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THE CORRELATION OF ONSET AGE AND OF INSTRUCTION TIME IN SCHOOL TO TAIWANESE EFL LEARNERS' PERCEPTION OF ENGLISH VOWELS

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ABSTRACT

This study primarily investigated the correlations of age of first exposure to formal English instruction and of the average number of hours per week of formal English instruction prior to enrollment in university to Taiwanese EFL learners' perceptual accuracy of four English vowels (/I/, /iy/, /ɛ/ and /ey/). A total of 104 freshmen from a single university in northern Taiwan participated in this study. Their accuracy in recognizing the tested vowels was evaluated by a listening identification test developed by the researcher. In addition, a questionnaire based on modifications of those of Cheung (2006) and Kuo (2001) was utilized to collect information about the students' language background. A series of Pearson Product-Moment Correlations demonstrated that the age of initial exposure to formal English instruction and the weekly amount of English instruction time at school showed significant correlations with the Taiwanese first-year university EFL learners' perceptual accuracy of certain tested vowels. The results of this study suggest that a critical period exists for foreign language acquisition of perception of vowels and that the extension of the amount of formal English instruction of EFL learners should start at an earlier stage of life.

Key Words: critical period, age of arrival (AOA), length of residence (LOR), second language acquisition (SLA), foreign language acquisition (FLA), perception of vowels

INTRODUCTION

Since Lenneberg first proposed his Critical Period Hypothesis (CPH) in 1967, the relationship between age and language acquisition (LA) has been extensively discussed. Originally, Lenneberg's hypothesis was applied to the field of first language

(L1) acquisition. Later on, second language (L2) researchers extrapolated it to second language contexts (Brown, 2000). In the second language acquisition (SLA) area, many studies have been conducted to investigate whether age plays an important role in L2 learners' proficiency in the target language. Most of the studies have focused on L2 phonology and grammar and have produced mixed results (Baker & Trofimovich, 2006; Bialystok & Miller, 1999; Bongaerts, 1999; Fathman, 1975; Flege, 1988; Flege, 1993; Flege, MacKay, & Meador, 1999; Flege, Munro, & MacKay, 1995; Flege, Schmidt, & Wharton, 1996; Harley, 1986; Johnson & Newport, 1989; Nikolov, 2000; Olson & Samuels, 1973; Snow & Hoefnagel-Hohle, 1977; Thogmartin, 1982; Wang & Kuhl, 2003).

Flege, Mackay, and Meador (1999) examined the perception and production of English vowels by seventy-two Italian English bilinguals, who were further divided into four subgroups based on their age of arrival (AOA) in Canada and the amount of Italian which they used. The first three groups, designated as early, mid and late groups respectively, differed in their AOA.[1] The fourth group (early-low group) was matched to the early group for AOA but reported using Italian less. All of the participants were evaluated on their accuracy in the perception and production of English vowels by means of a categorical discrimination test and an intelligibility test. The results of the tests showed that the later in life the native Italian participants began to learn English, the less accurately they perceived and produced English vowels. Flege, Munro, and MacKay (1995) reported that the perceived foreign accent of native Italian (NI) learners of English increased as their age of learning English increased. The later the NI subjects began learning English, the lower the ratings on their pronunciation of English sentences. Johnson and Newport (1989) showed that the accuracy of their Chinese and Korean participants in judging English grammatical structures decreased as the participants' age increased. In contrast, Bongaerts, Mennen, and Slik (2000) and Bialystok and Miller (1999) found that age is not a crucial determinant in SLA. In order to demonstrate that it was possible that L2 adult learners could also have a near native-like pronunciation, Bongaerts et al. (2000) examined the production of ten Dutch sentences by adult learners of

[1] The mean AOA for the early group was 7 years, that for the mid group 14 years, and that for late group 19 years.

