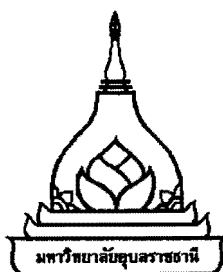


**THAI ENGLISH FOREIGN LANGUAGE LEARNERS'  
DISCRIMINATION OF VOICING CONTRAST  
IN ENGLISH OBSTRUENTS**

**APARAT PANUSATID**

**AN INDEPENDENT STUDY SUBMITTED IN PARTIAL FULFILLMENT OF  
THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS  
MAJOR IN ENGLISH AND COMMUNICATION  
FACULTY OF LIBERAL ARTS  
UBON RATCHATHANI UNIVERSITY  
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**INDEPENDENT STUDY APPROVAL  
UBON RATCHATHANI UNIVERSITY  
MASTER OF ARTS  
MAJOR IN ENGLISH AND COMMUNICATION  
FACULTY OF LIBERAL ARTS**

**TITLE** THAI ENGLISH FOREIGN LANGUAGE LEARNERS'  
DISCRIMINATION OF VOICING CONTRAST IN ENGLISH  
OBSTRUENTS

**NAME** MRS. APARAT PANUSATID

**THIS INDEPENDENT STUDY HAS BEEN ACCEPTED BY**

..... CHAIR  
(DR. SAOWANEE T. ALEXANDER)

..... COMMITTEE  
(DR. JIRAPORN MEECHAI)

..... COMMITTEE  
(DR. PILANUT PHUSAWISOT)

..... DEAN  
(ASST. PROF. DR. KANOKWAN MANOROM)

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(ASSOC. PROF. DR. UTITH INPRASIT)

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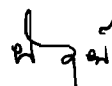
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(Mrs. Aparat Panusatid)

Researcher

## บทคัดย่อ

ชื่อเรื่อง : ความสามารถของผู้เรียนภาษาอังกฤษเป็นภาษาต่างประเทศในการจำแนก  
ความก้องของเสียงในกลุ่มเสียงปิดกั้น

โดย : อาภารัตน์ ภาณุสถิตย์

ชื่อปริญญา : ศิลปศาสตรมหาบัณฑิต

สาขาวิชา : ภาษาอังกฤษและการสื่อสาร

ประธานกรรมการที่ปรึกษา : ดร.เสาวนีย์ ตรีรัตน์ อเล็กซานเดอร์

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การศึกษานี้มีวัตถุประสงค์เพื่อศึกษาปัญหาและความสามารถของนักเรียนไทยในการจำแนกเสียงพยัญชนะที่มีในภาษาอังกฤษทั้งเสียงก้องและเสียงไม่ก้องของกลุ่มเสียงกักเสียงเสียดแทรก และเสียงกักกึ่งเสียดแทรก การศึกษานี้มีเสียงที่ถูกใช้ทดสอบทั้งสิ้น 16 เสียง ดังนี้ /p/, /t/, /k/, /b/, /d/, /g/, /f/, /v/, /θ/, /ð/, /s/, /z/, /ʃ/, /ʒ/, /tʃ/ and /dʒ/.

กลุ่มทดลองเป็นนักเรียนจำนวน 200 คนโดยเลือกจากนักเรียนชั้นมัธยมศึกษาปีที่ 3 และ 6 ของโรงเรียนอานาจเจริญ (นักเรียนชั้นมัธยมศึกษาปีที่ 3 จำนวน 107 คน และนักเรียนชั้นมัธยมศึกษาปีที่ 6 จำนวน 93 คน) แบบทดสอบการจำแนกประกอบไปด้วยเสียงปิดกั้นจำนวน 16 เสียง โดยจับคู่เปรียบเทียบได้ 24 คู่ โดยศึกษาตัวแปร 3 ด้านคือ 1) ตำแหน่งที่เกิดเสียง (ต้นพยางค์ กลางพยางค์ และท้ายพยางค์) 2) คุณลักษณะของเสียง (เสียงกัก เสียงเสียดแทรก และเสียงกึ่งกักกึ่งเสียดแทรก) และ 3) สถานะของเสียงในภาษาไทย (มี และไม่มี)

ผลการทดลองแสดงให้เห็นว่ากลุ่มทดลองทั้ง 2 กลุ่มมีความแตกต่างกันเพียงเล็กน้อยด้านระดับความสามารถในการแยกเสียง ทั้งนี้ผลการวิจัยสนับสนุนทฤษฎีการเรียนรู้เสียงในภาษาที่สอง (Flege, 1995) และสมมติฐานช่วงการเรียนรู้ที่เหมาะสมในการเรียนภาษาที่สอง (Lenneberg, 1967)

## ABSTRACT

TITLE : THAI ENGLISH FOREIGN LANGUAGE LEARNERS'  
DISCRIMINATION OF VOICING CONTRAST IN ENGLISH  
OBSTRUENTS

BY : APARAT PANUSATID

DEGREE : MASTER OF ARTS

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CHAIR : SAOWANEE ALEXANDER, Ph.D.

KEYWORDS : SECOND LANGUAGE PERCEPTION / DISCRIMINATION  
OF SOUNDS

The purpose of this study was to investigate common difficulties among Thai students in perceiving English voiced and voiceless stops, fricatives and affricates. The study specifically tested sixteen sounds: /p/, /t/, /k/, /b/, /d/, /g/, /f/, /v/, /θ/, /ð/, /s/, /z/, /ʃ/, /ʒ/, /tʃ/ and /dʒ/.

Two hundred students purposively selected from Mattayomseuksa 3 (M3) and 6 (M6) at Amnatcharoen School (107 M3, and 93 M6 students, respectively). The participants took a discrimination test consisting of sixteen English obstruents formed as 24 stimulus pairs. The variables under investigation were: syllabic position (onset, intervocalic, and coda), manner of articulation (stops, fricatives and affricates) and status in the Thai phonetic repertoire (present and absent).

The results of the experiment show little difference between the discrimination ability of the two groups of participants. The findings support and challenge the Speech Learning Model proposed by Flege (1995) while supporting the Critical Period Hypothesis (Lenneberg, 1967).

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# **CHAPTER 1**

## **INTRODUCTION**

This chapter discusses the rationale, purpose, research question, expected outcomes, and scope of the study.

### **1.1 Rationale**

Although Thai learners have studied English for many years from primary school to high school, they still have a lot of problems in English pronunciation especially with such consonants as voiced and voiceless stops, fricatives and affricates (obstruents). Based on my personal observation at Amnatcharoen School where I teach, it appears that the students have trouble distinguishing voicing contrast among obstruents, namely, /p/, /k/, /b/, /d/, /f/ and /s/ which exist in Thai and /t/, /g/, /v/, /θ/, /ð/, /z/, /ʃ/, /ʒ/, /tʃ/ and /dʒ/ which do not exist in Thai. This is apparent in their pronunciation. Recent research on Thai learners' pronunciation of English sounds has shown that learners tend to substitute voiced obstruents with their voiceless counterparts (Thongsin, 2007). Learners' abilities to pronounce and produce English sounds are not necessarily positively correlated (Shimanune & Smith, 1995) suggesting that they may be independent of each other, so it is a legitimate reason not to assume that pronunciation problems imply perception problems. Thus, it is therefore worthwhile to examine learners' perception in its own right.

### **1.2 Purpose of the study**

The purpose of this study was to investigate the degree to which Mattayomseuksa 3 and Mattayomseuksa 6 students at Amnatcharoen School accurately perceive voicing contrasts for obstruents, namely, /p/, /t/, /k/, /b/, /d/, /g/, /f/, /v/, /θ/, /ð/, /s/, /z/, /ʃ/, /ʒ/, /tʃ/ and /dʒ/ in three syllabic environments.

### **1.3 Research Question**

The research question guiding this study is: “To what extent M3 and M6 students accurately perceive voicing contrasts for English obstruents?”

### **1.4 Expected Outcomes**

This study attempted to identify and describe the learners’ abilities and problems in discriminating voicing contrasts for the target sounds. It was a survey of perceptual abilities and problems, which could be used as background information for English teachers who wish to address pronunciation issues.

### **1.5 Scope of the study**

This study investigated a group of 200 students in a high school learning context. Only their perceptual (discriminatory, to be exact) ability was investigated. Therefore, no assumption or generalization about their proficiency in this skill and other language skills was made.

## **CHAPTER 2**

### **FOCUSED LITERATURE REVIEW**

This chapter discusses common perceptual problems faced by learners of English, Thai learners' perception problems, and theoretical models of L2 phonetics.

