SYLLABIC POSITION AND MODE OF PERFORMANCE AS FACTORS IN PHONOLOGICAL INTERFERENCE

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ABSTRACT

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This study investigated the syllabic position of phonemes and the mode of performance as factors in phonological interference. The study focused on the error rate of initial versus final oral and nasal stops in both production and identification modes of performance for adult bilingual speakers. The focus of the study was threefold. First, the error frequency and pattern of initial versus final position in both modes of performance were regarded. Second, the relationship between error frequency, and segment class and type was observed in both modes of performance. Third, the relationship between performance on production and identification tasks was considered.

Six Mandarin speaking adults of Taiwanese origin, who spoke English as a foreign language, participated in the study. The general design was one in which the subjects read a list of test items, and identified spoken test items by listening to an audio tape.

Results supported the conclusion that syllabic position and mode of performance function as factors influencing the frequency and pattern of consonant errors made in English by native Mandarin speakers.

The general conclusion was that the phenomenon of interference is more complex than the contrastive analysis approach implies. In sum, comparison of the phonemic inventories of two langauges is insufficient to explain the errors that speakers make when learning the sounds of a foreign language.

DEDICATION

Dedicated to my parents and my husband
and all others who use more than one
language for communication.

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LIST OF ABBREVIATIONS

NL	Native Language
FL	Foreign Language
ESL	English as a Second Language
JSHD	Journal of Speech and Hearing Disorders
JSHQ	Journal of Speech and Hearing Research
ELTJ	English Language Teaching Journal
IRAL	International Research and Linguistics
SLA	Second Language Acquisition

CHAPTER I

BACKGROUND FOR THE STUDY

Introduction

The sophisticated technology and the increased mobility of the modern world have increased the opportunity for people to reach across the borders of their countries. One of the consequences entailed in this opportunity is communication in a language other than one's own. Considering interlingual communication from a linguistic point of view, one finds that the process of mastering a foreign language (referred to as FL in contradistinction to NL or native language) involves learning at all levels of a new language system. As described by Akmajian, Demers and Harnish (1979), these levels are phonology, representing the structure of sounds; morphology, which covers the structure of words; syntax, standing for the structure of sentences; and pragmatics, which includes the use of language for communication purposes. This implies that the learner of a FL will be faced with new phonological systems, new vocabulary, and different syntax and pragmatics, either totally or partially.

Interference as a Phenomenon in Second Language Acquisition

Much has been published on second language acquisition (referred to as SLA henceforth). Of particular interest to scholars studying the process and the results of learning a FL is the phenomenon of transfer. In the broadest sense transfer refers to the use of features or characteristics of one language that can or should be applied to another language. In the literature this phenomenon is referred to with different terminology and definitions. The two most frequently used terms appear to be transfer and interference.

Transfer and Interference Defined

Albert and Obler (1978) describe transfer as imposing structures from (a) previous language(s) on the target language. Laroche (1981) sees transfer as "utterances accepted in both languages conditioned by the native language." Clyne (1975), as cited in Hirschfeld (1983) uses the term transference for "Take-over of elements, characteristics and rules from another language" (p. 51). Hirschfeld (1983) states that generally in linguistics transfer is defined as influences from the mother tongue that do not violate the norm of the FL and stimulate the learning process. Bunte and Kendall (1981) add to this, the need of acknowledging and recognizing the existence and importance of transfer at the pragmatic level.

Hirschfeld (1983) mentions that the term interference is sometimes used in a narrow sense to refer to the interfering influences of the NL language on the acquisition of a FL.

Weinreich (1953) explains:

> The term interference implies the rearrangement of patterns that result from the introduction of foreign elements into the more highly structured domains of language, such as the bulk of the phonemic system, a large part of the morphology and syntax, and some areas of the vocabulary (kinship, color, weather, etc.) (p. 1).

In a broader sense, the term interference is used for the situation of language confusion, meaning the process as well as the result of the confusion.

In reviewing the definitions on interference and transfer, one finds contradicting use of the same terminology among the different authors. It seems that the distinction between the process and the effect of the phenomenon has been recognized, but not stated clearly (Hirschfeld, 1983).

Weinreich (1953) describes interference as follows:

> Those instances of deviation from the norms of either language which occur in the speech of bilinguals as a result of their familiarity with more than one language, i.e. as a result of language contact, will be referred to as INTERFERENCE PHENOMENA" (p. 1).

It follows from this description that the term <u>transfer</u> describes the process whereas the term <u>interference</u> indicates the effect of the phenomenon.

The term "interference" and its definition as used by Weinreich (1953) will be used in this study, since the goal of the study is to explore the effect and not the process of the phenomenon.

Phonological Interference

The aforementioned phenomenon of interference in learning a FL can occur at all levels of the FL. Among those levels the one of phonology is of particular interest. As Strevens (1973) describes, at the phonological level not only are mental processes required, but there is also a great deal of motor involvement. The other levels may function with only mental activities, such as perceiving, decoding, coding. Only the phonological level functions with the actual production and perception of the speech sounds, in which the concepts and thoughts are wrapped. Flege (1980) stresses the existence and importance of articulatory motor control for the production of speech sounds. He further mentions that the findings of research on articulatory motor learning requirements of second language learning suggest that:

> . . . establishment of articulatory motor control is itself an important part of second language learning. The language learner, it seems, must acquire complex new sets of highly automatic articulatory gestures or modify existing patterns of phonetic implementation <u>in addition</u> to acquiring control of an abstract, reorganized phonology" (p. 18).

In other words the levels of morphology, syntax and pragmatics represent the language system used for exchange of messages and thoughts. The actual realization of the system though occurs through phonology. It follows, then, that phonological interference differs from interference at the other levels in terms of the actual realization of the language system.

The results of phonological interference can have a great impact on the communicative functioning in the FL. It may appear in slight deviances at the allophonic level, such as unaspirated plosives in the initial position of words, that will not influence the communication in a langauge like English. Phonological interference may appear in more serious forms though, such as deletion, substitution, distortion, addition, and reduction of sounds. It speaks for itself that these forms can lead to confusion, misunderstanding and even complete lack of understanding, which in their turn hinder or even prevent the communicative function of the spoken or perceived language. Further it should be realized that phonological interference can penetrate at other linguistic levels. The deletion or addition of a final/s/ at the phonological level, may lead to confusion at the morphological level. So besides the difference of phonology in having one more aspect compared to the other linguistic levels, there is also the very practical aspect of direct communication that sets phonology apart and makes phonological interference a topic of special interest. Or, as Rivers states as cited by Ihenacho (1980, p. 245): "Since language is a means of communication, it is not enough for our students to learn words, phrases, grammatical features if they will not be able to produce these in a way which makes their utterance comprehensible to a native speaker of that language."

Phonological Interference and Speech-Language Pathology

The problems that learners of a FL encounter have not only been recognized from the side of linguistics and teaching of a SL but also from the side of Speech and Hearing Sciences, namely Speech-Language-Pathology. The American Speech-Language-Hearing Association, ASHA, (1985) states:

> Researchers and clinicians are only beginning to amass a knowledge base on the characteristics of normal language development in various minority languages, bilingual language learning, second language acquisition, dominance testing, bilingual assessment and remediation of communicative disorders, and the applications of emerging computer technology for use with minority language groups (p. 29).

Further, the position statement continues:

> However, the speech-language pathologist must have certain competencies to distinguish between dialectal differences (due to interaction from the minority language) and communicative disorders. These competencies include understanding the minority language as a rule-governed system, knowledge of the contrastive phonological, grammatical, semantic, and pragmatic features of the minority language, and knowledge of non-discriminatory testing procedures" (refer to "Social Dialects: a Position Paper," ASHA, September 1983).

There are several reasons for this interest from the side of Speech and Hearing Sciences. The main reason is the fact that nowadays speech-language pathologists are more and more confronted with people for whom English is a FL. This does not only hold for youngsters in schools but also for the older population with disorders such as aphasia, apraxia, dysarthria, voice disorders, hearing disorders. It is very important for the speech-language pathologist to be adequately informed about bilingual language and speech acquisition and possible interference in order to distinguish correctly between pathological patterns in the client's English and errors that result from language contact.

The second reason is the specialized competency of the speech-language pathologist for the practical aspects of phonology, such as speech development, production and perception, and the correction of speech errors. Although it can be argued that this competency has been proven for only the NL, it is still such that the field of Speech-Language Pathology can contribute importantly to the knowledge about the practical consequences of phonological interference.

Contrastive Analysis as an Approach to Phonological Interference

The literature available on phonological interferences is offered mainly from linguistics and Second Language Teaching. In this literature, the method of contrastive analysis has often been used to predict or account for errors occurring in the FL. In linguistics the term contrastive analysis is used for analyzing the existing differences between the two languages at several linguistic levels that make the two language systems contrastive. At the phonological level, for instance, the phonemic inventories of the languages under study are compared in order to predict pronunciation errors made in the FL.

Schumann and Stenson (1974) indicate that contrastive analysis manifests itself in two versions. They cite Wardhaugh (1974) in explaining those two versions. The strong version claims that by means of contrastive analysis the errors that learners of a FL will make in that FL, can be predicted. The weak version uses the differences between two languages to account for observed errors. According to Wardhaugh (1974), the strong version is untenable at the present, since it would require minimally a linguistic theory, covering linguistic universals of syntax, semantics and phonology, in order to deal adequately with those levels. Although such a linguistic theory is not available at the moment, the strong version is still the version that underlies much of the work done on interference.

Factors Not Taken Into Account by Contrastive Analysis

In the last decade the linguistic theory has started to acknowledge the limitations of contrastive analysis. Wardhaugh (1974) described the weakness of contrastive analysis and concluded: "The contrastive analysis hypothesis has not proved to be workable, at least not in the strong version in which it was originally expressed" (p. 18). He continued: "In its weak version, however, it has proved to be helpful and undoubtedly will continue to be so as linguistic theory develops" (p. 18).

Wardhaugh's (1974) position gains support from a number of writers who have examined phonological interference directly. Among the studies that concentrate on phonological interference are the ones of Flege (1980), Wilson and Møllergård (1981), and Broselow (1983). Flege (1980), who studied phonetic approximation in English as a FL for Saudi Arabians, concluded that phonetic norms of the NL may carry over to the production of speech in the FL. He suggested that phonetic interference is not static but should be regarded as a part of the interlanguage system of learners of a FL, which would allow for individual phonetic strategies among the learners. He ended with mentioning that the general pattern of phonetic learning in a FL shows similarity with that of a child learning a NL.

Wilson and Møllergård (1981) found in their study on production errors of the vowel /ʌ/ for Norwegian learners of English, that rarely one simple explanation can be given for a type of error. They considered a range of involved factors, such as different orthography, language background, teaching situation, phonological context and the difference in speech production for a reading task or during spontaneous speech. This position takes side with Chen (1976), who stressed the difference in speech production for single-word-reading and sentence-reading in his study on phonological interference.

Broselow (1983) in her study on transfer using epenthesis errors, argued that pronunciation errors "must be analyzed as belonging to syllable structures which are not permitted in the native language." She further argued that the mispronunciations "represent an attempt by the language learner to bring second language forms into conformity with first language restrictions defining possible syllables."

More writers have mentioned other causes of interference that go beyond contrastive analysis even though their claims were not based on actual studies of interference. These studies are of descriptive nature. The causes of interference that were found in those studies are summarized below.

The different causes for the found phonological interference vary from lack of proper eartraining for new sounds (Roy, 1975); unfamiliar sounds in the FL (Roy, 1975; Mirhassani, 1983; Reed, et. al., 1949); different spelling for shared sounds (Sumuktu, 1957; Mirhassani, 1983); to unfamiliar sound combinations (Mirhassani, 1983). Saunders (1963) added as reasons for the maintenance of phonological interference lack of awareness, the learner's attitude towards the FL and the psychological factors involved in pronouncing new phonemes that may sound or feel funny. The position follows Sapir, who mentioned in 1927 that speech sounds are not only a matter of articulatory or acoustical image, but also subject to symbolic expression, which involves psychological factors.

It appears, then, that there is a lot of support for the inadequacy of contrastive analysis to predict or explain errors in phonological interference. Therefore, further studies need to be done, that go beyond the information which contrastive analysis provides. Two factors that have not been regarded by contrastive analysis are context and mode of performance. In the following sections the importance of these factors will be considered.

Context as a Factor in Phonological Interference

In reviewing the literature one finds two kinds of context being ignored by the contrastive analysis hypothesis. The first one, situational context, is mentioned by Schumann and Stenson (1974), who state:

> No theory of contrastive analysis, strong or weak, should be expected to account for all errors of language learning. Much evidence is already available which suggests that many errors are due to target-language rule deviance as well. In addition, there are many errors induced by the classroom situation, but which cannot be considered to be a function of performance (i.e., due to inattention, memory lapse, outside interference, etc.) (p. 2 and 3).