different L1s. All of the participants were also advanced late learners of Dutch as an L2. They had settled in the Netherlands after the age of twelve and had acquired Dutch mainly in a naturalistic, non-classroom setting. The results of the study showed that at least two out of the thirty advanced late adult participants were found to fall within the category of that of native speaker-like performance. This finding was taken as evidence to disprove the CPH. Furthermore, a study by Bialystok and Miller (1999) investigated the performance of two Chinese age groups and two Spanish age groups on a grammaticality judgment test based on five structures of English grammar in both an oral and written form.[2] The results showed that while there were differences in proficiency in the handling of the grammaticality judgment task between the early Spanish group and the late Spanish group, no such differences were found between the early Chinese group and the late Chinese group. The researchers interpreted this outcome as failing to provide sufficient evidence to support the CPH. The findings of these latter studies tend to disconfirm the hypothesis that age is a critical element for SLA.

Given the conflicting findings above, it is apparent that there is no absolute answer to the question of whether early exposure to a L2 leads to better proficiency in that language. As little work has been done in the past regarding the relationship between the age of starting formal foreign language (FL) instruction and ultimate FL proficiency, the current study thus examines whether early exposure to formal English instruction is related to more accurate perception of four English vowels (/I/, /iy/, /ɛ/ and /ey/) to help solve the puzzle of the role of age in foreign language acquisition (FLA) (i.e., whether a critical period exists for FLA).

In addition to the age issue, length of residence (LOR) in the target country is another one of the main factors that has been investigated by L2 researchers. Like age, studies have been done on how LOR affects performance in the fields of L2 phonology and morphosyntax; however, such studies have produced contrasting outcomes. Some of them have argued for an effect of LOR in SLA (Asher & Garcia, 1969; Bialystok, 1997; Flege, Bohn, & Jang, 1997; Flege et al., 1995; Slavoff & Johnson, 1995; Yamada, 1995), whereas others have not (McAllister, 2001; Moyer, 1999; Piper & Dilek, 1988; Scales, Wennerstrom, Richard, & Wu, 2006).

Asher and Garcia (1969) tested the pronunciation of four English sentences by seventy-one Cuban immigrants which contained English

[2] The early groups arrived in Canada before age 15 and the late groups after age 15.

sounds that most Spanish speakers find difficult. The performance of the participants was compared with respect to their AOA and LOR. Regarding the influence of LOR, the statistical outcomes of the research indicated that about half of the Cuban children who had lived in the U.S. for 5 to 8 years had a near native-like pronunciation while only 15% of those who had lived in the U.S. for four years or less had a near native-like pronunciation. It was concluded that LOR was an important factor affecting the pronunciation of L2 learners. Flege, Bohn, and Jang (1997) assessed the perception and production of the English vowels /i I ɛ æ/ by twenty speakers each of German, Spanish, Mandarin, and Korean. The participants were divided into two groups based on their LOR in the US.[3] The results of the study also showed that the experienced group was more accurate in its perception and production of the English vowels than the inexperienced group. The research findings above demonstrated that LOR played a part in SLA. In contrast, Baker and Trofimovich (2006) performed two experiments, one of which was to determine whether AOA and LOR would affect the accuracy of L2 learners in perceiving and producing English vowels. The participants of this study were forty Korean learners of English, who were divided into four groups on the basis of their AOA and LOR in the U.S.[4] They were asked to recognize and produce six English vowels in two separate tasks—an open choice identification task and a word production task. Tukey HSD post-hoc tests revealed that the Early group perceived and produced the English vowels in an accurate degree similar to that of the native English (NE) control group, whereas the three late groups all scored lower in their perception and production of the vowels than the NE and the Early groups. The test results also showed that among the late groups, the Late+3 and the Late+10 groups did not perceive the English vowels significantly more accurately than the Late+0 group. These results demonstrated that the participants' perceptual and productive proficiencies of the English vowels were determined solely by their AOA, not LOR. In addition, Piper and Dilek (1988) investigated the effects of AOA, LOR, and linguistic contexts on the foreign accent of L2

[3] The mean LOR of the experienced group was 7.3 years, and that of the inexperienced group 0.7 years.