#### **2.1 English learners' phonetic problems**

Second language phonetic research has shown that learners of English from different language backgrounds are faced with phonetic issues regarding English segments (sounds) (Bohn & Flege, 1992; Ingram & Park, 1997; Sheldon & Strange, 1982). The English segments that cause problems for Thai EFL learners span over different manners of articulation—stops, fricatives, and affricates. Stops, or plosives, are phonemes that restrict the release of air flow from the mouth. Stops found in English include /d/, /t/ and /b/. Fricatives, such as /f/, /v/ and /ð/ allow air to escape the front or sides of the mouth. The airflow usually flows between the teeth and tongue or teeth and lips. The last group concerned is the affricate group, containing sounds such as /dʒ/. English only has two affricates, /tʃ/ and /dʒ/, both of which present problems for Thai EFL learners. These are sounds that begin as stops with restricted airflow, but the sounds turn into a fricative releasing the air from the mouth. Learners' problems have been found to be in both pronunciation (Lin et al., 1995; Wahba, 1998) and perception (Altmann, 2006 ; Khamkien, 2012). Phonetically speaking, problematic pronunciation interferes with communication and may also lead to inaccurate perceptions by native English speakers (Giles, 1970; Lambert et al., 1960).

In pronunciation, several studies (Lin et al., 1995 ; Thongsin, 2007) have found that learners substituted English sounds with the ones in their native language. For example, Thongsin (2007) investigated English pronunciation of Thai students' problems with /g/, /v/, /θ/, /ð/, /s/, /z/, /ʃ/, /ʒ/, /tʃ/ and /dʒ/ in the initial, medial and final positions. The participants were 22 undergraduate students at Naresuan University (Phayao Campus) and 18 Master's students at Naresuan University (Bangkok Campus). The participants were recorded while reading words with the target sounds. The results showed that the participants pronounced target sounds with varying degrees of accuracy. The author believed the findings reflected the effect of Thai, which is the participants' native language. In perception, it was also found that learners have trouble distinguishing English sounds. Supporters of the Contrastive Analysis Hypothesis (CAH) (Lado, 1957) would explain that this substitution is because of the fact that these problem sounds do not exist in English and so they are difficult to pronounce. The major assertion by the hypothesis about second language learners' treatment of the second language is,

“Those elements that are similar to his native language will be simple for him, and those elements that are different will be difficult.” (Lado, 1957: 2).

The CAH was very popular in the beginning because it supports the idea that the speaker's first language affects his or her performance in the second language—a position highly appealing to language teachers and practitioners. However, it became less cited as there were newer theories and models that give a better explanation for learner's behavior. The following section focuses on more recent theoretical models of learners' perception of L2 sounds.

## **2.2 The Speech Learning Model (SLM)**

The Speech Learning Model (SLM) was first proposed by Flege (1995) based on his extensive research in second language perception and production by L2 learners of various L1 backgrounds. The model posits that the learners' perceived relationship between L1 and L2 categories plays an important role in how they perceive or produce L2 sounds. Specifically, L2 sounds or segments which are similar

to L1 sounds will be assimilated to native categories. On the contrary, if there is a great difference perceptually, new L2 categories will be established over time. In refining the model with regard to L2 sound acquisition, Flege (1995) argues that the more dissimilar the L2 sound is to the L1, the more learnable it becomes. This model also assumes the existence of a sensitivity period after which it is more difficult for learners to acquire non-native phonetic contrasts. The separate model, the Critical Period Hypothesis (CPH), believes language acquisition occurs more easily before puberty. In this regard, it seems that the SLM model supports the Critical Period Hypothesis (see Johnson & Newport, 1989 for a discussion of the hypothesis and its effects on English as a second language) in stating that there is a period especially conducive to the learning of L2. However, the SLM is unlike the full-blown, strong version of CPH, which predicts that the ability to learn L2 decreases as a result of maturation. Rather, the model states that there is no evidence to support such prediction as far as empirical research is concerned.

Unlike the CAH, the SLM does not argue that similarities between the first and second language will ease acquisition. Rather, it predicts that similarities may be a source of difficulty because learners may confuse the new elements with ones in their first language. New sounds, on the other hand, may easily be acquired because they are not confused with the L1 sounds. Through a series of studies, Flege and his collaborators have put SLM predictions to the test. Some notable ones are discussed as follows.

Aoyama, Flege, Guion, Akane-Yamada and Yamada (2004) examined two groups of Japanese learners' (children and adults) production and perception of English /r/ and /l/. They hypothesized based on the SLM that the learners would be more accurate in producing and pronouncing the English /r/ than the English /l/ because the English /r/ is more dissimilar from the Japanese /r/ than the English /l/. To test their hypothesis, they gave the learners two sets of production and perceptual discrimination tests over a period of one year of living in the United States. They found that the children showed a better improvement in pronouncing the English /r/ than /l/ while such finding did not hold true for their adult counterparts. Furthermore, both groups of learners showed a higher rate of accurate perception for English /r/ than /l/. The results were taken to support the SLM.

In a similar experiment, Yi-hsiu Lai (2010) tested the perception of 90 Mandarin speaking Chinese EFL learners in Taiwan. The English learners were divided into two groups depending on their TOEIC scores, high and low. Two experiments were conducted; the first covered English vowel discrimination of the sounds [i, ɪ, eɪ, ɛ, æ, ʌ, ʊ, u, oʊ, ɔ, a], while the second studied English vowel assimilation. The first group of participants listened to sound stimuli and discriminated them as different or similar. The second experiment required the listeners to first label the heard sounds as new or similar while the second task required them to transcribe the heard sounds into the closest Mandarin sound. The results indicate which English vowel sounds pose the greatest difficulties for Mandarin speakers. The experiment also reflects interesting phenomena in percentage results. While the EFL learners with higher TOEIC scores scored higher overall, the significance was never more than 10% with the exception of one category. The Mandarin speakers easily discriminate between a native-non-native pair ([oʊ] being the Mandarin vowel shared with English and [ɔ] being the non-Mandarin vowel) regardless of their English proficiency difference. Lai hypothesized pairs such as this to present a challenge, but instead the participants judged them as “similar tokens.” This shows their greater sensitivity of discrimination for dissimilar sounds, supporting the SLM.

Another experiment, conducted by Flege, Mackey, and Meador (1999) tested the perception and production of Italian learners of English. The researchers tested 72 native Italian speakers who had lived in Canada for 18-35 years. The Italians participated in two experiments which both used varied sets of stimuli to test the learners’ abilities in discriminating English vowel sounds. This experiment also supports the perception assimilation model, stating a correlation between the maturation of English learners and the assimilation of nonnative sounds to native ones. The results found that native Italian speakers who arrived in Canada later were less accurate in their discrimination than those who arrived earlier; however, the results also showed a small difference between those who arrived in the early young portion of their lives and those who arrived in the middle-aged portion of their lives. The results showed the participants found discriminating English sounds with other

English sounds easier than discriminating English sounds with Italian. On the other hand, discriminating English sounds with Italian sounds was easier than discriminating Italian sounds with other Italian sounds. This suggests the Italian speakers can pronounce non-native sounds more closely than they can perceive them.

Finally, Sundara and Polka (2008) tested the discrimination of coronal stops /d/ and /t/ by monolingual and bilingual adults. Fifty adults participated for this experiment including both monolingual speakers and bilingual speakers of Hindi, Canadian French, and English. The participants discriminated English stops from multiple stimulus sets each containing three sounds. The sounds also tested the learners' perception of different manners of articulation as well as voicing. The results showed that Hindi listeners were not only discriminating L2 sounds, but also assimilating these sounds to the L1. A similar occurrence happened for the French speakers. Both groups scored a high accuracy rate when discriminating between the stops /d/ and /t/; they also assimilated these sounds to the closest sounds of their L1. The results were taken to support the SLM because of their high score of discrimination of new or dissimilar sounds compared to their lower scores for discriminating sounds closer to the L1, or similar sounds.

### **2.3 The Critical Period Hypothesis**

Lenneberg (1967) proposed the Critical Period Hypothesis, or CPH, which became a popular model for the relationship between language acquisition and age. The model proposes that the ability to acquire a second language decreases with age, as there is a critical period to do so ending with puberty. Several studies supporting and challenging this critical period soon followed because Lenneberg's model addressed only the acquisition of the first language (L1). Support still stands, including this research, for a critical period of second language learning due to the maturation of learners and their cognitive abilities. While the exact age window for a critical period may be debated, the following researchers have found results supporting either a critical period, or specifically the critical period ending with puberty.

Johnson and Newport (1989) completed perhaps one of the most influential studies to support the Critical Period Hypothesis. Their participant group, made up of

46 native speakers of Chinese and Korean, had lived in the United States for at least three years with exposure of English reaching at least five years. The participants' ages of immigration varied from 3 to 39. The experiment itself tested the participants' perception of English grammar through speech with 276 sentences recorded by a native English speaker. While 140 of the sentences contained incorrect English grammar the other 136 contained the correct counterparts. The results show a clear support for the CPH due to the 3-7 year old age group's mean score of 268.8 out of 276 correct sentences. As the groups' ages increase, their scores decrease ending with the oldest group (age 17-39) scoring a mean 210.3 out of 276 correct sentences. Overall, the results show children having an advantage for second language acquisition over adults, supporting the CPH.