Secondly, linguistic context has not been taken into account by the contrastive analysis approach. Trusting contrastive analysis as a predicting or explanatory means for phonological interference implies acquisition of single sounds, since contrastive analysis often makes use of phonemic charts to contrast the phonological systems of two languages. In this case, context cannot be taken into account. Many authors, though, stress the value of linguistic context. Ingram (1974) described contextual influence as combinatory influences of neighboring speech sounds on production and perception of other speech segments. The contextual importance has been stressed for phonology in the NL as well as for the FL.

With respect to the NL it has been shown that context is an importance learning variable in both normal and clinical populations. For normally developing children, Ingram (1974) showed in his study on phonological rules in young children that sounds are produced and perceived in context. Other evidence on normal development is provided by Templin (1957) and Olmsted (1971) in their studies on child speech development. They both concluded that the moment of acquisition of a sound depended on syllable or word position. The general conclusion for consonants was that they are acquired in word initial position before they are acquired in word final position.

Jakobson (1968) described the similarities between the phonological development in children and the phonological systems of the languages in the world. He mentioned the likelihood of a universal tendency towards the development of sounds in CV syllables rather than as single sounds. Mackay (1978) concluded in his study on speech errors inside the syllable by nonhandicapped adult native speakers that the phonological availability for sounds is influenced by the syllabic position of those sounds.

For the deviant speech in the NL, Hodson and Paden (1981) found in their study on phonological rules in unintelligble children, the deletion of final consonants as a factor. Blumstein (1980) studied phonological errors in aphasic speech and found syllabic position of phonemes within the syllable of importance for articulatory programming.

Often the process of acquiring a FL is believed to have much in common with the acquisition of a first language (Baetens-Beardmore, 1982; Owens, 1984). Owens (1984) also mentions that "phonological development follows a similar pattern in first and second language. The phonological system from the first language forms a foundation for the second" (p. 321). Similar conclusions are drawn by Flege (1980) in that the general pattern of phonetic learning in a FL for adults resembles the phonetic learning in the NL for a child.

Literature on FL learning has described syllabic position of phonemes as a form of linguistic context. Jackson (1981) who studied pronunciation of English consonants by Indian learners, mentioned the importance of considering the whole system of speech sounds in the involved languages. Saunders (1962), Sumuktu (1957), and especially Shen (1954, 1959, 1961, 1962), analyzed the errors observed in English as a Second Language (ESL henceforth) in speakers of different native languages. They stressed the differences in phoneme distribution within word or syllable as a factor of great importance in phonological interference. Sapir (1927) spoke of the influence of phonetic patterning; Amiz (1973) who described ESL for Iraqi students, mentioned the cluster position within a word; and Mirhassani (1983), in describing ESL for Iranian, considered unfamiliar positions for clusters within a word as a factor of phonological interference. All aforementioned studies regarding linguistic context were based on observations, without referral to any methodology for collecting and analyzing the data or specification of the circumstances under which the observations were made.

All authors have in common in their findings that there seems to be a difference for segments to occur in initial position and in final position. Whether in child speech disorders (Ingram, 1976; Hodson and Paden, 1981), aphasia (Blumstein, 1980), child speech development

(Templin, 1957; Jakobson, 1968; Olmsted, 1971) or in speech of non-handicapped native speakers (Mackay, 1978), it appears that consonants in initial position are different from those in final position. Initials seem to be earlier acquired, more stable, more readily available, and less susceptible to disorders than final consonants. Also in FL literature syllabic position has been mentioned as important. These findings raise questions about whether a sound not occurring in a certain position in the NL, would be produced correctly in that position in a FL, even if the phoneme is the same for each language.

Mode of Performance as a Factor in Phonological Interference

Another factor not regarded by the contrastive analysis approach is the mode of performance. Literature on phonological interference from the contrastive analysis hypothesis' point of view mentions only the production of speech sounds. It seems that the perceptual mode of performance is ignored. In linguistics speech production is considered the spoken realization of the language system, in other words spoken language. Further, in linguistics the terms language perception and speech perception are used to refer to the input of spoken language.

There are two components in perceiving spoken language. First, there is the comprehension aspect that refers to the content of the conveyed message. Second, there is the recognition of speech signals. The latter one allows distinction between different forms of a language system, such as words. In this way it contributes to the comprehension aspect. For example, a distinction between /t/ and /θ/ allows understanding of the words tree and three as two different meanings. It seems that recognition of speech signals mainly takes place at the phonological level. Comprehension, on the other hand, seems to relate to vocabulary, syntax, and pragmatics. Therefore, the two components often are considered as two levels and labeled as language or speech comprehension and speech perception.

Although contrastive analysis seems to disregard perception, literature on language acquisition values the contribution of perception to the learning process, especially from the view point of language comprehension. Baetens-Beardmore (1982), Garcia (1983), Albert and Obler (1978), and Gass and Selinker (1983) are among the authors in the field of second language learning who stress the importance of language input for the development of communication skills in a FL.

The ignorance of the perceptual mode by contrastive analysis leaves one to assume a symmetrical relationship between perception and production. Literature on both language comprehension and speech perception shows evidence for an asymmetrical relationship. In literature on bilinguality and learning of a FL, it is stressed that speakers of more than one language have different competencies for the modes of perception and production. It is, for instance, possible for a person to understand a FL well without being able to speak it fluently.

Further, this relationship is considered asymmetrical in that perception is thought to be prerequisite to production. Albert and

Obler (1978) argue that although a certain connection between the systems exist, they also are to some degree independent of each other (p. 251). They support their statement by referring to the observations that perception precedes production in language learning, and that the production system seems to suffer more than the perception system in those instances where one of the languages has not been used for a while. This independence of the two systems implies that within the general trend individual differences may occur.

At the level of speech perception, the asymmetrical relationship has been explored in the acquisition of a FL as well as a NL. On the side of speech language pathology it is known that perception and production are related in the acquisition of phonological rules. Edwards (1974) and Ingram (1974) both conclude the existence of the relationship between perception and production in child phonology. Edwards' findings show that "the order of development in phonemic perception may not be identical with the order in production" (p. 218). But in general it is accepted that phonemic perception precedes correct production.

Goto (1971), and Sheldon and Strange (1984) studied the perception and production of /l/ and /r/ by Japanese students of ESL. They concluded that perception and production do not have a symmetric relationship at the phonological level either and that correct production can occur along with incorrect perception. Sheldon and Strange (1984) stressed the important influence of the phonological environment on the target sound, including the phoneme distribution within the word. It seems, thus, that in language comprehension, perception is thought to be prerequisite for production. Speech perception, though, can precede or follow correct production.

The evidence pointing to asymmetry between perception and production suggests that performance patterns predicted for production need not apply to perception as a contrastive analysis interpretation would imply. Consequently, the question can be raised about whether there is a relationship between errors in the perception and production of the same phonemes.

Summary of Issues

In reviewing the limitations of contrastive analysis as a means of predicting or explaining phonological interference, it seems that many questions remain without answer. One of those questions considers the linguistic context of the phonemes that are contrasted especially their distribution within the syllable. Another question regards the mode of performance. The contribution of the perceptual ability and the relationship between perception and production in phonological interference seem not to be taken into account by contrastive analysis. The difference between the modes of performance--perception being a mental process and production being characterized by the motor aspect of realizing the language system--is also ignored.

Answering those questions would be of both theoretical and practical importance. Theoretical knowledge about the existence and extent of the syllable distribution of phonemes as a factor of phonological interference would add to better understanding of the phenomenon. Better and broader understanding of phonological interference would lead to a better and more adequate approach to avoid or reduce its effects. This could be useful for FL teaching and in speech language pathology as well.

Statement of the Problem

In reviewing the literature it appears that the topic of phonological interference in the acquisition of a FL is of great interest. This interest is shared by not only the fields of linguistics and Second Language Teaching, but also by speech-language pathology. The latter one adds knowledge about the motor aspects of speech, perception of speech, and the phonological development in the NL to the theoretical and practical/educational knowledge of the other two fields. It is further noticed that the literature reports little research on the positional effect of segments within the syllable as a factor in phonological interference. Nevertheless descriptive studies consider this factor of value, and in the research on phonological development within the NL, the influence of segment distribution in the syllable has been acknowledged. Since the acquisition of a FL, including the phonological acquisition, is regarded to take place similarly to the acquisition of the NL, the question may be raised whether and how far segment position effects play a role in the occurrence of phonology interference. Taking into account that phonology is the actual realization of the language system and thus directly related to communication, it seems that the effect of segment distribution within the syllable as a factor in phonological interference deserves a systematic investigation.

Examining Linguistic Context as a Factor in Phonological Interference

In order to study linguistic content as a factor in phonological interference it would seem appropriate to choose contrastive languages with very different segment distributions within the syllable but yet identical phonemic segments. It is hypothesized that the segment distribution within syllables that are accepted according to the phonological rules in the NL will interfere with the different segment distribution within syllables as accepted in the FL. It is further hypothesized that the interference will take the form of adapting the syllable structure of the FL as much as possible to an accepted form in the NL, whether by deletion or addition of segments.

Examples of two languages with very different syllable structures are English and Mandarin. They come from the two very different language families: Indo-European and Sino-Tibetan (Gage, 1981). Among these, English represents the Indo-European sub-language Germanic, and Mandarin represents the Chinese sub-language within the Sino-Tibetan language family (Gage, 1981). The sub-languages differ in phonemic inventory and phonemic distribution. In general it can be said that pitch at the syllabic level is phonemic in Chinese, but not in Germanic languages. A main difference in phonemic distribution can be considered the occurrence of consonant clusters in Germanic and the lack of them in Chinese.

The differences between the exemplars of the subfamilies can be described in more detail. Within the phonemic inventory category, the feature of aspiration for initial consonants is recognized as phonemic in Mandarin but not in English. Reversed, the distinction voiced-voiceless for consonants has phonemic value in English but not in Mandarin.

Within the category of phonemic distribution two main differences are found. In English consonant clusters occur frequently, but Mandarin lacks them. Further are only a few consonants used in Mandarin in the final position of a syllable, whereas most of the consonants in initial position in English do also occur in final position. In the phonetic inventory category similarities also are found. Besides in the close number of phonological elements (43 and 42 for respectively English and Mandarin) and in the close distribution of those elements over syllabic and nonsyllabic phonemes (19-24, and 20-22 for respectively English and Mandarin), similarities are found in the occurrence of vowels and consonants. The shared vowels are /i/a/u/, the shared dipthong is /au/, and the shared consonants are /p/t/k/f/s/z/m/n/ŋ/l/r/h. Of the set two entire natural classes are represented. They are the voiceless stops /p/t/k/ and the nasal stops /m/n/ŋ/. The segments of those natural classes represent similarities and differences in the distribution within the syllable for the two languages. All consonants of the plosive class occur word initial in both Mandarin and English. Word final they only occur in English. The class of the nasals shows less uniformity in their segment distribution. The /m/ is identical in position appearance to the plosives, and can occur word initial in Mandarin and in both positions in English. The /n/ occurs word initial and word final in both languages, and the /ŋ/ only appears in word final position in both languages.

According to the differences in occurrence of final consonants in the syllable then, the question arises whether native Mandarin speakers would be likely to show more deviations of final consonants than of initial ones. In order to allow for investigation of the distributional effect of segments within the syllable and to rule out the possible influence of unfamiliarity with certain segments, it seemed wise to choose shared consonants and vowels for the test items. These appear to be /p/t/k/m/n/ŋ/i/a/u/. To avoid any confusion between child language development and SLA, it was decided to explore the above mentioned positional influence in the syllable in adult bilingual speakers.

Examining the Mode of Performance as a Factor in Phonological Interference

As mentioned before, because of its static nature, contrastive analysis appears to have limitations as a means of predicting or explaining phonological interference. The limitation of ignoring the linguistic context of the target sound has been discussed above. Another limitation is the neglected influence of the perceptual mode of performance or the assumed symmetric relationship between perception and production of sounds. The influence of perception on production and the asymmetric relationship between the two modes of performance have been acknowledged in child phonological development. There are indications that this knowledge for the NL also holds for the phonological acquisition in SLA.

Broadening the knowledge about the role of the mode of performance in phonological interference as occurring in SLA would have implications for clinical purposes regarding bilingual or multilingual students. Taking this into account, it seems of interest to investigate the distributional influences of segments within the syllable as a factor in phonological interference in both modes of performance.

Purpose of the Study

The purpose of the present study, then, is to investigate the effect of segment distribution within the syllable on the perception and production of those segments as a factor of phonological interference. The study will be particularly considering the initial versus final position of single consonants.

The study will attempt to answer the following questions:

1. (a) What are the frequency and pattern of errors made by native Mandarin adult speakers in the production of initial versus final single consonants (oral and nasal stops) in monosyllabic words of CV and VC structures in an English environment?

   (b) Do the obtained error frequency and error pattern by segment position vary in relation to segment class or segment type of the target consonant?

2. (a) What are the frequency and pattern of errors made by the same native Mandarin speaking adults in the perception of initial versus final single consonants (the same oral and nasal stops) in monosyllabic CV and VC nonsense words in an English context?

3. Do the error frequencies and patterns obtained in the production and perception of the before mentioned monosyllabic words reveal any relationship?

