 3 or 4 times. This is in direct contrast with most second language learners who repeat a word once or twice and then let it go at that. Repetition is an inescapable part of language learning but spacing of repetition could well be a useful area of study.

This study probably doesn't have a great deal to offer the learning of second language phonology since the child is concentrating on developing a complete set of phonemes whereas the second language learner probably already has a number of the target language phonemes in the phonemic repertoire of his native language. For the second language learner it is a matter of introducing him to the phonemes he lacks. A contrastive analysis of the two languages in contact is a good starting point for the second language instructor.

The child in this study demonstrated control of basic intonation patterns before the study began. Prosody patterns colour every language differently and the second language student could benefit by being introduced to the features of intonation and stress early in the second language programme.

Although the parents' input seems to be modified to take into account the child's phonological deficiencies, possibly this may not need to be a feature of second language instruction in phonology. The child is developing in phonological competence and certain sounds (eg / θ,ʒ/) are not acquired until most children enter school. However, older second language learners are not restrained by developmental considerations and are potentially capable of being taught new phonemes.

In conclusion, this study discovered no detrimental effect on the language development of the child which can be attributed to bilingualism. The child's motivation to observe language may have caused her to perceive that two phonological systems were operating in the linguistic environment at least as early as 1 year 3 months. There is scope for further studies to discover just how early a child may comprehend the fact that it is in a bilingual environment.

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Appendices

Analyses of location of phoneme use in adult and child speech in English and Japanese.

1 English vowels and Japanese vowels at 1;3
2 English consonants at 1;3
3 Japanese consonants at 1;3
4 English vowels and Japanese vowels at 1;4
5 English consonants at 1;4
6 Japanese consonants at 1;4
7 English vowels and Japanese vowels at 1;5
8 English consonants at 1;5
9 Japanese consonants at 1;5
10 English vowels and Japanese vowels at 1;6
11 English consonants at 1;6
12 Japanese consonants at 1;6
13 English vowels and Japanese vowels at 1;7
14 English consonants at 1;7
15 Japanese consonants at 1;7
16 English vowels and Japanese vowels at 1;8
17 English consonants at 1;8
18 Japanese consonants at 1;8

Appendix 1 English vowels and Japanese vowels at 1;3

English Vowels	initial		medial		final		total	
	adult	child	adult	child	adult	child	adult	child
i					1		1	
I			1	1			1	1
e								
æ			1	2			1	2
ɑ								
o			3			1	3	1
ɔ								
ʊ			3	2		1	3	3
u			1	1			1	1
ə:			1	1			1	1
ə		1		1		1		3
ʌ								
eɪ			1				1	
aɪ								
ɔɪ								
əʊ			1	1	2	2	3	3
ɑʊ			1			1	1	1
ɪə								
ɛə								
ʊə								
Japanese Vowels								
i			1				1	
e								
ɑ	1	2	3	1	1	1	5	4
o	1				2		3	
u								
ə								
eɪ								
aɪ								
ɑʊ								

Appendix 2 English consonants at 1;3

English Consonants	initial		medial		final		total	
	adult	child	adult	child	adult	child	adult	child
p	1	1	1	1			2	2
b	3	2	1				4	2
t			1		1		2	
d	2	3	1	1			3	4
k					1		1	
g								
tʃ								
dʒ								
f								
v								
θ								
ð								
s			2		2		4	
z					2	1	2	1
ʃ	1	1		2		3	1	6
ʒ								
h	2	1					2	1
m								
n					1		1	
ŋ								
l			1		1		2	
r								
w	2	2	1	1			3	3
y								

Appendix 3 Japanese consonants at 1;3

Japanese Consonants	initial		medial		final		total	
	adult	child	adult	child	adult	child	adult	child
p								
b								
t			1				1	
d								
k								
g			1				1	
tʃ								
dʒ								
ɸ								
s								
z								
ʃ								
ʒ								
h								
m	1	1	1	1			2	2
n								
ŋ								
r			1				1	
y								
w								

Appendix 4 English vowels and Japanese vowels at 1;4

English Vowels	initial		medial		final		total	
	adult	child	adult	child	adult	child	adult	child
i					2		2	
I								
e								
æ			1	2			1	2
ɑ		1				1		2
o			3	1		1	3	2
ɔ			1	1			1	1
ʊ			3	2		1	3	3
u			1	1			1	1
ə:			1	1			.1	1
ə						2		2
ʌ	1	1					1	1
eɪ			1				1	
aɪ								
ɔɪ								
əʊ			2	2			2	2
ɑʊ			1			1	1	1
ɪə								
ɛə								
ʊə								
Japanese Vowels								
i			1		2		3	
e								
ɑ	1	1	2	1	1		4	2
o			1		1	1	2	1
u								
ə						1		.1
eɪ			1	1			1	1
aɪ			2	2	2	2	4	4
ɑʊ								