Hakuta, Bialystok, and Wily (2003) conducted a study to observe any discontinuity in second language acquisition for both Spanish and Chinese immigrants in the United States. The researchers used data from the 1990 U.S. Census, which showed language data from each U.S. state. They specifically targeted responses from native Spanish and Chinese speakers to determine whether a critical period does or does not exist for those learning a second language. Their large participant groups included data from 2,016,317 native Spanish speakers and 324,444 native Chinese speakers. At the time of the study, both groups had lived in the United States for at least ten years. Using the data the researchers involved the participants English proficiency level, education level, age of immigration and calculated an estimated critical period for the participants. After plotting lines of regression for each of the two language groups, a trend showed a decrease in language proficiency as the participants became older. The researchers used ages 15 and 20 as ending points for a critical period and found that after these points, participants showed no signs of improvement for second language acquisition. While the study shows a critical period of later than puberty, the support still stands for a critical period because the linear plots show a decline for both groups' L2 acquisition due to increased age after first exposure to the second language—which in this case was English.

Finally, Tsukuda, Birdsong, Bialystock, Mack, Sung and Flege (2003) carried out two experiments which were claimed to support the CPH, testing the language production and discrimination of native Korean speakers—children and



adults. 108 participants were included in the experiment and divided into groups based on length of residence age group. Further divided, the length of residence category was divided into two groups, 3 years and 5 years of residence in North America. The stimuli for the first experiment included the English sounds /æ/, as spoken by eight male native English speakers. The participants had to discriminate among these vowel sounds. In the second experiment, which focused on production, the participants recorded their speech of 25 test words, which included the same vowel tokens. For both experiments, the children for the native Korean-speaking group scored higher than their adult counterparts. Furthermore, the children learning English scored at least 50% higher for three out of four lengths of residence categories over the adults. For the fourth category the percent advantage of the children was still significantly higher than the adults. All of this data continues a supportive frame for the CPH.

In conclusion, the experiment conducted for this research supports both the Speech Learning Model and the Critical Period Hypothesis as do the experiments discussed in the above sections.

## **CHAPTER 3**

### **METHOD**

This chapter describes in detail the subjects, instruments, data-gathering procedures and data analysis employed in the present study.

#### **3.1 Participants**

Two hundred Mattayomseuksa 3 and 6 students (Grade 9 and Grade 12 equivalents, respectively) at Amnatcharoen School Amnatcharoen Province, Thailand, participated in the study. The students came from two classes of Mattayomseuksa 3 and two classes of Mattayomseuksa 6. These four groups of students were considered the best in school in terms of overall academic performance. The data from the participants was collected in June, 2012 during the first semester of the academic year 2012. Their participation was voluntary, and they were not financially compensated for the time they devoted to this study. Of these, 75 were males and 125 were females. The average ages for the Mattayomseuksa 3 and 6 students were 15 and 18 years old, respectively. Mattayomseuksa 3 and 6 students were chosen for this study because they had had a relatively long exposure to English, so it was reasonable to measure their perceptual ability. For a comparison purpose, these two groups differed by three years of study. It was justified to compare them to determine whether that relatively large amount of time difference, which supposedly provides more input for Mattayomseuksa 6 students, could be a factor in their perceptual abilities, if any. At the time the data was being gathered, Mattayomseuksa 3 students had 9 years of their English studying experience, and Mattayomseuksa 6 students had 12 years of their English studying experience. None of them reported any hearing problem.

### 3.2 Instruments

*Demographic questionnaire.* Before taking the discrimination test, all participants filled out a demographic questionnaire aiming to collect their personal information including gender, school class, years of studying English, school grades in English, and other information about the amount of their daily English use.

*Discrimination test.* The listening stimuli for the test consisted of 16 target English sounds: 3 voiced stops, 3 voiceless stops, 4 voiced fricatives, 4 voiceless fricatives, 1 voiced affricate and 1 voiceless affricate as shown in Table 3.1. These target sounds were used to create target pairs. Each pair was created in the following conditions. The first set of target pairs consisted of pairs of identical sounds. So there were 16 pairs in this set, for example, /b/-/b/, /f/-/f/ and /d/-/d/. In the second set, pairs of sounds in the same consonant class differing only in voicing were created. This resulted in 8 pairs based on 3 stop, 4 fricative and 1 affricate pairs, for example, /b/-/p/, /d/-/t/, and /tʃ/-/dʒ/. The first and second sets of stimuli became the original target pairs with a total of 24 pairs. These 24 pairs were used to create stimuli in 3 syllabic conditions (onset, intervocalic, and coda) in nonsense words. The reason for using nonsense words was to prevent listeners from prior semantic knowledge of words, which could interfere with their judgment. This process resulted in 72 target stimulus pairs (24 pairs x 3 syllabic conditions). These 72 stimulus pairs were presented 3 times to gauge the listeners' perceptual consistency, resulting in 216 trials. Each trial was followed by a 3 second pause to allow the listeners to respond. The entire test lasted about 20 minutes.

**Table 3.1** Target sounds

| Sounds     | Voiced | Voiceless |
|------------|--------|-----------|
| Stops      | /b/    | /p/       |
|            | /d/    | /t/       |
|            | /g/    | /k/       |
| Fricatives | /v/    | /f/       |
|            | /z/    | /s/       |
|            | /ð/    | /θ/       |
|            | /ʒ/    | /ʃ/       |
| Affricates | /tʃ/   | /dʒ/      |

**3.3 Data-collection procedure**

The test administration took place in the second week of the academic year 2012. The participants in four classes took the test simultaneously in the school hall. Before the test began, the participants were given instructions, answer sheets, and were allowed to ask questions. They were not told about the real purpose of the test. They were also informed that the test results would be kept confidential. However, it should be noted that 10 Mattayomseuksa 6 students were late for the experiment. The students were immediately given the test right after the first test was completed as well as the same clear instructions as the rest of the participants for how to complete the test. The stimuli were played on a computer program through loud speakers in the school hall at a loudness level approved by the students. The test went well with no interruption or any technical difficulty.

**3.4 Data Analysis**

After both groups of learners took the discrimination test, the results of the test were analyzed. Their scores were analyzed for accuracy rates. First, the scores were converted into percentages. This analysis aimed to detect the students’ discriminatory abilities in general. After that, both groups of learners’ scores were further compared in terms of three variables: 1) syllabic position (onset, intervocalic

and final), 2) manner of articulation (stops, fricatives and affricates) and 3) the presence or absence in Thai. The comparison of accuracy rates for both groups of learners by these variables helped to give a detailed description of their similarities or differences in their perceptual abilities.

## **CHAPTER 4**

### **RESULTS AND DISCUSSION**

This chapter offers results and discussion. It outlines the overall results and further offers detailed discussions of relevant variables to highlight similarities and differences between both groups of learners.

#### **4.1 Results**

Overall, there is little difference between both groups of students in terms of their perceptual abilities. As one might expect, M6 students scored a higher accuracy rate (70%) while their M3 counterparts scored a 65% accuracy rate. However, given their 3-year difference in exposure to English, only 5% scoring difference is not very satisfactory for the M6 students who are about to enter college. The scores for M3 and M6 were further categorized by three variables: syllabic position, manner of articulation, and presence in Thai to determine whether these variables had any relationship with the students' scores. The results are in Table 4.1 below.



**Table 4.1** Accuracy Rates by Syllabic Position, Manner and Status  
in the Thai Phonetic Repertoire

| Variables         | Average accuracy rates |      |      |
|-------------------|------------------------|------|------|
|                   |                        | M 3  | M 6  |
| Syllabic position | Onset                  | 0.61 | 0.61 |
|                   | Intervocalic           | 0.68 | 0.69 |
|                   | Coda                   | 0.68 | 0.69 |
|                   | Average                | 0.66 | 0.66 |
| Manner            | Stops                  | 0.69 | 0.70 |
|                   | Fricatives             | 0.63 | 0.63 |
|                   | Affricates             | 0.64 | 0.61 |
| Status in Thai    | Present                | 0.69 | 0.69 |
|                   | Absent                 | 0.60 | 0.61 |

In terms of syllabic position, both groups showed exactly the same pattern in which coda (final) and intervocalic sounds were equally easy, but onsets were much more difficult to perceive. Furthermore, their average perceptual accuracy rate was exactly at 66%.

Regarding manner of articulation, both groups show some degree of similarity as well as difference. While stops were the easiest consonant classes to perceive for both groups, affricates were a little more difficult than fricatives for the M3 students. This is not the case with the M6 students as the reverse pattern was observed in which affricates were more difficult than fricatives.