CHAPTER II

PROCEDURES

Subjects

Selection Criterion

The subjects were recruited so as to achieve as much uniformity as possible in age, field of study, and background in English as a Second Language. A further selection criterion required subjects to have normal hearing acuity.

Selection Procedure

In order to recruit subjects who met the criteria for the study, a survey of the Chinese population was done, with the help of the Chinese Student Association of Michigan State University. The president of the group agreed to enclose survey forms in the quarterly newsletters at the beginning of Fall term 1984. The questions on the form related to the selection criteria and the willingness of the person to participate in the study. Subjects were selected after the investigator reviewed the forms returned by 20 respondents. A copy of the survey form can be found in Appendix A.

The subjects' auditory acuity was screened for pure tones bilaterally at 250 - 500 - 1000 - 2000 Hz, and 20dB SPL per ASHA recommended level. All screening was conducted in an audiometric booth with a Tracoustics Audiometer.

Subject Characteristics

The subjects were three female and three male students from Taiwan, Republic of China, who were enrolled at Michigan State University at the time of the study. All subjects spoke only Mandarin-Chinese, however, Taiwanese could be understood by some. The subjects arrived in the USA during Fall 1983, a fact which places the duration of their US stay at about 17 months at the time of the study. The age range of the subjects varied from 24.1 to 29.11, with an average of 25.8 years.

The estimated total number of hours for studying ESL varied from 1200 to 3200, with an average of 2080 hours. Considering an academic year to include 40 weeks, those hours were calculated by multiplying the years of study by the hours per week. The subjects were exposed to and had communicated in English for at least 17 months at the time of the test.

Regarding judgements of their own communication ability in English, two subjects rated themselves as adequate enough to lecture to a group of students. Three rated themselves as having good proficiency, and the remaining one subject rated herself proficient enough to be understood.

The professional fields of study differed for all subjects and included Telecommunication, Communication, Advertisement, Mechanical Engineering, Computer Science and Marketing.

All subjects passed the Audiometric Pure Tone Screening Test at the 20dB SPL level in both ears.

Table 1

Overview of Subjects' Characteristics

Subject	Gender	Age	Major	Hours of ESL	Communication
1	F	27.0	Communication	1920	Sufficient
2	M	25.5	Computer Science	1680	Good
3	M	24.1	Mechanical Engineering	1600	Good
4	M	29.11	Marketing	3200	Lecture
5	F	24.7	Advertising	2880	Good
6	F	24.6	Telecommunication	1200	Lecture-Good

Materials

Overview of Tasks

The subjects were required to read individually a prestructured set of stimulus monosyllabic words under laboratory-like conditions. Their articulation of segments was judged by native speakers of English. This first task was labeled the production task.

In the same sitting, the subjects were required to listen individually to aurally presented structured monosyllables and to select the perceived item from a written list. This task was labeled as the identification task. Each task contained three presentations of the basic set of stimulus items, making a maximum of 108 items.

Description of Stimulus Items

The stimulus items were CV and VC syllables in which the consonants /p/t/k/m/n/ŋ/ were combined with one of the vowels /a/i/u/. Those vowels are present in both languages. The consonants /p/t/k/m/ occur in both English and Mandarin in syllable initial position but in final position in English only. The nasal /n/ occurs in both languages in both positions, and /ŋ/ occurs in both languages only finally. This would allow then to test for the hypothesis of the syllabic position of phonemes as a factor of influence in the occurrence of phonological interference.

Altogether 36 different syllables were created:

/pa/ta/ka/ma/na/ŋa/	/ap/at/ak/am/an/aŋ/
/pu/tu/ku/mu/nu/ŋu/	/up/ut/uk/um/un/uŋ/
/pi/ti/ki/mi/ni/ŋi/	/ip/it/ik/im/in/iŋ/

Carrier phrase

In both tasks the stimulus items appeared in the carrierphrase "say . . . again." The purpose of the carrier phrase was to allow for a closer approximation of the stimulus items in connected speech than would be possible when produced singly. The carrier phrase in this study was chosen in such a way that the phonetic environment of the target syllable would be as neutral as possible.

Rationale for Stimulus Choice

The stimulus consonants were chosen for several reasons, one of them being their syllabic position in English and Mandarin. In order to explore the influence of syllabic position of phonemes on the production and perception modes of performance, the study was in need of phonemes that are shared by both languages but differ in their syllabic distributions. The sounds /p/t/k/m/ satisfy this criterion: they occur initially in both languages but finally in English only. The nasal stop /n/ occurs in both positions in both languages. This distribution allows one to test the expectation that the error rate would not differ for the positions. Likewise, the nasal stop /ŋ/ is not expected to present much difference in error rate for the final position. Since /ŋ/ does not occur initially though, it would allow for testing the hypothesis that an unfamiliar phoneme distribution of the NL interferes with the production and perception of the according phoneme in the FL. Further, these six consonants span two articulatory classes: voiceless oral stops /p/t/k/ and voiced nasal stops /m/n/ŋ/. Since the places of articulation are related across the two classes /p-m/, /t-n/, /k-ŋ/, comparison at both the consonant class and segment levels was possible.

The vowels /a/i/u/ are shared by both languages. Further they are cardinal vowels and contrastively distinctive.

The next section will describe the data collection procedures for each task separately, after a brief overview of both tasks is given.

Data Collection Procedures

Overview of Tasks

The order of the 108 items was randomized separately for each task. Each subject participated in the study individually; no group testing was done. The order of accomplishing the production and identification within one and the same session was counter balanced.

The Production Task

Task Presentation

The subjects were required to read a list of stimulus items. The 108 stimulus items in the carrier phrase "say . . . again" were presented in written form to each subject. As shown in Appendix B, only the single stimulus syllables were written down, and the carrier phrase was presented in capital letters at the top of each page as a reminder.

The subjects read the stimulus items in an audiometric booth. The two rooms in the booth shared a window. The subject and the study leader were seated at a table in one room with the microphone (Model Ampex 2001) at a distance of six to eight inches from the subject's mouth. The production was taped in the adjacent room to reduce nonrelevant noises as much as possible.

For taping, a TEAC A-2340 4 channel SIMUL-SYNC Stereo reel-to-reel tape recorder was used. One subject per channel was taped on Scotch Magnetic Tapes 212 (45 min.) at a speed of 7 1/2 inches per second. Further, the chronograph function of a digital quartz watch of the brand Meister-Anker nr. 834.710-6 was used as a stopwatch.

The subjects were instructed to read the stimulus items in the carrier phrase column wise from the top to the bottom of the page. After each produced item, a three-second interval was held before the reading of the next item took place. To avoid rehearsal preparation for the next stimulus during this interval, the subjects were instructed to cover the item with a sheet of paper until the three seconds transpired. To indicate the end of the interval, a reading signal was given by the investigator. The signal consisted of a forward movement of the right hand.

To reduce the number of invalid responses due to unfamiliarity of the subjects with the task, a training set preceded the real task. The subjects received a test list with CV and VC syllables containing different consonants. Further, the set was identical to the genuine task. After practicing the reading of the items in the carrier phrase "say . . . again", the three-second-interval was introduced. When from the side of the project leader and the subject's side agreement was reached about the comprehension and the execution of the instructions, the original task was started.

The pre-task training was also used to adjust the loudness level of the input.

Judging the Production Responses

The judges were recruited among graduate students in the Department for Audiology and Speech Sciences. Knowledge and experience in phonetic transcription (IPA system) as required for the M.A. Degree for Speech-Language Pathology was the main selection criterion. In addition, hearing ability was required.

The three judges were all native Americans. One judge finished the M.A. Program for Speech-Language Pathology in August 1984 and was employed as a Clinical Fellow at the time of the judging. The two remaining judges were completing their last terms of graduate study for the M.A. degree in Speech-Language Pathology. All three judges had experience in phonetic transcription using the IPA system.

Their hearing ability was normal as screened bilaterally with the Program III Tracoustics Audiometer at the frequencies of 250 - 500 - 1000 - 2000 Hz, 20 dB SPL in both ears.

The judging took place in the same sound treated room in which the subjects' productions had been taped. The same tape recorder used for taping served for reproducing the taped speech (TEAC A-2340 4 Channel SIMUL-SYNC Stereo reel-to-reel tape recorder). To allow several people to listen to the tape at the same time, a headphone amplifier (HA 100) was connected with the tape recorder and the output fed to headphones binaurally. The intensity of the amplifier output was at a comfortable loudness level as judged by the listeners.. The judges received a list of the stimulus items in the same order as taped by the subjects on the recorder, as can be seen in Appendix C. Behind each word, space was allowed for the transcription and for rating the confidence of their judgments on a scale of one to three. The judges were instructed to do the following: to cover the stimulus word so any bias would be avoided, to transcribe only the target syllable by using the IPA system, to mark down special occurrences such as breaks and repetitions, and to rate the confidence of their judgment on the three-point rating scale. All this was to be done in the three-second-interval between one heard item and the next one. All three judges listened to the same subject at the same time, which resulted in three judgment lists per subject. The tapes were listened to only once without any break or repetition. A short break was held after the judging of two subjects in succession. The order in which the subjects were judged was randomly chosen.

All occurrences of a change in the target consonant, on which at least two of the three judges agreed, were considered as an error. Those items for which no agreement could be reached were considered indeterminant data and were excluded for data analysis. This explains the different n values that may occur among the six subjects. The scoring took place by deriving the percentage of the incorrect responses. The percentage was calculated by dividing the number of errors by the total number of responses.

The Identification Task

Task Presentation

The subjects were required to identify on a sheet stimulus items that were presented aurally.

Beforehand, a stimulus tape was prepared. The 108 items of the identification task were taped on a Scotch Magnetic Tape 212, with the help of a reel-to-reel tape recorder (A-2340, 4 channel SIMUL-SYNC

Stereo) at a speed of 7 1/2" per second. A microphone of the brand AMPEX 2001 was used. The speaker of the items was a native American speech-language pathologist who practiced the task individually and under guidance of the investigator before the actual recording took place. The three-second-interval, measured on site by the investigator, was maintained in between the items with the chronograph function of a digital quartz watch (Meister-Anker). The items were randomly ordered.

The 108 stimulus items were presented in the carrier phrase by audiotape. To allow for identification of the presented item, the subjects received a list, on which the target item was written plus two other possible syllables. Those other syllables consisted of the same vowel and two other consonants of the same consonant class. A copy of the identification form is available in Appendix D.

The subjects listened to the items in the silent room of the audiometric booth, in which their own production had been taped. In order to reduce the influence of environmental noises, a headphone of the AVID H brand was used while listening to the tape. The subjects were seated on a chair at a distance of about one meter from the tape recorder. They wrote on the small desk of their chair and were not in touch with the table on which the recorder was placed. The loudness level of the output was at a comfortable loudness level as judged by the listeners. The subjects listened to the tape one at a time.

The subjects were instructed to listen to the tape and to circle the item in the carrier phrase that they perceived. Further, the subjects were asked to indicate the confidence in their choice by checking the appropriate number on the rating-scale on the same form. To avoid invalid responses due to misunderstanding or incomplete understanding of the instructions, a trial test set preceded the actual task. The items of this set were the same in syllable structure as the study items but contained different consonants. The investigator read the trial items. The real task was begun only after appropriate responses to the test set.

Judging the Identification Responses

The judging determined the correct and incorrect identified items by comparing the items circled by the subjects with the list of items that were actually presented. Items that were not identified and those representing two choices were considered indeterminant. The scoring was based on the percentage of incorrect items. This percentage was calculated by dividing the number of incorrect responses by the total number of valid responses.

Data Analysis

Overview for Both Tasks

In both tasks the data that did not meet the judging criteria were considered indeterminant and excluded from the data-analysis. The data were analyzed for the production and identification tasks separately and after that compared across the tasks in order to find a possible relationship between them.

In all cases the data were presented in percentages of errors. The percentage of error was compared for initial versus final position and for each syllable position. The comparisons were extended to nasal and plosive segments considered individually and as a class. The parametric Pearson correlation coefficient statistic was applied to the data where appropriate.

The Production Task

The valid responses were analyzed in frequency rates of the errors from two different angles of view. The error rate of consonants in initial versus final position as well as the error rate of consonants per class (oral versus nasal) and segment were regarded. Finally, the analyzed data of the production task were compared with the data of the identification task in order to search for any relationship between the two.

The Identification Task

The valid data were analyzed according to two different points of view. At one hand the errors were compared to their occurrence in initial versus final position. At the other hand the errors were compared as consonant classes and segments oral versus nasal.

CHAPTER III

RESULTS

The purpose of the study was to explore the mode of performance and syllable position as factors of phonological interference. In particular, the initial versus final position of single consonants (oral and nasal stops) in the production and perception of CV and VC nonsense words were considered. Following the order of the three questions posed (see page 22), the results are presented in the order of the production and identification tasks respectively, followed by a section on the relationship between them. Performance on the production and identification tasks is examined in terms of error frequency and error pattern.