[4] Late+0 group (mean AOA=29, mean LOR=0.2 years), Late+3 group (mean AOA=24, mean LOR=3 years), Late+10 group (mean AOA=21, mean LOR=10 years), and Early group (mean AOA=9, mean LOR=11 years)

learners. Twenty-nine advanced ESL (English as a second language) students from two campuses of a Vancouver community college were interviewed individually to answer personal questions, read a short story out loud, and retell a personal narrative. According to the ratings given by thirteen native-speaker judges, only the AOA variable was proved valid in influencing the participants' foreign accent. LOR and linguistic contexts were not found to be significant. From the evidence provided above, the role of LOR in SLA is still unclear.

Some L2 researchers have argued that one of the main reasons for the ambiguous effect of LOR was that the variable was confounded with the age factor since LOR normally increases as AOA decreases. Among many L2 studies, these two variables were examined at the same time (Asher & Garcia, 1969; Flege, 1988; Flege et al., 1995; Moyer, 1999; Piper & Dilek, 1988; Slavoff & Johnson, 1995; Yamada, 1995), but the findings all showed that they correlated highly, thus affecting the analysis of the results (Piper & Dilek, 1988; Yamada, 1995). As for the impact of the equivalence (time of exposure to FL instruction) in FLA, it is even more unclear. Research by Cheung (2006) concluded that the total amount of time spent learning English contributed most to the performance on the listening and reading tests of GEPT (General English Proficiency Test) of the participants, but that the interpretation of the result of the study was deeply confounded by the participants' onset age of exposure to the target language. As a result, the researcher suggested that the results needed further analysis.

The confoundedness of the age and time variables outlined above gives a further reason as to why it is necessary to explore whether or not the time variable affects or correlates with EFL (English as a foreign language) learners' proficiency in the target language. Thus, in order to avoid the confoundedness just mentioned, the average number of hours per week of receiving formal English instruction instead of length (in years) of exposure to English was used as one of the experimental variables in this research.

The participants in this study were all freshmen from a single university in Taiwan, and at the time of the study, they had studied at the university for only three months. Given the shortness of the period of time spent at the university, it can be presumed that their exposure to the study of English since arriving at the university would not have led to any significant changes in their ability to accurately perceive the sounds of the target language. Hence, the experimental variable in question (i.e.,

the average number of hours per week of receiving formal English instruction) was specifically based on the participants' learning time in secondary school (including junior high and senior high) rather than in university.

In this study, two research questions were investigated. They are as follows:

1. Does the age of first exposure to formal English instruction correlate with Taiwanese first-year university EFL learners' perceptual accuracy of four English vowels (/I/, /iy/, /ɛ/ and /ey/), as measured by a listening identification test?
2. Does the average number of hours per week of formal English instruction prior to enrollment in university have any relationship with Taiwanese first-year university EFL learners' perceptual accuracy of the four English vowels, as assessed by a listening identification test?

METHODS

Participants

The participants in this study were selected from a university in the northern part of Taiwan. The sample was 104 students. These students had all studied English as a foreign language in Taiwan for at least six years at the time of the study. Originally, a total of 109 students took part in this research; however, as the primary aim of this study was to investigate the correlation of EFL learners' onset age and of their average number of hours per week of exposure to formal English instruction to their accuracy in perceiving English vowels, respectively, this study included students who had been learning English only in Taiwan. Those who had received English instruction outside of the country or had been raised in an environment where English is consistently spoken were excluded from the study. According to the collected data, five participants mentioned on the questionnaire that they had learned English in a foreign country.[5] Thus only 104 students' test scores and data were utilized for further statistical analysis. Additionally, none of the students participating in this research reported any impairment in their hearing ability.