With respect to their status in the Thai repertoire, generally sounds that exist in Thai were a lot easier to perceive than those that do not. This holds true for both groups.

To further explore the results in detail. The results were also analyzed for their relative degree of perceptual ease or difficulty in two main aspects: detection of identical sounds and discrimination of different sounds. The results are presented and discussed below.

4.2 Learners’ ability to detect identical sounds

This section compares the learners’ ability to detect identical English sounds. The tokens for analysis were 50 pairs of target sounds (out of the entire 72 stimulus pairs). Table 4.2 shows relative degrees of difficulty of sounds in ascending order. Sounds with higher average accuracy rates are considered to be perceptually less difficult while sounds with lower accuracy rates, more difficult. The table shows a strikingly similar pattern whereby both groups show the same difficulty order of certain sounds. That is, the following sounds: /g, z, k, s, ɵ, ð, ʒ / hold the exactly same ranks in both groups’ perceptual difficulty order. While /g, z, k, s, ɵ/ seem to be easier to perceive for both groups, /ð/ and /ʒ/ seem to be more difficult. The easiest sound for both groups is /g/ while the most difficult counterparts are /v/ for M3 students and /dʒ/ for M6 students. Interestingly, both sounds do not exist in Thai. Therefore, a typical contrastive analysis hypothesis style of assumption that non-native sounds are more difficult to learn does not seem to hold true here as /g/ does not exist in Thai, but yet it is the easiest to perceive.

Table 4.2 Average Accuracy Rates for Target Identical Sounds

| M 3 | Average accuracy rate | M 6 | Average accuracy rate |
|-----|-----------------------|-----|-----------------------|
| g   | 0.92                  | g   | 0.92                  |
| z   | 0.88                  | z   | 0.89                  |
| k   | 0.78                  | k   | 0.81                  |
| s   | 0.75                  | s   | 0.76                  |
| ɵ   | 0.70                  | ɵ   | 0.75                  |
| tʃ  | 0.68                  | d   | 0.72                  |
| d   | 0.68                  | b   | 0.67                  |
| b   | 0.66                  | p   | 0.67                  |



**Table 4.2** Average Accuracy Rates for Target Identical Sounds (Continued)

| M 3 | Average accuracy rate | M 6 | Average accuracy rate |
|-----|-----------------------|-----|-----------------------|
| ð   | 0.66                  | ð   | 0.66                  |
| p   | 0.65                  | tʃ  | 0.61                  |
| ʒ   | 0.60                  | ʒ   | 0.60                  |
| ʃ   | 0.55                  | t   | 0.55                  |
| t   | 0.54                  | ʃ   | 0.55                  |
| f   | 0.48                  | v   | 0.52                  |
| dʒ  | 0.40                  | f   | 0.46                  |
| v   | 0.37                  | dʒ  | 0.42                  |

However, after a further analysis of these sounds by different variables, interesting results emerged. In terms of voicing, both groups showed the same pattern of perception (see Table 4.3). That is, voiceless sounds were a little more difficult to perceive than their voiced counterparts. However, M6 students outperformed their M3 counterparts by a little in detecting identical sounds. In terms of class, for both groups, identical stops were perceptually the easiest, followed by identical fricatives and identical affricates, respectively. Regarding syllabic position, identical consonants were the easiest to detect in coda position, and followed by intervocalic and onset. This pattern holds true for both groups.

In terms of their statuses in the Thai repertoire, identical consonants that are present in Thai were a little easier than their non-Thai counterparts for the M3 students. In contrast, whether or not these consonants exist in Thai does not seem to have any effect on the M6 ability to correctly identify that they are identical.

**Table 4.3** Overall Accuracy Rates for Pairs of Identical Sounds

| Variables         |              | M3   | M6   |
|-------------------|--------------|------|------|
| Voicing           | Voiceless    | 0.64 | 0.65 |
|                   | Voiced       | 0.65 | 0.67 |
| Classes           | Stops        | 0.71 | 0.72 |
|                   | Fricatives   | 0.62 | 0.65 |
|                   | Affricates   | 0.54 | 0.52 |
| Syllabic position | Onset        | 0.58 | 0.58 |
|                   | Intervocalic | 0.66 | 0.69 |
|                   | Coda         | 0.68 | 0.71 |
| Status in Thai    | Present      | 0.65 | 0.66 |
|                   | Absent       | 0.64 | 0.66 |

In summary, both groups of learners show the same patterns in detecting pairs of identical sounds in terms of voicing, class, and syllabic position. However, while M3 students were a little better in detecting pairs of sounds, which are present in Thai, such observation does not hold true for the M6 students.

**4.3 Learners’ ability to detect pairs of different sounds**

There were 22 pairs of voicing contrasts in the entire stimulus set. Accuracy rates for these pairs were compared across listener groups. The results are shown in Table 4.4 below.

**Table 4.4** Overall Accuracy Rates for Pairs of Different Sounds

| Variables            |              | M3   | M6   |
|----------------------|--------------|------|------|
| Classes              | Stops        | 0.64 | 0.64 |
|                      | Fricatives   | 0.62 | 0.59 |
|                      | Affricates   | 0.85 | 0.81 |
| Syllabic<br>position | Onset        | 0.73 | 0.72 |
|                      | Intervocalic | 0.71 | 0.67 |
|                      | Coda         | 0.59 | 0.58 |
| Status in Thai       | Both present | 0.67 | 0.67 |
|                      | One present  | 0.54 | 0.56 |
|                      | Both absent  | 0.74 | 0.68 |

As can be seen in the table, different-affricate pairs were the easiest to perceive for both groups, although the M3 outperformed their M6 counterparts. Both groups were at the same accuracy level when detecting differences among stops. The most difficult to perceive for both groups were different-fricative pairs, although the M3 once again outperformed their M6 counterparts.

In terms of syllabic position for different-sound pairs, it is found that onset is the easiest position, followed by intervocalic and coda, respectively. Again, this observation holds true for both groups. However, the M3 students outperformed the M6 students in all positions.

Regarding the statuses of different-sound pairs, both groups show the same pattern in which different-sound pairs, which do not exist in Thai were the easiest to perceive, followed by pairs whose members exist in Thai. The most problematic were pairs whose one member is in Thai, but the other one is not. Interestingly enough, the M3 were better at detecting voicing different for non-Thai pairs than the M6 students

while the M6 students were relatively better in detecting pairs whose one member exists in Thai.

In summary, the results have shown the complex nature of students' perceptual ability. They have also shown that when different variables are taken into account, M3 students are in fact better than their M6 counterparts in many ways.

#### **4.4 Discussion**

##### **4.4.1 Little difference in outcome scores between the two groups**

As the averages of accuracy rates of perceptual ability differs by only 5%, the question remaining is, why does such a small improvement from M3 students to M6 students exist in terms of sound discrimination of a second language? The Critical Period Hypothesis helps to define the outcome of this particular situation, where younger students often outperform or equally perform against their older counterparts. The hypothesis states that cognitive ability may have an effect on second language acquisition and as age increases these abilities decrease in their efficiency (Bialystok and Hakuta, 1999). This would have a direct effect on student's perceptual ability of different sounds because they have to use these cognitive abilities as they discriminate sounds. Bialystok and Hakuta state that often times older learners require more time to determine new language information; they also feel greater anxiety while choosing and discriminating new language for fear of making mistakes.

This study of the discrimination of sounds between M3 and M6 students seems to support the Critical Period Hypothesis because of the relationship between the limited maturation period of students and their testing results. The CPH suggests that language acquisition, and the ability thereof, slowly decreases after puberty (Johnson and Newport, 1989). This research demonstrates that the M3 and M6 students differ very little in their ability to discriminate sounds, and both groups can only discriminate between 65-70% of the time. The results suggest that both groups may have passed the critical period as predicted by the CPH, and that the little progress that M6 students did as indicated their slightly better accuracy rate is indicative of their language learning slowing down as a result of maturation. Future

research should benefit from this hypothesis in trying to determine whether or not older learners will perform better than these two groups.

#### 4.4.2 Perception of sounds not part of the Thai repertoire

Table 4.4 demonstrates that students are not only able, but also relatively succeed, in discriminating sounds that do not exist in Thai with those that do exist in Thai. For example, the students discriminate the /g/ sound more easily than any other phoneme tested, even though this phoneme is not a part of the Thai repertoire. One explanation for this derives from Flege's Speech Learning model discussed in Chapter 2, suggesting that learners often assimilate non-native sounds to native sounds depending on the measure of difference between the tested sounds (Flege, 1999). For example, /g/ does not exist in the Thai language. It is possible that its acoustic, audible properties are salient and thus make the sounds easily distinguishable as predicted by the SLM.