The Production Task

Error Frequency

In analyzing the changes on the target syllable, three major categories of errors were observed. One category included errors on just the target consonant in the syllable (on nasal or oral stops). A second category included errors on the target segment plus the surrounding vowel segment. A third category consisted of errors on just the vowel segment while the target consonant was articulated correctly. Since only the first and second error categories were of interest, the third category was not included in the analysis of the results.

Overall Error Frequency

Table 2 displays the percentages of error for both categories together and for categories I and II separately. The table reveals three main findings. First, more correct than incorrect responses were yielded. The percentages of correct responses varied from 76.64% for S_1 to 87.76% for S_6. Second, all subjects showed errors in both categories. Third, the error percentages varied among the subjects, ranging from 12.26% (S_6) to 23.36% (S_1). The actual number of errors can be derived from the error percentage. For instance, S_1 showed 23.36% errors on a total of 107 items. The number of errors would be 25 in this case. Across the subjects there was no systematic tendency for Category I errors to be larger than Category II errors. For example, S_1 shows 4.67% errors for Category I and 18.69% for Category II, whereas S_2 shows 10.48% errors for Category I and 3.81% for Category II. Therefore, the error categories were pooled in subsequent analyses.

Table 2

Overall Percentage of Error on the Production Task

	Subjects							
	S_1 n=107	S_2 n=105	S_3 n=103	S_4 n=102	S_5 n=108	S_6 n=106	Mean	Std.
Overall	23.36	14.29	22.33	16.67	20.37	12.26	18.21	4.5
Cat. I	4.67	10.48	14.56	14.71	6.48	9.43	10.05	5.92
Cat. II	18.69	3.81	7.77	1.96	13.89	2.83	8.16	6.68

The original intention to impose statistical treatment on the data was not carried out. Statistical treatment typically requires pooling of data, which would obscure the individual variability among the subjects as observed in this study.

<u>Error Frequency by Syllabic Position</u>

The question regarding the frequency and pattern of errors made in the production of syllable initial versus final oral and nasal stops is regarded in Table 3. Table 3 displays the error rate by syllabic position for each of the two segment classes. Inspecting the overall rate, one finds that errors were made in both positions. Half of the subjects (S_1, S_3, S_5) show more errors in final than in initial position. For example, S_1 shows 14.81% errors in initial position and 33.96% errors in final position. The remaining subjects show the reversed picture.

The distribution of errors in initial versus final position varied per class. For the plosives all errors occurring for the two subjects (S_1, S_4) that did make errors were in final position. S_1, for example, showed no errors in initial position but demonstrated 3.7% errors in final position. Similar observations can be made for S_4.

For the nasals a variety in distribution was found. Three subjects (S_1, S_3, S_5) show more errors on the final consonants than on the initials. S_1, for example, made 33.34% errors on initials and 53.85% of errors on the finals. Conversely, three subjects (S_2, S_4, S_6) made more errors on nasals in the initial than final position.

Table 3

Percentage of Error by Syllabic Position for Plosive and Nasal Production

	Subjects												Mean		Std.	
	S_1		S_2		S_3		S_4		S_5		S_6					
Segment Classes	in*	fin**	in	fin	in	fin	in	fin	in	fin	in	fin	in	fin	in	fin
	n=54	n=53	n=54	n=51	n=54	n=49	n=53	n=49	n=54	n=54	n=54	n=52				
Overall	14.81	33.96	14.81	13.72	14.81	30.61	16.98	16.32	16.67	24.07	14.81	11.54	15.48	21.70	1.05	9.27
Plosives	n=27	n=27	n=27	n=25	n=27	n=27	n=27	n=26	n=27	n=27	n=27	n=27				
	---	3.7	---	---	---	---	---	3.84	---	---	---	---	---	1.26	---	1.94
Nasals	n=27	n=26	n=27	n=26	n=27	n=22	n=26	n=23	n=27	n=27	n=27	n=25				
	33.34	53.85	29.63	23.08	29.63	68.18	34.62	30.43	33.33	48.15	25.93	20.00	31.08	40.60	3.27	19.12

*in = initial syllable position

**fin = final syllable position

More subjects made errors in the nasal class than in the plosive class. In both positions more errors occurred on nasals than on plosives. Tables 4 and 5 show that individual segments within each class did not contribute equally to the error distributions.

Error Frequency by Individual Segment

Table 4 shows the error rate overall and for the segments within the plosives class. It can be seen that /t/ is the only segment contributing to the error frequency and that the errors made all occur in final position.

Table 5 shows the error rate by syllabic position for the nasal class and segments. The distribution of errors in initial versus final position differs for /m/ and /n/ in contrast to /ŋ/. For /m/ and /n/ more errors occurred in final than in initial position. For example, the only subject who did make errors on /m/ did so in the final position. S_1 made no error on /n/ in initial position and 19.23% in final position. S_3 made 3.7% errors on /n/ in initial position and 27.27% in final position.

Table 4

<u>Percentage of Error by Individual Segment for Plosive Production</u>

	Subjects															
	S_1		S_2		S_3		S_4		S_5		S_6		Mean		Std.	
Segments	in* n=27	fin** n=27	in n=27	fin n=25	in n=27	fin n=27	in n=27	fin n=26	in n=27	fin n=27	in n=27	fin n=27	in	fin	in	fin
Overall	---	3.70	---	---	---	---	---	3.84	---	---	---	---	---	1.26	---	1.94
p	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
t	---	3.70	---	---	---	---	---	3.84	---	---	---	---	---	1.26	---	1.94
k	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

*in = initial syllable position

**fin = final syllable position

Table 5

Percentage of Error by Individual Segment for Nasal Production

	Subjects															
	S_1		S_2		S_3		S_4		S_5		S_6		Mean		Std.	
Segments	in* n=27	fin** n=26	in n=27	fin n=26	in n=27	fin n=22	in n=26	fin n=23	in n=27	fin n=27	in n=27	fin n=25	in	fin	in	fin
Overall	33.33	53.85	29.63	23.08	29.63	68.18	34.62	30.43	33.33	48.15	25.93	20.00	31.08	40.60	3.27	19.12
m	---	---	---	---	---	13.64	---	---	---	---	---	---	---	2.27	---	5.57
n	---	19.23	---	7.69	3.7	27.27	---	17.39	---	22.22	---	---	.62	15.63	1.51	10.02
ŋ	33.33	34.62	29.63	15.39	25.92	27.27	34.62	13.04	33.33	25.93	25.93	20.00	30.46	22.70	3.89	8.09

*in = initial syllable position

**fin = final syllable position

In contrast /ŋ/ showed errors for every subject. At least 13% of the responses were in error for each subject in both tasks. The distribution of errors in initial versus final position showed that three subjects (S_1, S_3, S_5) made more errors in final position. The remaining subjects showed the reverse. Since /ŋ/ does not occur in syllabic initial position in Mandarin, the error rate of /ŋ/ being high in this position is in the expected direction. Since /ŋ/ is the only segment prone to not occurring in syllable initial position, the high rate in this position may obscure the overall bias toward syllable final errors. Thus, comparison of positional effect without the segment /ŋ/ may give a better view of bias toward syllable final as opposed to initial error.

Table 6 displays the error rate by syllabic position for both classes in such a way that the influence of /ŋ/ on the overall bias towards more errors syllable final is revealed. It appears that five subjects (S_1 - S_5) made more errors in final position than in initial when /ŋ/ was excluded.

Table 6

__Percentage of Error by Syllabic Position With and Without /ŋ/ for the Production Task__

	Subjects												Mean		Std.	
	S_1		S_2		S_3		S_4		S_5		S_6					
	in*	fin**	in	fin	in	fin	in	fin	in	fin	in	fin	in	fin	in	fin
__Segments__																
all segments	n=54	n=53	n=54	n=51	n=54	n=49	n=53	n=49	n=54	n=54	n=54	n=52				
including /ŋ/	14.81	33.96	14.81	13.72	14.81	30.61	16.98	16.32	16.67	24.07	14.81	11.54	15.48	21.70	1.05	9.27
all segments	n=45	n=44	n=43	n=44	n=45	n=43	n=43	n=44	n=45	n=45	n=45	n=44				
excluding /ŋ/	---	15.91	---	4.54	2.22	25.58	4.65	6.82	---	15.56	2.22	---	1.52	11.4	1.88	9.35

*in = initial syllable position

**fin = final syllable position

Error Pattern

The error pattern refers to the distribution of errors in terms of the type of error. Table 7 shows the error patterns by syllabic position for both classes. Eight patterns were required to account for the errors across the subjects. There were three simple patterns (substitution, rearrangement, and addition), four combined patterns (substitution + addition, rearrangement + addition, deletion + addition, and rearrangement + substitution) and one miscellaneous pattern consisting of other combinations not mentioned above.

Table 7

Error Pattern by Class for the Production Task Displayed in Percentage

Sound Type	Position and number of errors	1 Subst	2 Rearr	3 Add	4 Subst and Add	5 Rearr and Add	6 Del and Add	7 Rearr and Subst	8 Misc
Plosives	Initial n=1	100.00							
	Final n=2	50.00			50.00				
Nasals	Initial n=50	60.00			10.00	28.00			2.00
	Final n=55	45.45	3.64	9.09	18.18	7.27	3.64	1.82	10.91

The variation of patterns by syllable position appeared to be a function of segment class. The segment classes showed similarities and differences. Similarity was found in the observation that twice as many patterns were required to describe the errors in final position. The plosives needed two classes for the final position as opposed to one in the initial. The nasals required eight classes to cover final errors as opposed to four for initial errors. The difference was observed in the quantity of error patterns. For both positions, more patterns were required for the nasals than for the plosives.

The most prevalent error pattern by position across the segment classes appeared to be substitution. Appendix E provides a table that refers to the number of subjects participating per error pattern.

The Identification Task

The analysis of the results in this section focuses on the second research question, which considered the identification by syllabic position of consonants in monosyllabic nonsense words. The results are presented by error frequency and error pattern.

Error Frequency

The nature of this task yielded responses that were judged to be right or wrong. The subjects circled one item that either matched or did not match the spoken item. Criteria for error counting are described on page 34.

Overall Error Frequency

Table 8 displays the overall frequency of errors for each subject. All subjects made errors, though the frequencies vary. The scores ranged from 7.41% (S_6) to 18.86% (S_1).

Table 8

Overall Percentage of Error on the Identification Task

	Subjects S_1 n=106	S_2 n=104	S_3 n=90	S_4 n=108	S_5 n=107	S_6 n=108	Mean	Std.
Error Percentage								
Errors	18.86	16.35	14.44	13.89	10.28	7.41	13.53	4.13

Error Frequency by Syllabic Position

A major goal of this study was to consider errors as a function of initial versus final position.

Table 9 displays the error frequency by syllabic position overall and for each segment class. A view on the overall frequency reveals that errors were made in both positions. One subject (S_6) did not show a preference for errors in a certain position. The remaining subjects made more errors in favor of the final position.

The distribution of errors in initial versus final position varied per class. For the plosives all errors occurring for the three subjects that did make errors (S_1, S_3, S_6) were made in final position. S_1, for example, demonstrates no errors in initial position but 4.0% in final position. Similar observations can be made for S_3 and S_6. For the nasals the distribution of errors by syllabic position varied. Five subjects (S_1 –S_5) favored the final position. S_1, for example, made 25.92% errors in initial position and 44.44 in final position. The remaining subject (S_6) did the reverse, as can be seen in the 14.81% errors for the initial position compared to the 11.11% in

Table 9

Percentage of Error by Syllabic Position for Plosive and Nasal Identification

	Subjects												Mean		Std.	
	S_1		S_2		S_3		S_4		S_5		S_6					
Segment Classes	in*	fin**	in	fin	in	fin	in	fin	in	fin	in	fin	in	fin	in	fin
	n=54	n=52	n=54	n=50	n=45	n=45	n=54	n=54	n=54	n=53	n=54	n=54				
Overall	12.96	25.00	12.96	20.00	11.11	20.00	5.56	22.22	9.26	11.32	7.41	7.41	12.04	17.67	5.82	6.80
Plosives	n=27	n=25	n=27	n=27	n=27	n=27	n=27	n=27	n=27	n=27	n=27	n=27				
	---	4.00	---	---	---	3.71	---	---	---	---	---	3.71	---	1.90	---	2.09
Nasals	n=27	n=27	n=27	n=23	n=27	n=27	n=27	n=27	n=27	n=27	n=27	n=27				
	25.92	44.44	25.92	43.48	51.85	59.26	11.11	44.44	18.52	25.93	14.81	11.11	24.69	38.11	14.57	16.93

*in = initial syllable position

**fin = final syllable position the final position.

in the final position. It seems, thus, that the trend in the distribution of errors by syllabic position is similar for plosives and nasals.

More subjects made errors in the nasal class than in the plosive class. In both initial and final position, more errors were observed for the nasals than for the plosives.

Tables 10 and 11 show the unequal distribution of the individual segments to the error distribution.

Error Frequency by Individual Segment

Table 10 displays the error frequency by syllabic position overall and for the segments within the plosives class. The three subjects (S_1, S_3, S_6) that did make errors did so only in the final position. The segments /t/ (for S_1 and S_6) and /p/ (for S_3) were the contributing segments.