Appendix 5 English consonants at 1;4

English Consonants	initial		medial		final		total	
	adult	child	adult	child	adult	child	adult	child
p	1	1	1	1	1		3	2
b	3	2	1				4	2
t					1		1	
d	3	4	2	2			5	6
k					1		1	
g	1	1					1	1
tʃ								
dʒ								
f								
v								
θ								
ð								
s			1		1		2	
z					2	2	2	2
ʃ	1	1		1		1	1	3
ʒ								
h	1						1	
m	1	1					1	1
n					2	1	2	1
ŋ								
l					1		1	
r								
w	1	1	1	2			2	3
y								

Appendix 6 Japanese consonants at 1;4

Japanese Consonants	initial		medial		final		total	
	adult	child	adult	child	adult	child	adult	child
p	2	2	2	2			4	4
b	1	1					1	1
t			1				1	
d								
k								
g			1				1	
tʃ								
dʒ								
o								
s	1	1					1	1
z								
ʃ			2			1	2	1
ʒ								
h								
m	1	1	1	1			2	2
n								
n								
r			1				1	
y								
w								

Appendix 7 English vowels and Japanese vowels at 1;5

English Vowels	initial		medial		final		total	
	adult	child	adult	child	adult	child	adult	child
i					3	1	3	1
ɪ								
e								
æ			5	3			5	3
ɑ		1				4		5
o			3			2	3	2
ɔ				1	1		1	1
ʊ			3	2		1	3	3
u			1	1			1	1
ə:			1			1	1	1
ə			1			3	1	3
ʌ	1	1	1			1	2	2
eɪ			2				2	
aɪ			1			1	1	1
ɔɪ								
əʊ			1	1	2	2	3	3
ɑʊ			1			1	1	1
ɪə								
ɛə								
ʊə								
Japanese Vowels								
i			1		2		3	
e								
ɑ	1	1	1				2	1
o			1		1	1	2	1
u								
ə								
eI			1	1			1	1
aɪ			2	2	2	2	4	4
ɑʊ								

Appendix 8 English consonants at 1;5

English Consonants	initial		medial		final		total	
	adult	child	adult	child	adult	child	adult	child
p	2	1	1	1	2		5	2
b	4	4	1				5	4
t					3		3	
d	4	6	1	2	1		6	8
k	1		1		2		4	
g	1	2					1	2
tʃ								
dʒ								
f								
v								
θ								
ð								
s			1		1		2	
z					1	1	1	1
ʃ	1	1		1		1	1	3
ʒ								
h	2	1					2	1
m	2	3					2	3
n	1	1			4		5	1
ŋ			1				1	
l	1		3		1		5	
r								
w	1	1	1	1			2	2
y								

Appendix 9 Japanese consonants at 1;5

Japanese Consonants	initial		medial		final		total	
	adult	child	adult	child	adult	child	adult	child
p	2	2	2	2			4	4
b	1	1					1	1
t			1				1	
d								
k								
g			1				1	
tʃ								
dʒ								
o								
s	1	1					1	1
z								
ʃ			2			1	2	1
ʒ								
h								
m								
n								
n								
r			1				1	
y								
w								

Appendix 10 English vowels and Japanese vowels at 1;6

English Vowels	initial		medial		final		total	
	adult	child	adult	child	adult	child	adult	child
i					3	1	3	1
ɪ			1	1			1	1
e								
æ			4	2		2	4	4
ɑ		1				4		5
o			4			3	4	3
ɔ			1	1			1	1
ɚ			3	3			3	3
u			1	1			1	1
ə:			2			2	2	2
ə			2			4	2	4
ʌ	1		1	1		2	2	3
eɪ			2				2	
aɪ			2			1	2	1
ɔɪ								
əʊ			1	1	1	1	2	2
ɑʊ			1			1	1	1
ɪə								
ɛə					1	1	1	1
ɚə								
Japanese Vowels								
i			1		2	1	3	1
e					1	1	1	1
ɑ	1	1	2	2			3	3
o			1		1	1	2	1
u								
ə								
eɪ			1	1			1	1
aɪ			2	2	2	2	4	4
ɑʊ								

Appendix 11 English consonants at 1;6

English Consonants	initial		medial		final		total	
	adult	child	adult	child	adult	child	adult	child
p	2	1	1	1	2		5	2
b	7	8	1	1			8	9
t			1		3		4	
d	4	6	1	2	1		6	8
k	1		1		3		5	
g	2	3					2	3
tʃ								
dʒ								
f	1						1	
v								
θ								
ð								
s			1		1		2	
z					1	1	1	1
ʃ	1	1		1	1	2	2	4
ʒ								
h	1						1	
m	2	4					2	4
n	1				4		5	
ŋ			1				1	
l	1		2		3		6	
r								
w	1	2	1	1			2	3
y								

Appendix 12 Japanese consonants at 1;6

Japanese Consonants	initial		medial		final		total	
	adult	child	adult	child	adult	child	adult	child
p	3	3	2	3			5	6
b	1	1					1	1
t			1				1	
d								
k								
g			1				1	
tʃ								
dʒ								
ɸ								
s	1	1					1	1
z								
ʃ			2	1			2	1
ʒ								
h								
m	1	1		1			1	2
n						1		1
ŋ					1		1	
r			1				1	
y								
w								