[5] One in the United States, one in Canada, one in Thailand, and two in Malaysia

Instrumentation

A pilot study and two measures—a listening identification test and a questionnaire— were administered in the current research. The pilot study was conducted to ensure that the stimuli in the listening identification test would not constantly change the participants' judgment/decision on their answers. The listening identification test was used to assess the participants' accuracy in perceiving the four English vowels (/I/, /iy/, /ɛ/, /ey/). The questionnaire was utilized to gain information on the language background of each of the participants.

Pilot study

Prior to the administration of the listening identification test to the students in this study, the researcher sought to ensure that the stimuli on the test were as authentic as possible. Thus, ten native speakers of American English were asked to take the test to see whether there was consistency among their test scores. All of the native listeners were undergraduate students at a state university in the Midwestern U.S. and had lived in that state since they were born.

Table 1 illustrates the results of the pilot study. The test scores of the ten native listeners showed that only two listeners missed one question each out of eighty-eight. The other eight listeners all got a full score on the test. Hence, the results revealed that the test stimuli were authentic and suitable for evaluating the Taiwanese EFL learners' perception of the target vowels.

Table 1. Number of Stimuli Correctly Identified by Native Speakers in the Pilot Study

Subject	Gender	Obtained Score/Total Score
1.	Male	88/88
2.	Male	88/88
3.	Male	88/88
4.	Male	88/88
5.	Male	87/88
6.	Female	88/88

Table 1. Number of Stimuli Correctly Identified by Native Speakers in the Pilot Study (continued)

Subject	Gender	Obtained Score/Total Score
7.	Female	88/88
8.	Female	88/88
9.	Female	88/88
10.	Female	87/88

Listening identification test

The main goal of this study was to test Taiwanese first-year university EFL learners' perception of English vowels; therefore, a listening identification test of four English vowels (/I/, /iy/, /ɛ/ and /ey/) was designed. The tested vowels were those that pose great difficulty for native Mandarin Chinese speakers in that the English /I/ and /iy/ are not phonetically contrastive in Mandarin Chinese, the official language of Taiwan, and neither are /ɛ/ and /ey/ (Avery & Ehrlich, 1992; Ma, 1995).

The reason for using these four vowels in the present research was that they could produce more contrastive data for further statistical analysis than using ones that are easy for the participants. In addition, other studies, such as that of Ma's (1995) rated the English vowel /æ/ in their experiment. However, the current study did not include it due to the fact that adding it would make it very difficult to design as many test items (i.e., minimal sets) as possible to more accurately assess the participants' perception of the originally selected vowels.

The listening test of this project consisted of ninety-two stimuli elicited from twenty-three minimal sets (see Appendix C). Each minimal set was presented with four English monosyllabic words in the /CVC/ syllable, and each word was different from the others only in the vowel (such as rid, read, red, raid). The four tested vowels were equally distributed in both the test and stimuli (i.e., 23 correct answers for /I/, /iy/, /ɛ/ and /ey/**,** respectively).

The stimuli in the listening identification test were selected on the basis of a frequency criterion (Nelson Francis & Kucera, 1982) and divided into three sections according to their functions: explanation of the test procedure, the trial, and the test (see Appendix C). In the section on the explanation of the test procedure, four stimuli from the same minimal set were selected to demonstrate to the participants how they should take the test. In the trial section, eight stimuli from two other

minimal sets were picked for students to use for practice and adaptation to the quality of the sound produced by the speaker and to the test format. The remaining twenty minimal sets (in total, 80 stimuli) functioned as test items in the test section.

Before the researcher picked the three minimal sets for the clarification of the test procedure and for students' practice, a one-way ANOVA was conducted on the stimuli selected for the study to determine whether there was a significant difference among the four groups of stimuli (see Appendix C) in terms of their frequency of occurrence.[6,7] After the researcher picked the three minimal sets, another one-way ANOVA with the same independent and dependant variable was carried out. Neither of the one-way ANOVAs found significant differences among the overall frequency of occurrence of the four groups— the *p* value before picking the three sets was .430 (> .05), and the *p* value after picking the three sets was .383 (> .05). The results suggested that the words in the four vowel groups were well selected and appropriate to be used as stimuli in the current research.