Table 11 shows the error frequency by syllabic position for the nasal class and segments. The distribution of errors in initial versus final position showed a difference for /m/ and /n/ in contrast to /ŋ/. The differences were found in the higher error frequency for /ŋ/ in initial position as compared to /m/ and /n/ and in the larger number of subjects who made errors in initial position. For /m/ more errors were observed in final position for the four subjects that did make errors (S_1 -S_4). For example, S_1 made no errors on /m/ in initial position but identified 7.4% of the items in final position incorrectly. The same trend of favoring errors in final position is observed for five of the six subjects who made errors on /n/ (S_1, S_2,

Table 10

Percentage of Error by Individual Segment for Plosive Identification

	Subjects															
	S_1		S_2		S_3		S_4		S_5		S_6		Mean		Std.	
Segments	in* n=27	fin** n=25	in n=27	fin n=27	in n=27	fin n=27	in n=27	fin n=27	in n=27	fin n=27	in n=27	fin n=27	in	fin	in	fin
Overall	---	4.00	---	---	---	3.71	---	---	---	---	---	3.71	---	1.90	---	2.09
p	---	---	---	---	---	3.71	---	---	---	---	---	---	---	0.62	---	1.51
t	---	4.00	---	---	---	---	---	---	---	---	---	3.71	---	1.29	---	1.99
k	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

*in = initial syllable position

**fin = final syllable position

Table 11

Percentage of Error by Individual Segment for Nasal Identification

	Subjects															
	S_1		S_2		S_3		S_4		S_5		S_6		Mean		Std.	
Segments	in* n=27	fin** n=27	in n=27	fin n=23	in n=27	fin n=27	in n=27	fin n=27	in n=27	fin n=27	in n=27	fin n=27	in	fin	in	fin
Overall	25.92	44.44	25.92	43.48	51.85	59.26	11.11	44.44	18.52	25.93	14.81	11.11	24.69	38.11	14.57	16.93
m	---	7.40	---	8.70	---	11.11	3.71	14.81	---	---	---	---	.62	7.0	1.51	5.98
n	---	3.71	3.71	21.74	22.22	18.52	---	11.11	---	3.71	---	3.71	4.32	10.42	8.89	8.12
ŋ	25.92	33.33	---	13.04	29.63	29.63	7.40	18.52	18.52	22.22	14.81	7.40	16.05	20.69	11.15	9.82

*in = initial syllable position

**fin = final syllable position

S_4, S_5, S_6). For example, S_4 made no errors on /n/ syllable initial but misidentified 11.1% of the items with /n/ syllable final. Only S_3 showed 22.22% of errors for /n/ in initial position, and 18.52% in final position.

In contrast, /ŋ/ showed higher error frequencies for errors made in initial position than in final position. Comparison of the error frequency for /m/, /n/, and /ŋ/ reveals for S_4 values of respectively 3.71%, 0%, and 7.4%, for example. Further, five subjects made errors on /ŋ/ final (S_1, S_2, S_4, S_5) as opposed to two on /n/ initial (S_2, S_3) and one on /m/ initial (S_4). The distribution of errors in initial versus final position showed that four subjects (S_1, S_2, S_4, S_5) made errors that favored the final position, that S_6 showed a reversed result, and that S_4 showed no preference for either position. Since /ŋ/ does not occur syllable initial in Mandarin, the high error rate in this position is according to the expectations. This high error frequency for /ŋ/ though may obscure the overall bias towards more errors in final position. Thus, comparison by syllabic position without the segment /ŋ/ may reveal a different view on the distribution of initial versus final.

Table 12 displays the error rate by syllabic position for the two classes combined with and without /ŋ/. All subjects favored errors in final position and that three subjects (S_1, S_5, S_6) made no errors in initial position when /ŋ/ was excluded. For the remaining subjects (S_2, S_3, S_4) who made errors in initial position, the frequency dropped.

Table 12

Percentage of Error by Syllabic Position With and Without /ŋ/ for the Identification Task

	Subjects												Mean		Std.	
	S_1		S_2		S_3		S_4		S_5		S_6					
Segments	in*	fin**	in	fin	in	fin	in	fin	in	fin	in	fin	in	fin	in	fin
all segments	n=54	n=52	n=54	n=50	n=45	n=45	n=54	n=54	n=54	n=53	n=54	n=54				
including /ŋ/	12.96	25.00	12.96	20.00	11.11	20.00	5.56	22.22	9.26	11.32	7.41	7.41	12.04	17.67	5.82	6.80
all segments	n=43	n=45	n=45	n=41	n=40	n=40	n=45	n=45	n=45	n=45	n=45	n=45				
excluding /ŋ/	---	8.89	2.22	17.07	2.50	10.00	2.22	15.56	---	2.22	---	24.44	1.57	13.03	1.27	7.70

*in = initial syllable position

**fin = final syllable position

Error Pattern

The error pattern refers to the distribution of errors in terms of the type of error. Because of the nature of the identification task, which required indication of the perceived item on a list with choices, the possible error responses allowed for analysis of substitution patterns only.

Table 13 shows the substitution patterns by class and segment. The variation of patterns by syllable position appeared to be a function of class. Similarities and differences were observed for both classes. Similarity was found for the distribution of substitution frequencies in initial versus final position. More errors were made in final position in both classes. For the plosives substitutions were found only in final position. For the nasals six substitutions occurred in final position, whereas four occurred in initial position.

Differences were observed in the variability of substitutions and in their distribution by syllabic position. The plosives showed for each involved segment only one other segment substituted. For example, /p/ was only substituted by /k/ but not by /t/. The nasals in contrast showed for each involved segment two other segments as a substitute. For example, /m/ has been substituted by /n/ as well as by /ŋ/. The difference in distribution of the error patterns by syllabic position showed no substitutions in initial position for the plosives. The nasals showed substitutions in initial position for four of the six possibilities.

Table 13

Error Pattern by Class for the Identification Task Displayed in Percentage

Sound Type	Sound Confusion and # of errors	Position Initial	Final
Plosive	p --- k* n=1	---	100.00
	t --- k n=3	---	100.00
Nasal	m --- n n=9	20.00	80.00
	m --- ŋ n=5	---	100.00
	n --- m n=4	50.00	50.00
	n --- ŋ n=11	---	100.00
	ŋ --- m n=9	55.56	44.44
	ŋ --- n n=38	60.53	39.47

*p --- k should be read as p is substituted by k.

Inspection of the error pattern frequencies by syllabic position reveals a higher rate on /m/ final and /ŋ/ initial as could be expected. For /n/ only the even rate on /n/ ---- /m/ would be according to expectation.Appendix F provides a table displaying the number of subjects participating per error pattern.

The Relationship Between Production and Identification

The third question for this study considered the relationship between the performance in production and identification of initial versus final oral and nasal stops.

Figure 1 displays production and identification errors graphed by syllabic position separately for each subject. Each figure shows the error rate in percentage on the vertical axis, and the phonemic segments on the horizontal axis. For each subject, the error frequencies for the initial position are displayed in the left figure, and those for the final position in the right figure.

<u>Relationship by Syllabic Position</u>

An overall inspection of the figures reveals that the relationship between production and identification depends on syllabic position. For initial position high and uniform correlations between the two modes were observed across all subjects. The correlation coefficients varied from a high of r=1.0 for three subjects (S_1, S_5, S_6) to a low of r=.84 (S_3). The uniformity of the curves was observed in terms of the rank order by segment class, and is noticeable in the nasal segments, which were most frequently in error. Note that the segment /ŋ/ had the highest error frequencies on both tasks, followed respectively by /n/ and /m/.

The nice uniformly high relationship between production and identification performance for initial segments contrasts with the variable relationship for final segments. Variability was observed for the correlation rates and for the uniformity of the curves. The

S_1

S_2

S_3

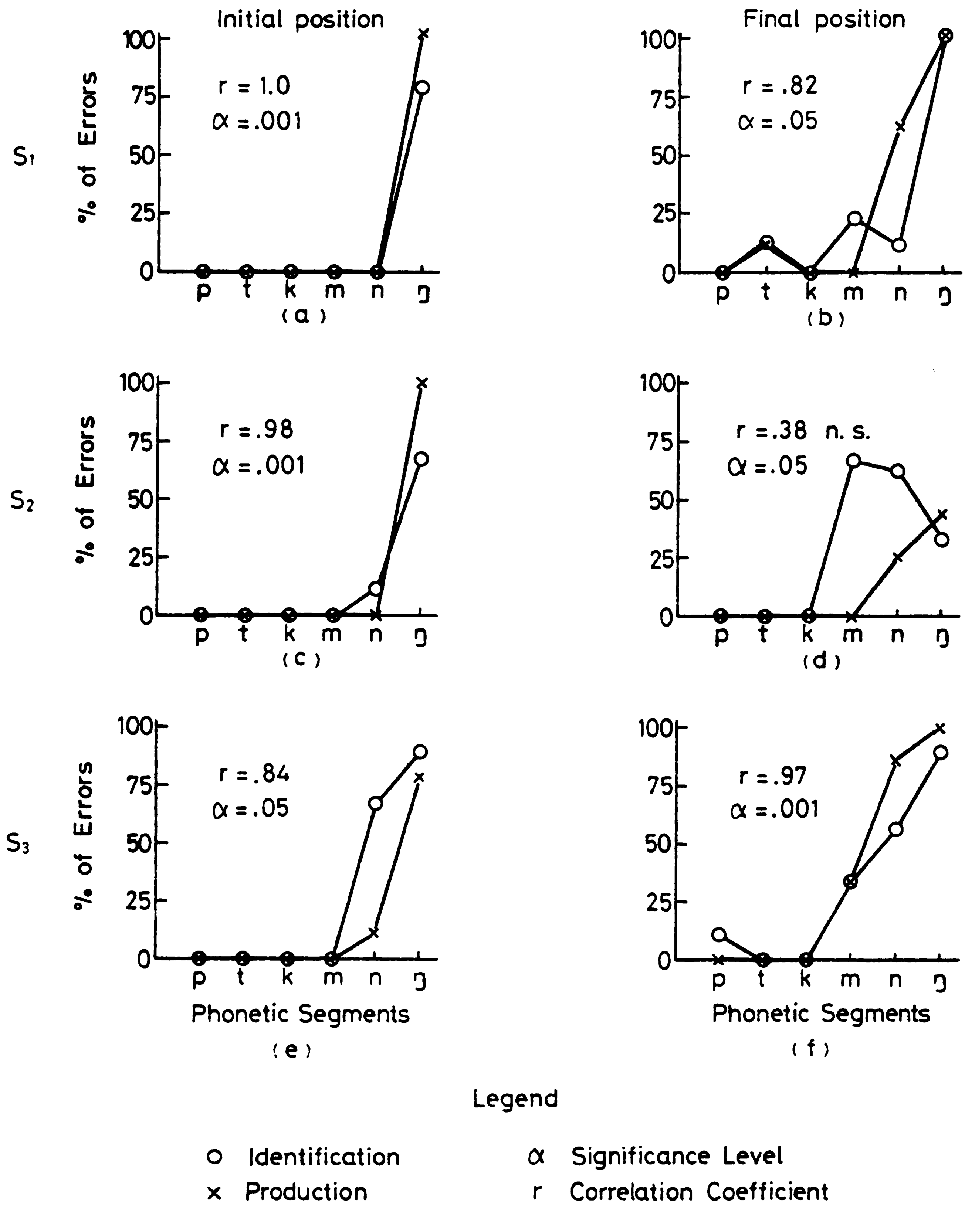

Figure 1. The Relationship By Syllabic Position Between The Error Percentage Of The Production And The Identification Task