Flege's Model continues to describe how students determine different sounds as time increases. Language learners discriminate sounds that differ in significantly greater ways over time indicating exactly what the table displays. Table 4.2 shows students having difficulty perceiving the sounds /dʒ/ and /ʒ/, which do not exist in Thai. One can conclude from this observation that while students cannot currently perceive these sounds, they will increase this ability over time and exposure to the sounds /dʒ/ and /ʒ/. The SLM and the results of this study of student perception show that students perceive certain sounds that do not exist in Thai differently. Perception performance is not as black and white as discriminating sounds that do not exist poorly and sounds that do exist well; the *degree* of sound difference seems to be a major factor.

#### 4.4.3 Discrimination of sounds with one known and one unknown

As stated in Chapter one, the sounds which do exist in Thai are /p/, /k/, /b/, /d/, /f/, and /s/ while the sounds /t/, /g/, /v/, /θ/, /ð/, /z/, /ʃ/, /ʒ/, /tʃ/ and /dʒ/ do not. Students performed most poorly when they discriminated one sound with which they were familiar against one sound with which they were not familiar. When students perform in tests they probably rely heavily on their familiar sound background to base their decisions. As a result, they often choose the answer they have heard, which is not always correct—they guess the meaning by using their

background. As with the previous section, students assimilate the unknown sounds to known sounds. This assimilation sometimes causes errors when the answer is a sound that does not exist in Thai. In contrast, the scores for other areas of sounds were better because the students more clearly knew whether the sounds were both non-native sounds, or both native sounds.

In summary, the SLM and the CPH offer plausible explanations for the results of this study. However, given its being small scale with no inferential statistics, the results should be taken as a starting point for further research. The following chapter will conclude this study.

## **CHAPTER 5**

### **CONCLUSION**

This chapter presents conclusions, limitations of the study and recommendations for further study.

#### **5.1 Conclusion**

Controlled tests for accuracy rates were conducted on two groups of learners to determine their perceptual ability when distinguishing sounds from specific domains of language learning. Three variables were analyzed; the syllabic position (onset, intervocalic and final), the consonant class, manner of articulation (stops, fricatives, and affricates) and the sound status in Thai (presence, absence). The tests also compared similarities and differences between both groups of learners given the differences in their years of schooling and age.

The results reveal not only little or no major difference between the two groups (M3 and M6) tested but in fact, in detailed analyses have shown M6 students who had more schooling experience in English were outperformed by their M3 counterparts in certain areas. The results were explained by the Speech Learning Model (Flege, 1995) and The Critical Period Hypothesis (Johnson & Newport, 1989).

#### **5.2 Pedagogical Recommendations**

This study is useful for Thai English teachers to know where they can more specifically place their focus when teaching English pronunciation. Certain English sounds are so similar to English and students easily assimilate these sounds to Thai. At the beginning of their pronunciation instruction Thai English teachers should give students knowledge to understand the different manners of articulation for those sounds of difficulty. The study may also help teachers highlight the importance of pronouncing voiced and voiceless sounds correctly. While not all teaching situations are ideal, the study also supports teaching these various pronunciation factors before

puberty in correlation with the Critical Period Hypothesis.

### **5.3 Limitations of the study**

Because the study used an elicitation task, which was relatively controlled, therefore it is important to note that learners do not necessarily rely solely on acoustic information when they listen to real speech. The test results should therefore be served as a theoretical-based observation as far as the acoustic properties of the sounds themselves in learners' perception, which is just one part of the learning mechanisms.

### **5.4 Recommendations for further research**

The results of the study suggest a possible effect of critical period hypothesis and confirmed the SLM predictions. There are many research avenues which can be pursued. A few important ones are suggested here. Further studies should follow up on age and year-of-study differences. It may be fruitful to widen the gap between the age and length of schooling experience. It may also be interesting to compare learners younger than M3 students against adult learners in order to test the critical period hypothesis. Future studies may also benefit from a comparison between perception and production of obstruents in both controlled and natural settings.



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## **APPENDICES**

**APPENDIX A**  
**DEMOGRAPHIC QUESTIONNAIRE**

แบบสอบถามข้อมูลส่วนตัว

เลขประจำตัวนักเรียน..... อายุ.....

เพศ .....ชาย .....หญิง .....ไม่ประสงค์จะระบุ  
ชั้น .....

ผลการเรียนวิชาภาษาอังกฤษภาคปลาย//2554.....

นักเรียนมีปัญหาการได้ยินหรือไม่ ..... มี ..... ไม่มี

การชมภาพยนตร์ภาษาอังกฤษ

นักเรียนชมภาพยนตร์ภาษาอังกฤษ (พากย์อังกฤษ) หรือไม่ ..... ชม ..... ไม่ชม

หากนักเรียนชมภาพยนตร์ภาษาอังกฤษ นักเรียนชมภาพยนตร์บ่อยแค่ไหน (โดยเฉลี่ย) .....เรื่อง/ปี

นักแสดงที่นักเรียนชื่นชอบ .....

การฟังเพลงภาษาอังกฤษ

นักเรียนฟังเพลงภาษาอังกฤษหรือไม่ ..... ฟัง ..... ไม่ฟัง

หากนักเรียนฟังเพลงภาษาอังกฤษ นักเรียนฟังบ่อยแค่ไหน (โดยเฉลี่ย)

..... นานๆ ครั้ง ..... บางครั้ง ..... เป็นประจำ

นักร้องที่นักเรียนชื่นชอบ .....

เพลงที่นักเรียนชื่นชอบ.....

เพื่อนที่นักเรียนชื่นชอบ

นักเรียนมีเพื่อนชาวต่างชาติที่ต้องใช้ภาษาอังกฤษในการสื่อสารหรือไม่ ..... มี ..... ไม่มี

หากมีนักเรียนสื่อสารกับเพื่อนอย่างไร

.....ผ่านการพิมพ์/การเขียน .....ผ่านการพูด

นักเรียนสื่อสารกับเพื่อนบ่อยแค่ไหน

..... นานๆ ครั้ง ..... บางครั้ง ..... เป็นประจำ

เพื่อนของนักเรียนดังกล่าวมาจากประเทศอะไร (ตอบได้มากกว่าหนึ่งประเทศ ตามความเป็นจริง

.....

**APPENDIX B**  
**DISCRIMINATION SCORES FOR MATTAYOMSUKSA**  
**3/8 & 3/9 (MALE)**



| Number | 1st | 2nd | 3rd | Total |
|--------|-----|-----|-----|-------|
| 1      | 51  | 48  | 50  | 149   |
| 2      | 43  | 46  | 44  | 133   |
| 3      | 53  | 45  | 50  | 148   |
| 4      | 47  | 51  | 46  | 144   |
| 5      | 43  | 42  | 43  | 128   |
| 6      | 38  | 40  | 40  | 118   |
| 7      | 53  | 52  | 44  | 149   |
| 8      | 39  | 45  | 49  | 133   |
| 9      | 45  | 44  | 42  | 131   |
| 10     | 53  | 44  | 50  | 147   |
| 11     | 43  | 36  | 44  | 123   |
| 12     | 46  | 47  | 45  | 138   |
| 13     | 48  | 42  | 50  | 140   |
| 14     | 49  | 46  | 46  | 141   |
| 15     | 45  | 51  | 44  | 140   |
| 16     | 46  | 44  | 50  | 140   |
| 17     | 48  | 48  | 41  | 137   |
| 18     | 49  | 48  | 51  | 148   |
| 19     | 40  | 45  | 27  | 112   |
| 20     | 51  | 46  | 50  | 148   |
| 21     | 46  | 46  | 50  | 142   |
| 22     | 47  | 52  | 55  | 154   |
| 23     | 38  | 44  | 42  | 124   |
| 24     | 44  | 44  | 45  | 133   |
| 25     | 54  | 50  | 45  | 149   |
| 26     | 49  | 41  | 44  | 134   |
| 27     | 55  | 50  | 47  | 152   |
| 28     | 49  | 48  | 52  | 149   |
| 29     | 46  | 44  | 47  | 137   |
| 30     | 54  | 49  | 56  | 159   |

| Number | 1st | 2nd | 3rd | Total |
|--------|-----|-----|-----|-------|
| 31     | 52  | 56  | 55  | 163   |
| 32     | 34  | 37  | 34  | 105   |
| 33     | 57  | 58  | 57  | 172   |
| 34     | 34  | 39  | 31  | 104   |
| 35     | 44  | 48  | 46  | 138   |
| 36     | 44  | 39  | 44  | 127   |
| 37     | 44  | 43  | 51  | 138   |
| 38     | 35  | 31  | 51  | 138   |
| 39     | 40  | 31  | 38  | 107   |