Furthermore, all of the stimuli were produced by a male American English speaker, who was an undergraduate student at the state university where the native participants in the pilot study studied and also had lived in that state since he was born.

The stimuli of the listening identification test were recorded in the anechoic chamber of the Department of Linguistics at the state university where the native speaker for the recording studied by using a Marantz PMD671 solid-state recorder and an Electro-Voice RE20 microphone. After recording, the data was immediately digitized onto a PC by means of Praat.

Questionnaire

The questionnaire was used to gather data about the language background of the participants for further analysis along with the test scores. It was filled out before the participants took the identification test. The questionnaire was based on those from Cheung (2006) and Kuo

[6] The independent variable; Group 1= words containing the vowel /iy/, Group 2= words containing the vowel /I/, Group 3= words containing the vowel /ey/, and Group 4= words containing the vowel /ɛ/.

[7] Frequency of occurrence is performed as the dependant variable.

(2001). It elicited information related to the participants' English learning experiences such as their onset age of exposure to formal English instruction, average number of hours per week spent learning English at school (i.e., junior high school and senior high school) and on their own (self-study), their previous experience of receiving listening training and so forth. Some of the questions required the participants to fill in a blank, and others to check the most appropriate or approximate answer (see Appendix B).

The questionnaire administered to the participants was written in Mandarin Chinese (see Appendix A) and had been proofread by a native Mandarin Chinese speaker who was studying in the field of TESL.

The scoring of the measures

In the listening identification test, a correct answer was worth one point. The maximum score was 80/80, and the minimum was 0/80. The more accurately a participant could perceive the four English vowels, the higher the score he or she was given. In terms of the questionnaire, the collected information was only used for analyzing the relationship between different variables and the test scores.

Procedures

The listening identification test was performed in a language laboratory of the university where the 104 participants studied. The participants were randomly assigned to four groups and were tested on a class basis. Before the experimenter started to play the stimuli, all of the participants were informed of the purpose of the study, required to fill out a questionnaire about their language background and instructed on how to answer the questions. The task was a four-alternative forced-choice identification test. Each participant was given an answer sheet on which there were eighty-eight minimal sets (i.e., 88 test items– the first eight items were for student practice, see Appendix D), each with the four tested vowels, provided as answer cues (for example, 1. fill- /I/, feel- /iy/, fell-/ɛ/, fail- /ey/). The participants were required to select the correct cue for each item according to what they heard from the stimuli. Each stimulus was repeated twice with a three-second interval, and the next stimulus was played five seconds after the last one was finished. A response was required for each stimulus, and the participants were told to guess if uncertain.

After the experiment was done, the test scores for each participant were then calculated and incorporated with his or her language background for further statistical analysis.

RESULTS

To address the first research question of this study, the participants' onset ages of learning English and their scores on the listening identification test were subjected to a Pearson Product-Moment Correlation test to determine the level of significance of the relationship between the two variables. Table 2 and Table 3 summarize the data obtained.

Table 2 illustrates the mean age at which the Taiwanese university EFL students had started receiving formal English instruction and the mean scores they received for the four English vowels and their overall performance on the listening identification test. The statistical data indicate that the mean score for the English vowel /ey/ was the highest (12.519), followed by the scores for /iy/ (12.221), /ɛ/ (12.202), and /I/ (9.779), respectively. The findings suggest that the English /ey/ is the easiest vowel for the students to perceive, and /I/ is the most difficult one. The students' perceptual accuracy of /iy/ and /ɛ/ lay in the middle of the scale of difficulty.