Appendix 13 English vowels and Japanese vowels at 1;7

English Vowels	initial		medial		final		total	
	adult	child	adult	child	adult	child	adult	child
i					3	1	3	1
ɪ			3	2			3	2
e			1	2			1	2
æ			7	3		3	7	6
ɑ		1			2	4	2	5
o			4			3	4	3
ɔ				1	1		1	1
ʊ			3	2		1	3	3
u			1	1			1	1
ə:			2			2	2	2
ə			3			3		3
ʌ	1	1	1			1	2	2
eɪ			2				2	
aɪ			1			1	1	1
ɔɪ								
əʊ			1	1	2	2	3	3
ɑʊ			1			1	1	1
ɪə			1				1	
ɛə					1	1	1	1
ʊə								
Japanese Vowels								
i			3	1	4	3	7	4
e					2	2	2	2
ɑ	1	1	4	1		1	5	3
o	2		2	1	3	2	7	3
u								
ə		1						1
eɪ			1	1			1	1
aɪ			1	1	1	1	2	2
ɑʊ					1	1	1	1

Appendix 14 English consonants at 1;7

English Consonants	initial		medial		final		total	
	adult	child	adult	child	adult	child	adult	child
p	2	1	2	1	2		6	2
b	7	10	2	1			9	11
t	2	1	2		4		8	1
d	4	6	2	2	1		7	8
k			1		3		4	
g	4	2					4	2
tʃ		1						1
dʒ								
f	1	1					1	1
v								
θ								
ð								
s			1		1		2	
z					2	1	2	1
ʃ	1	1		1	1	3	2	5
ʒ								
h	1						1	
m	2	4	2	1			4	5
n	2	1	3		4		9	1
ŋ			1				1	
l	1		4		3		8	
r	1		2				3	
w	1	1	1	1			2	2
y								

Appendix 15 Japanese consonants at 1;7

Japanese Consonants	initial		medial		final		total	
	adult	child	adult	child	adult	child	adult	child
p	2	2	1	1			3	3
b	1	1		1			1	2
t	1	1	2				3	1
d								
k								
g	1						1	
tʃ								
dʒ		1	1				1	1
ʦ								
s	1	1	1				2	1
z								
ʃ			2	1			2	1
ʒ								
h								
m	3	3	2	2			5	5
n	1	1	1				2	1
ɳ					2		2	
r			2				2	
y			1	1			1	1
w								

Appendix 16 English vowels and Japanese vowels at 1;8

English Vowels	initial		medial		final		total	
	adult	child	adult	child	adult	child	adult	child
i			1	1	4	2	5	3
ɪ			1	1			1	1
e				1		2		3
æ			5	2		2	5	4
ɑ		1	2	1	1	8	3	10
o	1	1	4			3	5	4
ɔ		1	3	1		2	3	4
ʊ			3	2		2	3	4
u			2	1			2	1
ə:			1			1	1	1
ə			4		2	4	6	4
ʌ		1	2		1	1	3	2
eɪ			3				3	
aɪ			4			2	4	2
ɔɪ								
əʊ			3	1	3	5	6	6
ɑʊ			3			1	3	1
ɪə								
ɛə					2	1	2	1
ʊə								
Japanese Vowels								
i	1	1	3	1	5	2	9	4
e			1		4	3	5	3
ɑ	2	2	8	1	4	5	14	8
o	1		5	3	5	4	11	7
u			1				1	
ə		1				1		2
eɪ			1	1			1	1
aɪ			2	2	2	2	4	4
ɑʊ					1	1	1	1

Appendix 17 English consonants at 1;8

English Consonants	initial		medial		final		total	
	adult	child	adult	child	adult	child	adult	child
p	3	2	1	2	1		5	4
b	10	13	3	1	1		14	14
t	1		2		4		7	
d	4	5	1	1	2		7	6
k			2		3		5	
g	3	2					3	2
tʃ	1	2					1	2
dʒ								
f	2	1			1	1	1	1
v								
θ					1		1	
ð								
s			1		3	1	4	1
z					2	1	2	1
ʃ	1	1		1	1	3	2	5
ʒ								
h	3	1					3	1
m	2	3	1	1			3	4
n	1	2	1	1	7		9	2
ŋ			1				1	
l	1		3		3		7	
r	6		1				7	
w	2	7	2	1			4	8
y								

Appendix 18 Japanese consonants at 1;8

Japanese Consonants	initial		medial		final		total	
	adult	child	adult	child	adult	child	adult	child
p	2	1	1	2			3	3
b	2	2		1			2	3
t	1	1	2				3	1
d	1	1					1	1
k	2	2	1				3	2
g			3				3	
tʃ			1				1	
dʒ				1				1
ɸ								
s	1	1	1				2	1
z			1				1	
ʃ			2			1	2	1
ʒ								
h	1	1					1	1
m	5	5	3	2			8	7
n	2	2	2	1			4	3
ŋ			1		1		2	
r			5				5	
y	1	1	3	3			4	4
w				1				1

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