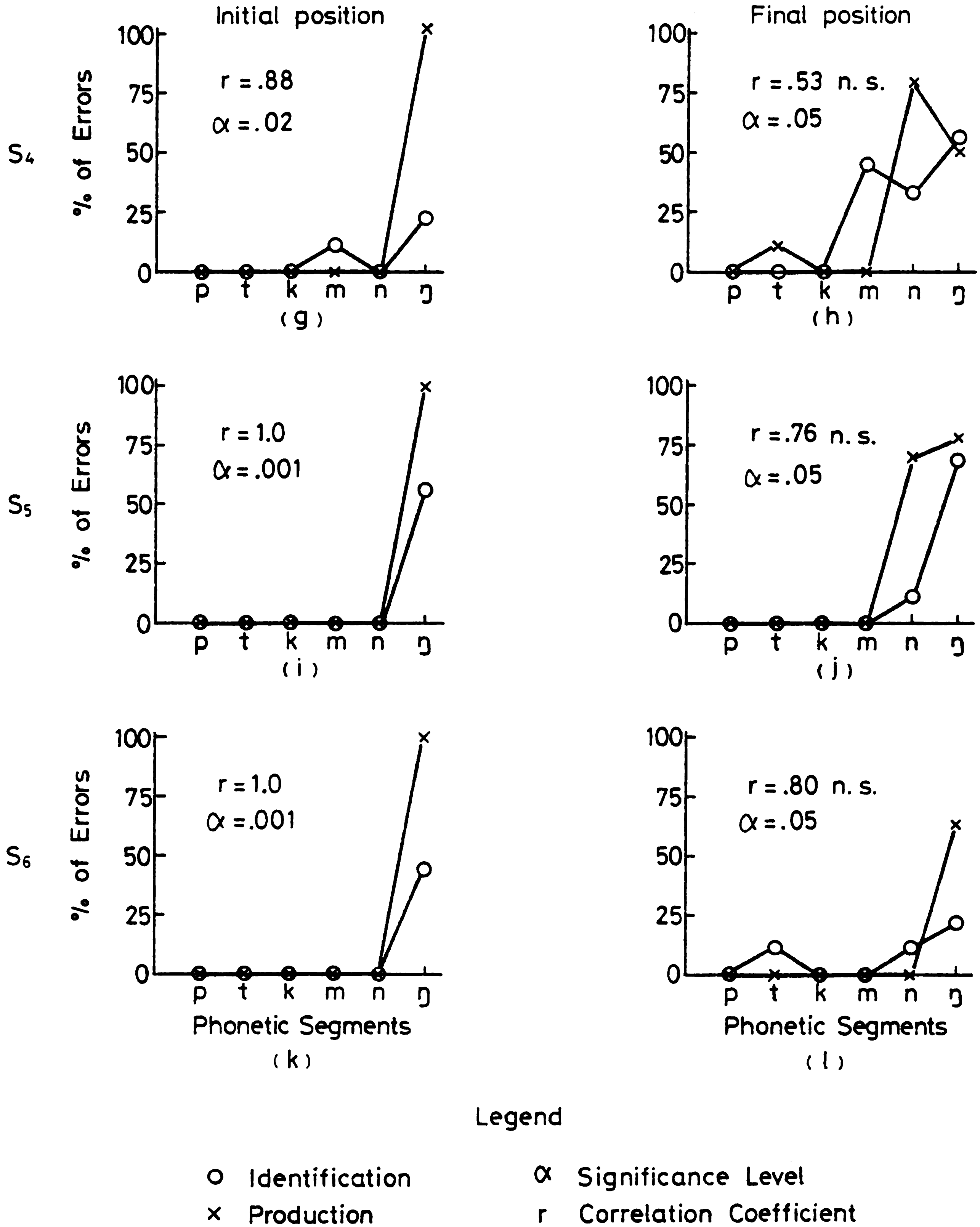

Figure 1. Continued

correlation curves varied from a high of r=.97 for S_3 to a low of r=.38 for S_2. Four of the correlation coefficients did not reach significance at the .05 level, which would require a minimal coefficient of r=.81.

Variability in the uniformity of the curves was observed in two ways. First, variability of the correlation curves across the subjects manifested itself in the different participation of the subjects in the both involved segment classes. For instance, S_1 in Figure 1b made errors in both tasks on /t/n/ŋ/, whereas S_2 in Figure 1d made errors in both tasks on /n/ŋ/.

Second, the preference for errors in one task to another varied across the subjects. S_1, for example, showed in Figure 1b no preference for a certain mode in errors on /t/and /ŋ/, more errors in identification for /m/, and more errors for production on /n/. Only S_5 in Figure 1j showed consistently more errors on production than on identification for all involved segments.

Comparison of the correlation curves for both tasks by syllabic position for each subject revealed that the height of correlation in one position does not necessarily imply a corresponding height in the other position. Subjects 2, 4, 5, and 6 showed high correlation rates in initial position but nonsignificant coefficients in final position. Contrastively, S_3 who showed a coefficient of r=.84 at α=.05 in initial position, reached a r=.97 at α=.001 in final position. Further, a tendency towards more errors in one mode for initial position is not necessarily followed by the same tendency in final position. Only S_5 (Figure 1i-j) favored errors on production in both positions. The findings as described above suggest a dependency of the relationship between the two modes of performance on syllabic position.

Relationship by Segment Class and Type

Uniformity by Syllabic Position Across Subjects

In the initial position, much uniformity was observed for the plosives in such a way that no errors were made in both tasks. The correlation for the nasals showed uniformity across the subjects for /m/ and /ŋ/. On /m/, five subjects (S_1, S_2, S_3, S_5, S_6) made no errors in both tasks. On /ŋ/ all subjects made errors on both tasks. Five of the subjects (S_1, S_2, S_3, S_5, S_6) showed a higher error percentage for the production task than for the identification. Less uniformity on error correlation for the modes of performance across the subjects was demonstrated for /n/. Four subjects (S_1, S_4, S_5, S_6) showed no errors on /n/ for both tasks, whereas S_2 and S_3 showed errors for at least one task. In the final position less uniformity was noticed for the relationship between the two modes of performance across the subjects. Errors were made in both segment classes by four subjects (S_1, S_3, S_4, S_6). Three of these subjects (S_1, S_3, S_6) showed a preference for more errors in perception than in production, whereas S_4 showed more errors in production. These results suggest a dependency of the correlation between the modes of performance on segment class.

<u>Uniformity by Syllabic Position Within Subjects</u>

In the initial position, uniformity within the subjects could only be inspected for the subjects who had more than one segment involved (S_2, S_3, S_4). Only S_3 (Fig. 1e) showed consistent preference for more errors in one mode as opposed to S_2 and S_4, who favored more errors in a certain mode depending on segment (Figures 1c and 1g).

In the final position only one of all subjects (S_5) showed consistently more errors for production than for identification (Figure 1j). The remaining five subjects showed inconsistent preference for one mode to another. These findings suggest a dependence of the relationship between the two modes of performance on individual segments and on individual subjects. This dependency tends in initial position towards more errors on the production task, whereas no consistent preference for any task is found in final position.

CHAPTER IV

DISCUSSION AND IMPLICATIONS

Purpose of the Study

The purpose of the study was to explore syllabic context of phonemes and mode of performance as factors in phonological interference. Interference was defined as a result of language contact, manifesting itself in the occurrence of elements, characteristics, and rules in one language that belong to another language. The questions posed in the study regarded the difference in error rate for phonemes in initial versus final syllabic position. The influence of syllabic position was tested in both the production and identification mode of performance in order to learn about their relationship. Further, a possible relationship between error rate at one side and segment class and type of the phonemes at the other side was regarded. The studied phonemes were oral and nasal stop consonants combined with the three cardinal vowels.

Summary of the Results

The results showed for both production and identification more correct than incorrect responses. More errors were observed for the nasals than for the plosives.

For most of the subjects a positive effect on the initial versus final bias was observed, with slightly higher evidence for the identification task.

Correlation was observed between error rate at one side and segment class and type at the other hand. The class of the plosives appeared to be less in error rate involvement, participating subjects, and involved segments. The nasals showed a high error rate overall and per segment, more participating subjects, and involvement of all segments.

Occurrence of errors appeared to be highly related in the production and identification tasks in such a way that errors occurring on items in one task were very likely to occur in the other task. For errors made in only one mode of performance, no bias towards a certain mode could be observed. High and uniform correlation between the two modes was shown in initial position, as opposed to the variable correlation for performance in final position. The relationship between the production and perception mode of performance seemed to depend on syllabic position of the phonemes, segment class and type, and individual subjects. The discussion examines those findings in terms of the inconsistency of the bias towards more errors in final position and the higher involvement of nasals than of plosives. The questions will be discussed in this order.

Discussion of the Results

Inconsistency of the Initial Versus Final Effect

Three main factors may have played a role in the observed inconsistency of the initial versus final effect across and within the subjects. The factors relate to the linguistic theory about phonological interference, to the task, and to the subjects. They will be regarded in this order.

<u>Factors Related to the Linguistic Theory</u>

The way contrastive analysis approaches phonological interference implies a static nature of the phenomenon. This would mean that a FL learner's pronunciation as measured at a certain point in time would not be subject to change. Much of the literature describes phonological interference in this way (Sumuktu, 1957; Saunders, 1962, 1969; Aziz, 1973; Roy, 1975; Jackson, 1981; Mirhassani, 1983). In the last two decades, though, transfer is more and more considered as a dynamic process. It is explained that mastering of new structures in the FL will start with performances close to structures in the NL. Gradually, the performances will get closer to the structure of the FL. Authors like Van Teslaar (1965), Dickerson (1976), and Flege (1980) apply this version of transfer to the phonological level. Dickerson (1976) studied sound changes within the same language group, concluding that the phonological acquisition of a FL learner resembles the sound acquisition process of a NL learner within his NL. Van Teslaar (1965) and Flege (1980) apply the theory directly to the acquisition of new phonological structures in FL learning. In this vision on transfer, interference reflects a temporary stage in the acquisition of a new phonological system. Application of this view to the subjects and the results of this study would explain the differences within and across the subjects as different stages within the process of transfer.

Factors Related to the Task

The nature of the production task very likely had an influence on the responses. Wilson and Møllergård (1981) and Chen (1976) mention the differences between single word reading, sentence reading, prose reading, and spontaneous speech for the production of speech. From single word reading to spontaneous speech there is a gradual shift from focusing on form to focusing on content. When more content comes in, less energy, time, and concentration can be given to the pronunciation. Conversely, where less content exists, more attention can be given to the form. The latter condition, then, may explain the results of the study. Recall that the production task in this study was a highly structured sentence reading task with many nonmeaningful stimulus items. Consequently, it is possible that because of the reduced meaning of task, the subject's awareness of the motor act was increased. The nature of the stimuli may also have influenced the performance in both tasks. The CV and VC syllable structures are very basic in all languages (Jakobson, 1968) and might have been too simple to evoke a more consistent initial versus final effect than they did.

The presentation of the stimuli may have had impact on the results as well. The three-second-interval in the production task may have allowed for increased awareness of the motor act. The simple and ever returning carrier phrase might have provided a context so ideal that it reduced the error rate.

A last factor of influence related to the task could be orthography. Although many languages make use of the same Latin alphabet, the pronunciation of the same letters may vary among the languages. An example would be the letter z, which is used for the sound combination /ts/ in German but pronounced /z/ in English. The NL of the participating subjects in this study does not make use of single letters to form written words but uses characters for writing. One of the implications is that sounds occurring in the NL are not always recognized as such in a letter orthography system as the Latin alphabet. In this way the English spelling may have influenced the results on both tasks. Sumuktu (1957), Wilson and Møllergård (1981), and Mirhassani (1983) reported orthographic influence in their studies and descriptions on the production of ESL for students with several language backgrounds (resp.Sundanese and Javanese; Norwegian; Iranian).

Factors Related to the Subjects

Although the main selection criterion considered uniformity of the subjects' backgrounds, there still remain factors that could not be controlled in the framework of a study like this. One of the factors is the language background of the subjects in the country of origin. The teacher's pronunciation, for example, may have influenced the subjects' present performances in the FL. The emphasis on ESL for reading or speaking purposes may have a strong impact on fluency and pronunciation in the FL. If emphasis is placed on speaking skills, the amount of practice in speaking ESL could have been a factor. Although all subjects reported to speak only Mandarin, it should be taken into consideration that in Taiwan several dialects are frequently used for communication. These dialects have their own phonological structures, that differ in many cases from Mandarin. In this way they may have influenced the production of Mandarin from other speakers and so the perception of the subjects. Examples would be the presence of the final consonants /p/t/k/ in implosive form in Hokkien and the /m/ (Tay, 1969), or the interchangeability of final /n/ and /ŋ/ in the Shanghai dialect (Shen, 1953). Another possibility is that Mandarin was used as a second language by both parents, since their own dialects differed too much to allow for communication. Traits of their dialects might have occurred in their Mandarin and have passed to their offspring, thus influencing perception and/or production of their offspring's Mandarin.

Another factor might be the different language experience in English related to the field of study in the USA. The requirement for a certain level of English varies across professional fields and consequently during training. For example, majors such as communication, telecommunication, advertisement and marketing might emphasize speaking skills more than the majors of computer science and mechanical engineering do. Related to the major areas of study might be the personal tendency towards speaking. Maybe students in the first four mentioned fields of study tend to speak more than students in the remaining areas. For this study this explanation does not seem to hold though. Subjects from the more mechanical areas of study did not consistently show higher error percentages than the subjects from other fields of study.

A third factor, related to the subjects, concerns the individual differences in a broad way. Strevens (1973) and Flege (1980) in their studies on pronunciation in SLA mention the physical aspect of pronunciation. The individual difference in physical-motor skills might have influenced the subjects to respond to the task differently. For some of them, physical abilities might have been too sophisticated for the task or not sophisticated enough. The same would hold for the different perceptual skills of the subjects.

Further the motor-cognitive make-up is very likely to differ per subject and thus to influence difference in results. Suter (1976) and Tahta, Loewenthal and Wood (1981) found that the language spoken at home influences the pronunciation in the FL. This would imply that students who spoke Mandarin most of the time would be likely to score higher error rates than those who spoke more English. A factor like this went beyond the scope of this study. The same holds for the mental and social influences on the pronunciation as mentioned by Sapir (1927) and Strevens (1973).