Table 2. Means and Standard Deviations for the Variable of Onset Age and the Tested Vowels (N=104)

	Mean	**Standard Deviation**
Onset Age	11.125	1.852
/I/	9.779	3.511
/iy/	12.221	3.131
/ɛ/	12.202	3.460
/ey/	12.519	3.256
Overall Performance	46.721	9.832

Table 3 represents the correlations between the participants' onset age of exposure to formal English instruction and their test scores for the four English vowels. The Pearson Product-Moment Correlation results

show that significant negative correlations can be found between the participants' onset age and their perception of the English /I/ and /iy/ and between the participants' onset age and their score for the overall identification of the tested vowels. However, no significant correlations were revealed between the onset age and the participants' recognition of the English /ɛ/ and /ey/. These results suggest that the earlier the Taiwanese first-year university EFL students were exposed to formal English instruction, the more accurately they were able to perceive the two English vowels /I/ and /iy/. However, this relationship did not extend to the students' perception of /ɛ/ and /ey/.

Table 3. Pearson Product-Moment Correlation Results for the Onset Age of Learning English of Taiwanese First-Year University EFL Learners and Their Scores for the Four English Vowels (N=104)

	/I/	**/iy/**	**/ɛ/**	**/ey/**	**Overall**
Onset Age	**-.245***	**-.226***	-.133	-.012	**-.210***

* p < .05, ** p < .01.

To answer the second research question, the participants' average number of hours per week of learning English in secondary school and their scores on the listening identification test were subjected to a Pearson Product-Moment Correlation test to determine the level of significance of the relationship between the two variables.[8] Table 4 and Table 5 summarize the data obtained.

Table 4 depicts the average number of hours per week that the Taiwanese first-year university EFL learners had spent studying English in secondary school (overall) and the hours that they had spent in such study in junior high and in senior high, respectively. The descriptive statistics indicated that the average English instruction time that the learners received per week in senior high was slightly longer than the time they received in junior high.

[8] Including the average number of hours per week in both junior high and senior high and the average number of hours in each of the schools.

Table 4. Means and Standard Deviations for the Number of Weekly Average Hours of English Instruction in Secondary School (N=104)

	Mean	**Standard Deviation**
Secondary School (Overall)	5.572	.857
Junior High	5.375	.987
Senior High	5.769	1.017

Table 5 reports the correlations between the average number of hours per week of formal English instruction in secondary school which the Taiwanese EFL students had received and their scores for the four English vowels on the listening identification test. The results for the Pearson Product-Moment Correlation showed that there was a significant positive correlation between the average number of hours per week of formal English instruction in secondary school (overall) and the Taiwanese EFL learners' perception of the English /ey/. However, no significant correlations were found between the time variable and the learners' identification of the other three vowels and their overall recognition of the tested vowels. The statistical results further revealed significant positive correlations between the participants' average number of hours per week of formal English instruction in junior high school and their perception of the English /ɛ/ and /ey/, whereas there were no significant correlations at all between the number of the participants' average hours in senior high school and their perception of the four vowels.

Table 5. Pearson Product-Moment Correlation Results for the Average Number of Hours per Week of Exposure to Formal English Instruction of the Taiwanese First-Year University EFL Learners Prior to Enrollment in University and Their Scores for the Four English Vowels (N=104)

	/I/	**/iy/**	**/ɛ/**	**/ey/**	**Overall**
Secondary School (Overall)	-.049	-.113	.169	**.218***	.078
Junior High	-.068	-.065	**.211***	**.271****	.119
Senior High	-.017	-.127	.080	.104	.016

* $p < .05$, ** $p < .01$.

The evidence above implies that the more weekly instruction time the Taiwanese first-year university EFL learners had received in secondary school (overall), the more precisely they were able to identify the English /ey/. Moreover, when further examining the relationships between the learners' test scores and the weekly instruction time that they had received in junior high and in senior high separately, it was found that the higher the number of weekly instruction hours they had received in junior high, the more accurately they were able to recognize the English /ɛ/ and /ey/. However, no significant relationship was found between the participants' perceptual accuracy of the four English vowels and the weekly amount of time they had spent studying English in senior high.