Discrimination Scores for Mattayomsuksa 3/8 & 3/9 (Female)

| Number | 1st | 2nd | 3rd | Total |
|--------|-----|-----|-----|-------|
| 1      | 51  | 51  | 44  | 146   |
| 2      | 50  | 50  | 54  | 154   |
| 3      | 43  | 46  | 48  | 137   |
| 4      | 48  | 47  | 44  | 139   |
| 5      | 48  | 47  | 45  | 140   |
| 6      | 55  | 54  | 53  | 161   |
| 7      | 49  | 47  | 45  | 141   |
| 8      | 48  | 48  | 36  | 132   |
| 9      | 44  | 44  | 41  | 129   |
| 10     | 49  | 42  | 45  | 136   |
| 11     | 45  | 43  | 52  | 140   |
| 12     | 48  | 47  | 48  | 143   |
| 13     | 50  | 49  | 51  | 150   |
| 14     | 48  | 45  | 43  | 136   |
| 15     | 44  | 46  | 42  | 132   |
| 16     | 46  | 43  | 43  | 132   |
| 17     | 46  | 45  | 44  | 135   |
| 18     | 47  | 50  | 49  | 146   |
| 19     | 44  | 43  | 43  | 130   |
| 20     | 42  | 52  | 49  | 143   |
| 21     | 40  | 36  | 37  | 113   |
| 22     | 42  | 47  | 45  | 134   |
| 23     | 49  | 42  | 38  | 129   |
| 24     | 44  | 45  | 48  | 137   |
| 25     | 51  | 48  | 42  | 141   |
| 26     | 43  | 39  | 41  | 123   |
| 27     | 46  | 44  | 44  | 134   |
| 28     | 47  | 47  | 52  | 145   |
| 29     | 45  | 47  | 44  | 136   |

| Number | 1st | 2nd | 3rd | Total |
|--------|-----|-----|-----|-------|
| 30     | 52  | 47  | 45  | 144   |
| 31     | 45  | 51  | 47  | 143   |
| 32     | 44  | 44  | 42  | 130   |
| 33     | 43  | 47  | 50  | 140   |
| 34     | 48  | 50  | 51  | 149   |
| 35     | 39  | 47  | 45  | 131   |
| 36     | 47  | 47  | 47  | 141   |
| 37     | 41  | 40  | 45  | 126   |
| 38     | 51  | 53  | 52  | 156   |
| 39     | 47  | 52  | 49  | 148   |
| 40     | 52  | 55  | 53  | 160   |
| 41     | 47  | 51  | 46  | 144   |
| 42     | 50  | 51  | 57  | 158   |
| 43     | 51  | 58  | 57  | 166   |
| 44     | 57  | 58  | 57  | 166   |
| 45     | 45  | 41  | 41  | 127   |
| 46     | 53  | 41  | 52  | 152   |
| 47     | 37  | 46  | 49  | 132   |
| 48     | 47  | 46  | 47  | 140   |
| 49     | 42  | 44  | 44  | 130   |
| 50     | 55  | 47  | 55  | 157   |
| 51     | 45  | 42  | 44  | 131   |
| 52     | 51  | 50  | 48  | 149   |
| 53     | 49  | 46  | 51  | 146   |
| 54     | 34  | 36  | 40  | 110   |
| 55     | 49  | 45  | 39  | 133   |
| 56     | 37  | 40  | 46  | 127   |
| 57     | 50  | 47  | 45  | 142   |
| 58     | 36  | 32  | 36  | 104   |
| 59     | 50  | 51  | 45  | 165   |

| Number | 1st | 2nd | 3rd | Total |
|--------|-----|-----|-----|-------|
| 60     | 51  | 48  | 51  | 150   |
| 61     | 46  | 48  | 43  | 137   |
| 62     | 50  | 49  | 45  | 144   |
| 63     | 49  | 48  | 46  | 143   |
| 64     | 44  | 43  | 51  | 138   |
| 65     | 47  | 46  | 51  | 136   |
| 66     | 44  | 44  | 44  | 132   |
| 67     | 48  | 47  | 47  | 142   |
| 68     | 49  | 53  | 53  | 155   |

**Discrimination Scores for Mattayomsuksa 6/8 & 6/9 (Male)**

| <b>Number</b> | <b>1st</b> | <b>2nd</b> | <b>3rd</b> | <b>Total</b> |
|---------------|------------|------------|------------|--------------|
| 1             | 46         | 52         | 45         | 143          |
| 2             | 47         | 50         | 49         | 146          |
| 3             | 46         | 43         | 43         | 132          |
| 4             | 49         | 53         | 47         | 149          |
| 5             | 50         | 45         | 43         | 138          |
| 6             | 43         | 46         | 48         | 137          |
| 7             | 42         | 41         | 43         | 126          |
| 8             | 45         | 38         | 38         | 121          |
| 9             | 49         | 48         | 44         | 141          |
| 10            | 53         | 50         | 56         | 159          |
| 11            | 49         | 47         | 54         | 150          |
| 12            | 50         | 51         | 49         | 144          |
| 13            | 40         | 42         | 43         | 125          |
| 14            | 49         | 44         | 47         | 140          |
| 15            | 55         | 51         | 52         | 158          |
| 16            | 39         | 35         | 42         | 116          |
| 17            | 31         | 27         | 31         | 89           |
| 18            | 49         | 45         | 50         | 144          |
| 19            | 50         | 46         | 50         | 146          |
| 20            | 43         | 44         | 41         | 128          |
| 21            | 55         | 49         | 55         | 159          |
| 22            | 47         | 51         | 53         | 151          |
| 23            | 54         | 49         | 55         | 158          |
| 24            | 53         | 46         | 47         | 146          |
| 25            | 37         | 38         | 44         | 119          |
| 26            | 52         | 46         | 49         | 147          |
| 27            | 46         | 51         | 48         | 145          |
| 28            | 47         | 49         | 38         | 134          |
| 29            | 47         | 47         | 50         | 144          |

| Number | 1st | 2nd | 3rd | Total |
|--------|-----|-----|-----|-------|
| 30     | 44  | 42  | 45  | 131   |
| 31     | 54  | 53  | 50  | 157   |
| 32     | 35  | 26  | 36  | 97    |
| 33     | 53  | 56  | 52  | 161   |
| 34     | 46  | 44  | 39  | 129   |
| 35     | 51  | 47  | 48  | 146   |
| 36     | 44  | 41  | 47  | 132   |

Discrimination Scores for Mattayomsuksa6/8 and 6/9 (Female)

| Number | 1st | 2nd | 3rd | Total |
|--------|-----|-----|-----|-------|
| 1      | 49  | 49  | 56  | 154   |
| 2      | 50  | 46  | 51  | 147   |
| 3      | 44  | 45  | 52  | 141   |
| 4      | 47  | 44  | 44  | 135   |
| 5      | 46  | 46  | 43  | 135   |
| 6      | 46  | 44  | 46  | 136   |
| 7      | 45  | 41  | 47  | 133   |
| 8      | 50  | 47  | 52  | 149   |
| 9      | 44  | 52  | 50  | 146   |
| 10     | 53  | 45  | 45  | 143   |
| 11     | 48  | 46  | 48  | 142   |
| 12     | 52  | 49  | 54  | 155   |
| 13     | 53  | 46  | 49  | 148   |
| 14     | 51  | 48  | 43  | 142   |
| 15     | 46  | 50  | 36  | 132   |
| 16     | 46  | 47  | 44  | 137   |
| 17     | 53  | 44  | 44  | 141   |
| 18     | 48  | 48  | 45  | 141   |
| 19     | 44  | 49  | 48  | 141   |
| 20     | 59  | 55  | 53  | 167   |
| 21     | 48  | 53  | 49  | 150   |
| 22     | 30  | 35  | 35  | 100   |
| 23     | 46  | 41  | 42  | 129   |
| 24     | 42  | 44  | 40  | 126   |
| 25     | 45  | 48  | 50  | 143   |
| 26     | 47  | 50  | 46  | 143   |
| 27     | 45  | 46  | 47  | 138   |
| 28     | 43  | 45  | 44  | 132   |
| 29     | 44  | 47  | 44  | 135   |



| Number | 1st | 2nd | 3rd | Total |
|--------|-----|-----|-----|-------|
| 30     | 50  | 52  | 49  | 151   |
| 31     | 41  | 45  | 46  | 132   |
| 32     | 51  | 49  | 43  | 143   |
| 33     | 50  | 49  | 48  | 147   |
| 34     | 46  | 45  | 45  | 136   |
| 35     | 56  | 55  | 52  | 163   |
| 36     | 48  | 47  | 48  | 143   |
| 37     | 40  | 42  | 40  | 122   |
| 38     | 58  | 57  | 54  | 172   |
| 39     | 43  | 47  | 43  | 133   |
| 40     | 54  | 54  | 50  | 158   |
| 41     | 54  | 47  | 47  | 148   |
| 42     | 45  | 44  | 44  | 133   |
| 43     | 52  | 46  | 45  | 143   |
| 44     | 50  | 50  | 55  | 155   |
| 45     | 47  | 52  | 47  | 146   |
| 46     | 50  | 47  | 50  | 147   |
| 47     | 51  | 45  | 45  | 141   |
| 48     | 43  | 49  | 45  | 137   |
| 49     | 48  | 56  | 50  | 154   |
| 50     | 46  | 49  | 44  | 139   |
| 51     | 49  | 48  | 54  | 151   |
| 52     | 55  | 51  | 49  | 155   |
| 53     | 47  | 45  | 48  | 140   |
| 54     | 57  | 48  | 51  | 156   |
| 55     | 54  | 45  | 47  | 146   |
| 56     | 45  | 44  | 45  | 134   |
| 57     | 33  | 55  | 58  | 164   |