Also hard to control within the scope of this study was the awareness-level of the phonemic importance of final consonants which is indicated as a factor by Shen (1959). According to Suter (1976) in his study on pronunciation accuracy, two more factors are of importance: the speaker's concern about his pronunciation as having a great impact and the ability for oral mimicry. Those factors were not regarded in this study.

Higher Error Frequency for Nasals Than for Plosives

According to the contrastive analysis approach, more errors would be expected to occur in the FL on phonemes in a certain position that do not occur in that position in the NL. For the phonemes and positions as used in this study it would mean that more errors would be expected on /p/t/k/m/ in final position, since they do not occur finally in Mandarin. Further, it would be expected that /n/ would show no difference in error rate since it occurs in both positions in Mandarin. Finally, /ŋ/ would be expected to show a higher error rate in initial position since it does not exist initially in Mandarin. The results, though, showed fewer errors and participating segments for the plosives in final position than for the nasals. The /k/ showed no errors at all for both tasks, the segments /t/ and /p/ showed a low rate of errors in the perception task, and on /t/ only errors in the production task occurred. Contrastively, all nasal segments were affected on both tasks in one or both positions.

Although errors were biased toward final position as expected, more errors were found on nasals than on plosives. This differential error rate by segment class contrasts with the prediction of contrastive analysis (See pages 19-21).

Reasons for the higher error rate on nasals might be found in the different acoustic properties of the two phoneme classes and in the multilingual communication situation on Taiwan. The different acoustic properties may only account for the errors on perception.

Liberman et al. (1963) studied the role of consonant-vowel transitions in the perception of plosive and nasal stop consonants. They described the importance of the transition between consonant and vowel, especially in the second formant, as a cue to the perception of place within the classes of oral and nasal stops. The second formant cue appeared to be less effective for the nasals though. This might explain the difference in error rate between the nasal and oral stops as observed in this study.

Malécot (1963) studied acoustic cues for nasal consonants. A nasal resonance functioned primarily as a class marker, and only secondarily as placemarker, mainly in final position. He noted that the /m/ resonance differed from /n/ and /ŋ/ for which the resonances appeared similar. This might explain the unexpected high error rate on final /n/ and /ŋ/ in the perception task. The high error rate on /n/ final is also observed by Riekert and Swennen (1984) in their study on speech problems in Vietnamese and Chinese speaking Dutch.

The multilingual situation in Taiwan, might also help to explain the results. A possible explanation for the lower than expected error rate for the plosives and /m/ in final position might be found in the syllable structure of the widely spoken Taiwanese dialect (also referred to as Hokkien, Fukienese, Amoy or Southern Min-dialect) which exhibits those phonemes in word final position, /p/t/k/ in unreleased form though (Tiee, 1969; Tay, 1970). As discussed before the subjects might have developed an unconscious awareness of phonemic values of final consonants in hearing Taiwanese although not speaking it themselves. Further, the Mandarin spoken in Taiwan might bear influences from Taiwanese also in regard of phonological structure. The error rates on /n/ and /ŋ/ in final position were higher than expected on both tasks. It was observed that those phonemes were confused with each other in this position.

According to Shen (1976), /n/ and /ŋ/ are interchangeable in the Shanghai dialect. This study did not include data about the subjects' parents' language background and therefore can relate this information only as a possibility to the obtained results. Another possibility might be the existence of some assimilation rules in spoken Mandarin which reduce the phonemic distinction between final /n/ and /ŋ/ in certain contexts.

The Relationship Between Production and Identification

Whereas the constrastive analysis hypothesis regards the production mode of performance in phonological interference extensively, the perception mode of performance is not mentioned at all. One is led to assume a symmetrical relationship between the two modes. The results of this study show indeed a strong relationship between production and identification errors though the relationship is stronger for initial than final position. Especially for the initial position, a strong uniformity is observed in class and segments that are involved in the error rate, thus favoring the assumption of symmetry as predicted by contrastive analysis. However, the picture seems more complex for phonemes in syllable final position.

More nonsignificant correlation coefficients occur, and those that are significant look less uniform than their counterparts in initial position. No consistent preference for more errors in production or perception can be observed within and across the subjects. Further, there is not much uniformity in class and segments that participate in the error rate. Some subjects show involvement of all segments, some of only a few segments.

It would follow, then, that the relationship between production and perception seems to depend on syllabic position, segment class and type, and individual subjects. The discrepancy between the modes provides clues for the learning process. For the initial position, the error bias towards production would suggest that correct perception does not necessarily imply correct production. This supports the generally accepted vision of perception preceding production.

This vision is used in SLA for perception defined as language comprehension or language input as opposed to language production. Perception at the phonological level has been less considered in SLA. Those studies that have been done on phonological acquisition are not always in agreement with the vision on the relationship between production and perception as used in SLA.

Goto (1971) and Sheldon and Strange (1982) studied identification and production of /l/ and /r/ in English words for Japanese adult students. Their findings showed an overall better production than identification performance of the target phonemes. Catford and Pisoni (1970) conducted an experiment to describe the efficacy of articulatory versus auditory training of foreign sounds. Their findings showed a better performance of the students in the articulatory group for production as well as for identification of the target sounds than for the auditorily trained subjects. In this study, the observation of the relationship between perception and production of phonemes in final position seem to be consistent with the findings of the above cited studies.

The results would advocate that besides unidirectional support from perception to production, mutual support between the two modes of performance should be regarded as a clue on FL phonological acquisition. The results further suggest that intensity and form of the relationship between production and perception are related to segment class and type.

Limitations of the Study

The main limitations of this study that reduce the generalization possibility of the results are related to the selection of the subjects and to the nature of the tasks.

Since the subjects were not randomly chosen but rather chosen according to certain selection criteria (language background and experience, age, etc.), they do not represent the overall population of English-speaking Chinese with Mandarin as NL. It follows that the results in this study can only be generalized to subjects with similar characteristics. Further, the number of subjects is very small, which means that even to a population with similar characteristics the results should be generalized with caution.

The nature of the task also can be considered as a limitation. Both tasks were highly structured and did not have a direct relationship with daily-live performance. Examples are the use of pure monosyllabic stimulus items, a three-second-interval between the readings, the very controlled phonological context in the form of only one carrier phrase, and the orthographic presentation of both tasks. For the identification task , it can be added that only one native American-English speaker had to be identified, whereas identification of more speakers and of the subjects' own productions had not been taken care of.

Further, no comparison is made with the performance of native speakers. The literature shows that even for NL speakers errors tend to occur more often in initial than final position. Therefore, in this study it cannot be separated out how much the error bias towards final position is due to phonological interference and how much may be due to the inherent perceptual-motor differences between syllable initial and final position.

Finally, analysis of the adjacent vowels could supply further information on the segmental differences in error rate.

Implications for Practical Purposes

Information about syllabic position as a factor in phonological interference and about the relationship between production and identification of phonemes in FL acquisition has direct practical implications for both teachers of ESL and speech-language pathologists.

Knowing that not only unfamiliarity with a phoneme but also the unfamiliar position of a known phoneme may cause differences in perception and production shifts the emphasis from training of only new phonemes to training of phonemes in new contexts. Knowledge about phonological acquisition that considers mastering of phonemes in context would lead to stressing the teaching of sounds in context instead of as single phonemes.

Being informed about the asymmetrical relationship between production and identification would lead one to consider both perception and production aspects in teaching pronunciation. It would be realized that development of one of the modes could stimulate development of the other mode of performance.

For speech-language pathology, knowledge as described before is of great importance in order to distinguish correctly between errors as a result of phonological interference and those resulting from speech disorders.

Implications for Future Research

Closely related to the learning of a FL is the phenomenon of interference. Phonological interference is just one part of the phenomenon, but it has direct impact on the communication skills. Since societies nowadays require more and more multilinguality, it will be worthwhile to continue research on phonological interference. The research should also include aspects such as the role of syllabic distribution of sounds in perception and production on segment class and type. Implications of this study for future research would be related to the selection of subjects and the nature of the task.

In regard to the selection of subjects, subsequent studies on phonological interference could consider to select a larger population and/or a population exhibiting more variety in background (lingual, educational, social, vocal) and age in order to collect data that could be applied to the whole population of native Mandarin speakers who speak ESL.

The nature of the task could be adapted in several ways, depending on the focus of the further research projects. More natural environments, such as reading of prose or spontaneous speech, would provide information about the manifestation of phonological interference in daily life situations. The use of multisyllabic words and/or consonant-clusters would make the task more natural and thus increase the possibility of generalizing the results to the actual speech in daily life.

Further, the study of different segments could be considered. Adding to the perception task the identification of not only more native speakers' speech but also of the subjects' own speech would provide another dimension of the perception mode.

Participation of native subjects would allow for comparison between performance of native and foreign speakers on the tasks. This would allow to investigate how much of the error bias towards final position is due to phonological interference and how much is due to the position. Finally, the adjacent vowel as a variable in error frequency on the segments would be worth an investigation. It would provide better insight in the process of perception.

Conclusions

It is concluded from the findings of this study that syllabic position and mode of performance have an effect on the error frequency and error pattern of phonemes in a FL. This effect interacts with segment class and type of the phonemes and with the subjects. The positional effect of phonemes manifests itself in an error bias towards final position. The interaction manifests itself in the higher error frequency for nasals as opposed to plosives for both positions, the higher frequency of participating nasal segments as opposed to plosives for both positions, and the variability in participation of the subjects particularly in final position

Further, the existence of a relationship between the two modes of performance is concluded. The relationship interacts with the syllable position of the phonemes, with segment class and type, and with the subjects. The interaction with the syllabic position is demonstrated by the high correlation between production and perception on initial segments as opposed to the variability on final segments. The interaction with segment type and class is noticed in the low error frequencies for the plosives as opposed to the nasals in both positions and the different error frequency for the segments within each class. Variability in participation of the subjects, particularly in final position, shows interaction with the subjects.

It is concluded from the findings about syllabic position and mode of performance of phonemes as influencing factors in error frequency and pattern of segment class and type that phonological interference is a complex phenomenon, that cannot be predicted or explained by merely comparing the sound inventories of two languages.

APPENDIX A

SURVEY FORM FOR RECRUITMENT AND SELECTION OF SUBJECTS

This week I was approached by Erna Pluut who is a graduate student at the Department of Audiology and Speech Sciences. She has a great interest in Chinese languages as her husband is a Chinese himself. For her thesis she wants to do research on the linguistic features of Chinese speakers for the English language. In order to do so she needs some basic information and later on she will need volunteers. They will read an English text for her, which will not require much time. Filling out the form and returning it soon (by October 9) to the address that will be most convenient to you, will be of great help.
I hope you will support her and encourage you to do so.

Chang, Ta - Ching

Before starting the research, I would like to conduct an anonymous survey which will not bind you in any way to continued participation in the program. If you would please fill out and return form PART I, it would be greatly appreciated.
I will also need some further volunteers for continued participation in my research program. For those people, if you would fill out and return (either together or separately) both form PART I and PART II, I would appreciate it very much. You will be contacted later.
Thank you very much for your help.

Erna Pluut

PART I PLEASE, TO BE FILLED OUT BY EVERYONE

a) Date of birth: month ________, year ______ / Major ______/
Male _______ Female ________

b) When did you come to the USA? month _____________ year __________

c) What dialect did you speak at home?
Mandarin____, Taiwanese____, Other_____

d) What Chinese dialects do you speak? ______________________________

e) What Chinese dialect do you use mainly? __________________________

f) At what age did you start to learn English? ______________________

g) How many years have you studied English? _______
How many hours per week? _______

h) How many years have you been speaking English? __________________

i) What education did you receive in your native country?
high school _____, vocational school _____, college _____,
university ______

j) What statement would be applicable to you? Please, mark with an X

My English is such that
a) I could lecture a group of students
b) I can communicate well
c) I can make myself understood
d) I prefer not to speak English unless I have to.