**APPENDIX C**  
**LIST OF LISTENING STIMULI**

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- |                   |                   |                   |
|-------------------|-------------------|-------------------|
| 1. /az/-/az/      | 25. /aba/-/apa/   | 49. /ap/-/ap/     |
| 2. /ata/-/ata/    | 26. /fa/-/fa/     | 50. /aga/-/aga/   |
| 3. /ða/-/ða/      | 27. /ba/-/ba/     | 51. /adʒ/-/adʒ/   |
| 4. /fa/-/va/      | 28. /aθ/-/aθ/     | 52. /sa/-/sa/     |
| 5. /ak/-/ak/      | 29. /ak/-/ag/     | 53. /θa/-/θa/     |
| 6. /aθ/-/að/      | 30. /za/-/sa/     | 54. /af/-/av/     |
| 7. /aθa/-/aða/    | 31. /aʃa/-/aʒa/   | 55. /ta/-/ta/     |
| 8. /aka/-/aga/    | 32. /afa/-/ava/   | 56. /θa/-/ða/     |
| 9. /ka/-/ga/      | 33. /asa/-/aza/   | 57. /ava/-/ava/   |
| 10. /af/-/af/     | 34. /av/-/av/     | 58. /aʃ/-/aʒ/     |
| 11. /afa/-/afa/   | 35. /ab/-/ab/     | 59. /ʃa/-/ʒa/     |
| 12. /aba/-/aba/   | 36. /aʃa/-/aʃa/   | 60. /az/-/as/     |
| 13. /da/-/ta/     | 37. /aða/-/aða/   | 61. /ka/-/ka/     |
| 14. /aʃ/-/aʃ/     | 38. /ag/-/ag/     | 62. /at/-/at/     |
| 15. /va/-/va/     | 39. /ada/-/ata/   | 63. /dʒa/-/dʒa/   |
| 16. /da/-/da/     | 40. /ada/-/ada/   | 64. /að/-/að/     |
| 17. /aθa/-/aθa/   | 41. /adʒa/-/adʒa/ | 65. /ʃa/-/ʃa/     |
| 18. /atʃa/-/atʃa/ | 42. /ʒa/-/ʒa/     | 66. /atʃ/-/adʒ/   |
| 19. /aʒ/-/aʒ/     | 43. /tʃa/-/tʃa/   | 67. /atʃa/-/adʒa/ |
| 20. /atʃ/-/atʃ/   | 44. /ad/-/ad/     | 68. /ga/-/ga/     |
| 21. /aʒa/-/aʒa/   | 45. /tʃa/-/dʒa/   | 69. /aka/-/aka/   |
| 22. /ab/-/ap/     | 46. /apa/-/apa/   | 70. /pa/-/pa/     |
| 23. /za/-/za/     | 47. /ba/-/pa/     | 71. /ad/-/at/     |
| 24. /as/-/as/     | 48. /asa/-/asa/   | 72. /aza/-/aza/   |

**APPENDIX D**  
**EXAMPLES OF CODING SHEETS**

| Class | Number | Gender | Item 1 | Item 3 | Item 3 | Item 4 | Item 5 | Item 6 |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|
| 6     | 1      | 1      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 2      | 1      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 3      | 2      | 1      | 1      | 0      | 0      | 1      | 0      |
| 6     | 4      | 2      | 1      | 1      | 1      | 0      | 1      | 1      |
| 6     | 5      | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 6      | 2      | 1      | 0      | 1      | 0      | 1      | 1      |
| 6     | 7      | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 8      | 2      | 1      | 1      | 0      | 1      | 1      | 0      |
| 6     | 9      | 1      | 1      | 0      | 1      | 0      | 1      | 1      |
| 6     | 10     | 1      | 1      | 1      | 0      | 0      | 1      | 0      |
| 6     | 11     | 2      | 1      | 0      | 0      | 0      | 1      | 1      |
| 6     | 12     | 1      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 13     | 2      | 1      | 1      | 0      | 1      | 1      | 1      |
| 6     | 14     | 2      | 1      | 0      | 1      | 0      | 1      | 0      |
| 6     | 15     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 16     | 2      | 1      | 0      | 0      | 0      | 0      | 1      |
| 6     | 17     | 1      | 1      | 0      | 1      | 0      | 1      | 1      |
| 6     | 18     | 2      | 1      | 0      | 1      | 0      | 1      | 1      |
| 6     | 19     | 1      | 1      | 0      | 1      | 1      | 0      | 1      |
| 6     | 20     | 1      | 0      | 1      | 1      | 1      | 1      | 1      |
| 6     | 21     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 22     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 23     | 2      | 1      | 0      | 0      | 0      | 1      | 1      |
| 6     | 24     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 25     | 1      | 1      | 1      | 0      | 1      | 1      | 1      |
| 6     | 26     | 1      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 27     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 28     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 29     | 2      | 0      | 1      | 0      | 0      | 1      | 1      |
| 6     | 30     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |

| Class | Number | Gender | Item 1 | Item 3 | Item 3 | Item 4 | Item 5 | Item 6 |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|
| 6     | 31     | 1      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 32     | 2      | 1      | 1      | 1      | 0      | 0      | 0      |
| 6     | 33     | 2      | 1      | 0      | 0      | 0      | 1      | 0      |
| 6     | 34     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 35     | 1      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 36     | 1      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 37     | 1      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 38     | 1      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 39     | 2      | 1      | 0      | 1      | 0      | 1      | 1      |
| 6     | 40     | 1      | 1      | 1      | 0      | 1      | 1      | 0      |
| 6     | 41     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 42     | 2      | 1      | 1      | 1      | 0      | 1      | 1      |
| 6     | 43     | 1      | 1      | 0      | 0      | 0      | 1      | 0      |
| 6     | 44     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 45     | 2      | 1      | 1      | 0      | 1      | 1      | 1      |
| 6     | 46     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 47     | 1      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 48     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 49     | 2      | 0      | 1      | 0      | 0      | 1      | 1      |
| 6     | 50     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 51     | 1      | 1      | 0      | 0      | 1      | 1      | 1      |
| 6     | 52     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 53     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 54     | 2      | 1      | 0      | 1      | 0      | 1      | 0      |
| 6     | 55     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 56     | 1      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 57     | 2      | 1      | 0      | 1      | 0      | 1      | 1      |
| 6     | 58     | 1      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 59     | 1      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 60     | 1      | 1      | 1      | 0      | 0      | 1      | 1      |

| Class | Number | Gender | Item 1 | Item 3 | Item 3 | Item 4 | Item 5 | Item 6 |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|
| 6     | 61     | 1      | 1      | 1      | 0      | 0      | 0      | 1      |
| 6     | 62     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 63     | 1      | 0      | 0      | 0      | 1      | 0      | 0      |
| 6     | 64     | 1      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 65     | 1      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 66     | 1      | 1      | 1      | 0      | 0      | 0      | 1      |
| 6     | 67     | 1      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 68     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 69     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 70     | 1      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 71     | 2      | 1      | 0      | 0      | 0      | 1      | 1      |
| 6     | 72     | 2      | 1      | 1      | 1      | 0      | 1      | 1      |
| 6     | 73     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 74     | 2      | 1      | 0      | 1      | 0      | 1      | 0      |
| 6     | 75     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 76     | 1      | 1      | 0      | 1      | 1      | 1      | 1      |
| 6     | 77     | 1      | 1      | 0      | 1      | 1      | 0      | 0      |
| 6     | 78     | 2      | 1      | 0      | 0      | 0      | 1      | 1      |
| 6     | 79     | 1      | 1      | 0      | 0      | 0      | 1      | 1      |
| 6     | 80     | 2      | 1      | 0      | 0      | 1      | 1      | 1      |
| 6     | 81     | 2      | 1      | 1      | 0      | 0      | 0      | 1      |
| 6     | 82     | 1      | 1      | 1      | 0      | 1      | 0      | 1      |
| 6     | 83     | 2      | 1      | 0      | 0      | 0      | 1      | 1      |
| 6     | 84     | 2      | 1      | 0      | 0      | 0      | 0      | 1      |
| 6     | 85     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 86     | 1      | 1      | 1      | 1      | 0      | 1      | 1      |
| 6     | 87     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 88     | 2      | 1      | 0      | 1      | 0      | 1      | 1      |
| 6     | 89     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 90     | 1      | 0      | 1      | 0      | 1      | 1      | 1      |

| Class | Number | Gender | Item 1 | Item 3 | Item 3 | Item 4 | Item 5 | Item 6 |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|
| 6     | 91     | 1      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 92     | 2      | 1      | 1      | 0      | 0      | 1      | 1      |
| 6     | 93     | 2      | 1      | 1      | 0      | 0      | 0      | 1      |



**APPENDIX E**  
**EXAMPLES OF PERCENTAGE CODING SHEETS**

| Item 1   | Item 2   | Item 3   | Item 4   | Item 5   | Item 6   | Item 7   |
|----------|----------|----------|----------|----------|----------|----------|
| 1        | 1        | 0.333333 | 0        | 1        | 1        | 0.333333 |
| 1        | 1        | 0.333333 | 0.333333 | 1        | 1        | 0.333333 |
| 1        | 1        | 0        | 0        | 1        | 0.666667 | 1        |
| 1        | 1        | 0.666667 | 0.333333 | 1        | 0.666667 | 0.333333 |
| 1        | 1        | 0        | 0        | 1        | 1        | 0.666667 |
| 1        | 0.666667 | 1        | 0        | 1        | 1        | 0.333333 |
| 1        | 1        | 0.666667 | 0.666667 | 1        | 1        | 0.333333 |
| 1        | 1        | 0        | 0.333333 | 0.666667 | 0.666667 | 0.333333 |
| 1        | 0.666667 | 1        | 0        | 1        | 1        | 0.333333 |
| 1        | 1        | 0        | 0        | 1        | 0        | 1        |
| 1        | 0.666667 | 0.666667 | 0        | 1        | 1        | 0.666667 |
| 1        | 1        | 0.666667 | 0        | 1        | 1        | 0.333333 |
| 1        | 1        | 0.666667 | 0.666667 | 1        | 0.666667 | 0.666667 |
| 1        | 0.666667 | 1        | 0        | 1        | 0.333333 | 0.333333 |
| 1        | 0.666667 | 0.666667 | 0        | 1        | 1        | 0        |
| 1        | 0.666667 | 0.666667 | 0.333333 | 0.333333 | 1        | 0.666667 |
| 1        | 0.666667 | 0.333333 | 0.333333 | 1        | 0.666667 | 0.333333 |
| 1        | 0.666667 | 0.666667 | 0        | 1        | 1        | 0.333333 |
| 1        | 0.666667 | 1        | 0.333333 | 0.666667 | 0.666667 | 0        |
| 0.333333 | 0.666667 | 0.333333 | 1        | 0.666667 | 0.666667 | 0.333333 |
| 1        | 1        | 0        | 0.333333 | 1        | 0.333333 | 1        |
| 1        | 1        | 0.666667 | 0        | 1        | 1        | 0.666667 |
| 1        | 0.333333 | 0.333333 | 0        | 0.666667 | 0.666667 | 0.333333 |
| 0.666667 | 1        | 0        | 0        | 0.666667 | 0.666667 | 0.666667 |
| 1        | 1        | 0        | 0.333333 | 1        | 1        | 1        |
| 1        | 1        | 0.333333 | 0.333333 | 1        | 0.666667 | 0.666667 |
| 0.666667 | 1        | 0        | 0        | 0.666667 | 0.666667 | 0.333333 |
| 1        | 1        | 0        | 0        | 0.666667 | 1        | 0        |
| 0.666667 | 1        | 0        | 0        | 1        | 1        | 0.333333 |
| 1        | 1        | 0        | 0        | 1        | 0.333333 | 1        |

| Item 1   | Item 2   | Item 3   | Item 4   | Item 5   | Item 6   | Item 7   |
|----------|----------|----------|----------|----------|----------|----------|
| 1        | 1        | 0        | 0        | 1        | 1        | 0.666667 |
| 1        | 1        | 1        | 0.666667 | 0.666667 | 0.333333 | 0.666667 |
| 0.666667 | 0.666667 | 0        | 0.666667 | 0.333333 | 0.333333 | 1        |
| 1        | 1        | 0        | 0        | 1        | 1        | 1        |
| 1        | 1        | 0        | 0        | 1        | 1        | 0.333333 |
| 1        | 1        | 0.666667 | 0        | 0.666667 | 0.666667 | 1        |
| 1        | 1        | 0.666667 | 0        | 0.666667 | 1        | 0.333333 |
| 1        | 1        | 0.666667 | 0        | 1        | 0.333333 | 0.666667 |
| 1        | 0.333333 | 0.666667 | 0.333333 | 1        | 0.666667 | 0.333333 |
| 0.666667 | 0.666667 | 0.333333 | 0.666667 | 1        | 0.333333 | 0.666667 |
| 1        | 1        | 0.666667 | 0.333333 | 1        | 1        | 1        |
| 1        | 1        | 1        | 0        | 1        | 1        | 0.666667 |
| 0.333333 | 0        | 0.666667 | 0.333333 | 0.666667 | 0.333333 | 1        |
| 1        | 1        | 0        | 0        | 1        | 1        | 0.333333 |
| 1        | 1        | 0.666667 | 0.333333 | 1        | 1        | 0.666667 |
| 1        | 1        | 0.333333 | 0.333333 | 1        | 1        | 0        |
| 1        | 0.666667 | 0.333333 | 0.333333 | 1        | 1        | 0.666667 |
| 1        | 1        | 0.333333 | 0        | 1        | 1        | 0.333333 |
| 0.666667 | 1        | 0.666667 | 0        | 1        | 1        | 1        |
| 1        | 1        | 0.333333 | 0.333333 | 1        | 1        | 1        |
| 1        | 0.666667 | 0.666667 | 0.666667 | 1        | 0.666667 | 0        |
| 1        | 1        | 0.333333 | 0        | 1        | 1        | 0.666667 |
| 1        | 1        | 0.333333 | 0        | 1        | 1        | 0.333333 |
| 1        | 0.666667 | 1        | 0        | 1        | 0        | 0.666667 |
| 1        | 1        | 0.666667 | 0        | 1        | 1        | 1        |
| 1        | 1        | 0.333333 | 0.333333 | 1        | 1        | 0        |
| 1        | 0.666667 | 1        | 0        | 1        | 1        | 0.333333 |
| 1        | 1        | 0.333333 | 0        | 1        | 0.333333 | 0        |
| 1        | 1        | 0.666667 | 0        | 1        | 1        | 0        |
| 1        | 1        | 0.333333 | 0        | 1        | 0.333333 | 0        |

| Item 1   | Item 2   | Item 3   | Item 4   | Item 5   | Item 6   | Item 7   |
|----------|----------|----------|----------|----------|----------|----------|
| 1        | 1        | 0        | 0.333333 | 0.333333 | 1        | 0.333333 |
| 1        | 1        | 0        | 0.666667 | 1        | 0.333333 | 1        |
| 0.333333 | 0.666667 | 0.666667 | 0.333333 | 0.666667 | 0        | 0.333333 |
| 1        | 1        | 0.333333 | 0.333333 | 1        | 0.666667 | 0.333333 |
| 1        | 1        | 0        | 0.333333 | 0.666667 | 1        | 1        |
| 1        | 1        | 0.333333 | 0.333333 | 0.666667 | 1        | 0.333333 |
| 1        | 1        | 0.333333 | 0.333333 | 1        | 1        | 1        |
| 1        | 1        | 0        | 0        | 1        | 1        | 1        |
| 1        | 1        | 0.333333 | 0        | 1        | 1        | 1        |
| 1        | 1        | 0        | 0        | 1        | 1        | 0        |
| 1        | 0.333333 | 0        | 0.333333 | 1        | 0.333333 | 1        |
| 0.666667 | 1        | 0.333333 | 0        | 1        | 1        | 0.333333 |
| 1        | 1        | 0        | 0        | 1        | 1        | 0.666667 |
| 1        | 0.666667 | 1        | 0        | 1        | 0        | 0.333333 |
| 1        | 1        | 0.333333 | 0.333333 | 1        | 0.333333 | 0.333333 |
| 1        | 0.666667 | 0.666667 | 1        | 1        | 1        | 0.666667 |
| 0.333333 | 0.666667 | 0.333333 | 0.333333 | 0        | 0.333333 | 0.666667 |
| 1        | 0.666667 | 0.333333 | 0.666667 | 0.666667 | 1        | 1        |
| 0.666667 | 0.666667 | 0.333333 | 0        | 1        | 1        | 1        |
| 1        | 0.666667 | 0        | 1        | 1        | 1        | 0.333333 |