-----------------------separate here if you wish----------------------

PART II FILL OUT IF YOU ARE WILLING TO PARTICIPATE

Name ____________________________ Telephone number ___________________

Age ______

a) What Chinese dialects do you speak? _____________________________

b) How long have you been in the USA? ______________________________

c) Are you presently a student? _________ Major ___________________

APPENDIX B

SUBJECTS' READING LIST FOR THE PRODUCTION TASK

SAY . . . . AGAIN

ook	aan	paa
poo	maa	aang
oot	poo	aak
paa	pee	oong
aang	taa	moo
maa	eek	eep
oom	moo	aang
koo	moo	eep
poo	oop	oong
ngaa	kaa	aat
een	een	kaa
noo	kee	taa

SAY . . . . AGAIN

mee	too	oot
aam	koo	kee
eeng	ngaa	eeng
maa	ngoo	aam
eem	eet	oop
aak	pee	aat
tee	ngaa	ngoo
eeng	oop	pee
mee	kee	too
aak	aap	ngee
naa	kaa	nee
aap	naa	eem

SAY . . . . AGAIN

noo	ngee	nee
noo	tee	ook
koo	oon	naa
oop	aan	eet
eep	taa	ngee
paa	tee	eet
oong	oom	eek
aam	aan	oot
oon	oom	ook
ngoo	eem	nee
een	too	eek
oon	aat	mee

APPENDIX C

JUDGES' LIST FOR THE PRODUCTION TASK

very sure 1 - 2 - 3 very unsure

ook	______	1 - 2 - 3	moo	______	1 - 2 - 3
poo	______	1 - 2 - 3	moo	______	1 - 2 - 3
oot	______	1 - 2 - 3	oop	______	1 - 2 - 3
paa	______	1 - 2 - 3	kaa	______	1 - 2 - 3
aang	______	1 - 2 - 3	een	______	1 - 2 - 3
maa	______	1 - 2 - 3	kee	______	1 - 2 - 3
oom	______	1 - 2 - 3	paa	______	1 - 2 - 3
koo	______	1 - 2 - 3	aang	______	1 - 2 - 3
poo	______	1 - 2 - 3	aak	______	1 - 2 - 3
ngaa	______	1 - 2 - 3	oong	______	1 - 2 - 3
een	______	1 - 2 - 3	moo	______	1 - 2 - 3
noo	______	1 - 2 - 3	eep	______	1 - 2 - 3
aan	______	1 - 2 - 3	aang	______	1 - 2 - 3
maa	______	1 - 2 - 3	eep	______	1 - 2 - 3
poo	______	1 - 2 - 3	oong	______	1 - 2 - 3
pee	______	1 - 2 - 3	aat	______	1 - 2 - 3
taa	______	1 - 2 - 3	kaa	______	1 - 2 - 3
eek	______	1 - 2 - 3	taa	______	1 - 2 - 3

Remarks:

<u>very sure</u> 1 - 2 - 3 <u>very unsure</u>

mee	_____	1 - 2 - 3	ngaa	_____	1 - 2 - 3
aam	_____	1 - 2 - 3	oop	_____	1 - 2 - 3
eeng	_____	1 - 2 - 3	kee	_____	1 - 2 - 3
maa	_____	1 - 2 - 3	aap	_____	1 - 2 - 3
eem	_____	1 - 2 - 3	kaa	_____	1 - 2 - 3
aak	_____	1 - 2 - 3	naa	_____	1 - 2 - 3
tee	_____	1 - 2 - 3	oot	_____	1 - 2 - 3
eeng	_____	1 - 2 - 3	kee	_____	1 - 2 - 3
mee	_____	1 - 2 - 3	eeng	_____	1 - 2 - 3
aak	_____	1 - 2 - 3	aam	_____	1 - 2 - 3
naa	_____	1 - 2 - 3	oop	_____	1 - 2 - 3
aap	_____	1 - 2 - 3	aat	_____	1 - 2 - 3
too	_____	1 - 2 - 3	ngoo	_____	1 - 2 - 3
koo	_____	1 - 2 - 3	pee	_____	1 - 2 - 3
ngaa	_____	1 - 2 - 3	too	_____	1 - 2 - 3
ngoo	_____	1 - 2 - 3	ngee	_____	1 - 2 - 3
eet	_____	1 - 2 - 3	nee	_____	1 - 2 - 3
pee	_____	1 - 2 - 3	eem	_____	1 - 2 - 3

Remarks:

<u>very sure</u> 1 - 2 - 3 <u>very unsure</u>

noo	_____	1 - 2 - 3	oom	_____	1 - 2 - 3
noo	_____	1 - 2 - 3	aan	_____	1 - 2 - 3
koo	_____	1 - 2 - 3	oom	_____	1 - 2 - 3
oop	_____	1 - 2 - 3	eem	_____	1 - 2 - 3
eep	_____	1 - 2 - 3	too	_____	1 - 2 - 3
paa	_____	1 - 2 - 3	aat	_____	1 - 2 - 3
oong	_____	1 - 2 - 3	nee	_____	1 - 2 - 3
aam	_____	1 - 2 - 3	ook	_____	1 - 2 - 3
oon	_____	1 - 2 - 3	naa	_____	1 - 2 - 3
ngoo	_____	1 - 2 - 3	eet	_____	1 - 2 - 3
een	_____	1 - 2 - 3	ngee	_____	1 - 2 - 3
oon	_____	1 - 2 - 3	eet	_____	1 - 2 - 3
ngee	_____	1 - 2 - 3	eek	_____	1 - 2 - 3
tee	_____	1 - 2 - 3	oot	_____	1 - 2 - 3
oon	_____	1 - 2 - 3	ook	_____	1 - 2 - 3
aan	_____	1 - 2 - 3	nee	_____	1 - 2 - 3
taa	_____	1 - 2 - 3	eek	_____	1 - 2 - 3
tee	_____	1 - 2 - 3	mee	_____	1 - 2 - 3

Remarks:

APPENDIX D

SUBJECTS' WRITTEN FORM FOR THE IDENTIFICATION TASK

1.	pee	tee	kee	1 ----- 2 ----- 3
2.	mee	nee	ngee	1 ----- 2 ----- 3
3.	maa	ngaa	naa	1 ----- 2 ----- 3
4.	oop	oot	ook	1 ----- 2 ----- 3
5.	oong	oom	oon	1 ----- 2 ----- 3
6.	ngoo	moo	noo	1 ----- 2 ----- 3
7.	paa	taa	kaa	1 ----- 2 ----- 3
8.	koo	too	poo	1 ----- 2 ----- 3
9.	eem	eeng	een	1 ----- 2 ----- 3
10.	aan	aam	aang	1 ----- 2 ----- 3
11.	ngaa	naa	maa	1 ----- 2 ----- 3
12.	ngee	nee	mee	1 ----- 2 ----- 3
13.	too	poo	koo	1 ----- 2 ----- 3
14.	ook	oop	oot	1 ----- 2 ----- 3
15.	oop	oot	ook	1 ----- 2 ----- 3
16.	paa	taa	kaa	1 ----- 2 ----- 3
17.	pee	tee	kee	1 ----- 2 ----- 3
18.	nee	ngee	mee	1 ----- 2 ----- 3
19.	aam	aan	aang	1 ----- 2 ----- 3
20.	ook	oop	oot	1 ----- 2 ----- 3
21.	poo	too	koo	1 ----- 2 ----- 3
22.	maa	mgaa	naa	1 ----- 2 ----- 3

1.	kee	tee	pee	1 ----- 2 ----- 3
2.	eeng	een	eem	1 ----- 2 ----- 3
3.	eeng	een	eem	1 ----- 2 ----- 3
4.	nee	ngee	mee	1 ----- 2 ----- 3
5.	poo	too	koo	1 ----- 2 ----- 3
6.	taa	paa	kaa	1 ----- 2 ----- 3
7.	aat	aak	aap	1 ----- 2 ----- 3
8.	aam	aan	aang	1 ----- 2 ----- 3
9.	noo	moo	ngoo	1 ----- 2 ----- 3
10.	moo	ngoo	noo	1 ----- 2 ----- 3
11.	maa	naa	ngaa	1 ----- 2 ----- 3
12.	eek	eep	eet	1 ----- 2 ----- 3
13.	een	eem	eeng	1 ----- 2 ----- 3
14.	kaa	paa	taa	1 ----- 2 ----- 3
15.	kee	tee	pee	1 ----- 2 ----- 3
16.	tee	pee	kee	1 ----- 2 ----- 3
17.	ook	oop	oot	1 ----- 2 ----- 3
18.	eep	eet	eek	1 ----- 2 ----- 3
19.	ngee	nee	mee	1 ----- 2 ----- 3
20.	ngoo	moo	noo	1 ----- 2 ----- 3
21.	ngoo	moo	noo	1 ----- 2 ----- 3
22.	oon	oong	oom	1 ----- 2 ----- 3

1.	aan	aam	aang	1 ----- 2 ----- 3
2.	pee	tee	kee	1 ----- 2 ----- 3
3.	taa	paa	kaa	1 ----- 2 ----- 3
4.	moo	ngoo	noo	1 ----- 2 ----- 3
5.	eep	eet	eek	1 ----- 2 ----- 3
6.	eek	eep	eet	1 ----- 2 ----- 3
7.	maa	naa	ngaa	1 ----- 2 ----- 3
8.	koo	too	poo	1 ----- 2 ----- 3
9.	aak	aap	aat	1 ----- 2 ----- 3
10.	oot	ook	oop	1 ----- 2 ----- 3
11.	aap	aat	aak	1 ----- 2 ----- 3
12.	moo	ngoo	noo	1 ----- 2 ----- 3
13.	maa	naa	ngaa	1 ----- 2 ----- 3
14.	eet	eep	eek	1 ----- 2 ----- 3
15.	eem	eeng	een	1 ----- 2 ----- 3
16.	oong	oom	oon	1 ----- 2 ----- 3
17.	koo	too	poo	1 ----- 2 ----- 3
18.	ngaa	naa	maa	1 ----- 2 ----- 3
19.	oom	oong	oon	1 ----- 2 ----- 3
20.	aap	aat	aak	1 ----- 2 ----- 3
21.	oon	oong	oom	1 ----- 2 ----- 3
22.	mee	nee	ngee	1 ----- 2 ----- 3

1.	tee	pee	kee	1 ----- 2 ----- 3
2.	aap	aat	aak	1 ----- 2 ----- 3
3.	oom	oong	oon	1 ----- 2 ----- 3
4.	aak	aap	aat	1 ----- 2 ----- 3
5.	tee	pee	kee	1 ----- 2 ----- 3
6.	paa	taa	kaa	1 ----- 2 ----- 3
7.	oon	oong	oom	1 ----- 2 ----- 3
8.	aak	aap	aat	1 ----- 2 ----- 3
9.	oot	ook	oop	1 ----- 2 ----- 3
10.	too	poo	koo	1 ----- 2 ----- 3
11.	ngee	nee	mee	1 ----- 2 ----- 3
12.	eek	eep	eet	1 ----- 2 ----- 3
13.	aat	aak	aap	1 ----- 2 ----- 3
14.	aang	aam	aan	1 ----- 2 ----- 3
15.	taa	paa	kaa	1 ----- 2 ----- 3
16.	pee	tee	kee	1 ----- 2 ----- 3
17.	oong	oom	oon	1 ----- 2 ----- 3
18.	eet	eep	eek	1 ----- 2 ----- 3
19.	eet	eep	eek	1 ----- 2 ----- 3
20.	maa	ngaa	naa	1 ----- 2 ----- 3
21.	kaa	paa	taa	1 ----- 2 ----- 3
22.	eep	eet	eek	1 ----- 2 ----- 3

1.	aang	aam	aan	1 ----- 2 ----- 3
2.	aat	aak	aap	1 ----- 2 ----- 3
3.	nee	ngee	mee	1 ----- 2 ----- 3
4.	poo	too	koo	1 ----- 2 ----- 3
5.	een	eem	eeng	1 ----- 2 ----- 3
6.	eeng	een	eem	1 ----- 2 ----- 3
7.	eem	eeng	een	1 ----- 2 ----- 3
8.	kaa	paa	taa	1 ----- 2 ----- 3
9.	noo	moo	ngoo	1 ----- 2 ----- 3
10.	aan	aam	aang	1 ----- 2 ----- 3
11.	oop	oot	ook	1 ----- 2 ----- 3
12.	oom	oong	oon	1 ----- 2 ----- 3
13.	too	poo	koo	1 ----- 2 ----- 3
14.	ngaa	naa	maa	1 ----- 2 ----- 3
15.	oot	ook	oop	1 ----- 2 ----- 3
16.	een	eem	eeng	1 ----- 2 ----- 3
17.	noo	moo	ngoo	1 ----- 2 ----- 3
18.	mee	nee	ngee	1 ----- 2 ----- 3
19.	aang	aam	aan	1 ----- 2 ----- 3
20.	aam	aan	aang	1 ----- 2 ----- 3

A P P E N D I X E

NUMBER OF SUBJECTS PARTICIPATING PER ERROR PATTERN IN THE PRODUCTION TASK

Table 14

Number of Subjects Participating Per Error Pattern in the Production Task

Sound Type	Position	1 Subst	2 Rearr	3 Add	4 Subst and Add	5 Rearr and Add	6 Del and Add	7 Rearr and Subst	8 Misc
Plosives	Initial	1	---	---	---	---	---	---	---
	Final	1	---	---	1	---	---	---	---
Nasals	Initial	5	---	2	3	4	---	---	1
	Final	6	1	1	4	2	1	1	2

A P P E N D I X F

NUMBER OF SUBJECTS PARTICIPATING PER ERROR PATTERN IN THE IDENTIFICATION TASK

Table 15

Number of Subjects Participating Per Error Pattern in the Identification Task

Sound Type	Sound Confusion	Position Initial	Position Final
Plosive	p --- k* n=1	---	1
	t --- k n=3	---	2
Nasal	m --- n n=5	1	3
	m --- ŋ n=5	---	3
	n --- m n=4	2	1
	n --- ŋ n=11	---	5
	ŋ --- m n=9	4	1
	ŋ --- n n=38	6	5

*p --- k should be read as p is substituted by k.

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