From all the aforementioned results, it seems that onset age and weekly instruction time at school both play a role in the Taiwanese students' perception of certain English vowels. The first variable is related to their recognition of the high front vowels (/I/ and /iy/) and the second to their identification of the mid front vowels (/ɛ/ and /ey/). Furthermore, the learners' perceptual accuracy of the mid front vowels was found to be associated with an onset age of study at an earlier stage of life (say junior high).

DISCUSSION AND CONCLUSION

This project resulted in two key findings. First of all, the results for the Pearson Product-Moment Correlations showed that the earlier the Taiwanese first-year university EFL students started learning English, the more accurately they were able to perceive the English high front vowels (/I/ and /iy/). Second, the statistical analysis also revealed that the more hours of English instruction the learners had received per week in junior high school, the more precisely they were able to recognize the English mid front vowels (/ɛ/ and /ey/). However, no significant relationship was seen between the learners' perceptual accuracy of the tested vowels and the amount of weekly instruction time they had received in senior high school.

As stated earlier, previous L2 research that investigated the relationship between age and language learners' proficiency in the target language normally focused on either L2 phonetics or morphosyntax. Among the L2 phonetics studies, some researchers examined the effect of onset age on language learners' perception of English vowels, and the

results were mostly positive. For instance, Baker and Trofimovich (2006) measured forty Korean participants' perception of six English vowels. The results showed that the early group had a significantly higher perception score than the late group did. This research finding confirmed the crucial role of age in L2 learners' perceptual acquisition of vowels.

In addition, Tsukada et al. (2005) compared the discrimination of four English vowel contrasts (/i/-/I/, /e/-/ɛ/, /ɛ/-/æ/, /a/-/ʌ/) by thirty-six native Korean children and thirty-six native Korean adults who were immigrants in North America. The participants' perception of the vowels was evaluated using a categorical discrimination test employed in previous L2 research (Flege et al., 1999). The statistical data of the study indicated that the native Korean children consistently outperformed the native Korean adults in discriminating the English vowel contrasts. Again, this evidence provides validation for the claim that age is a determinant in acquiring perceptual proficiency of L2 vowels.

Combining the findings of the studies above with the findings of this research, we are able to discover that onset age occupies a position in the language learners' perceptual accuracy of English vowels in all of the studies even though it only significantly correlated with the participants' perception of the English /I/ and /iy/ in the current project. Moreover, the two studies above were conducted in a L2 context, but this one was carried out in an FL setting. Hence, it can be concluded that a critical period exists not only for second language acquisition of perception of vowels, but that the existence of such period also extends to the foreign language acquisition of perception of vowels.

With reference to the second key finding of this research, although the average number of hours per week of formal English instruction was only related to the participants' perceptual accuracy of the English /ɛ/ and /ey/, and the correlations existed only for the time when the students studied in junior high school, the variable still played a role in the EFL participants' perceptual acquisition of vowels. This finding is not congruous with the outcome of Cheung (2006), who proposed that the total amount of time of exposure to formal English instruction in junior and senior high school was not significantly related to Taiwanese college EFL students' listening and reading abilities.

If we compare the second research finding to the first finding of this study, an interesting phenomenon can be observed. In the section of Results, it was claimed that the earlier the Taiwanese EFL learners started formal English instruction, the more accurately they were able to

recognize the high front vowels (/I/ and /iy/). However, the statistical data of this research also demonstrated that the more weekly English instruction the learners had received at school (junior high), the better they were able to perceive the mid front vowels (/ɛ/ and /ey/). It appears that earlier exposure to English as a foreign language is particularly beneficial to the perceptual acquisition of the pair of vowels (/I/ and /iy/) and more weekly instruction time at school to the acquisition of the pair (/ɛ/ and /ey/). Do such tendencies really exist in the acquisition of the phonology of a foreign language? So far, few studies have been done to provide evidence or support. However, the researcher of the present project considers that certain data in Hillenbrand, Getty, Clark, and Wheeler (1995) might be able to offer explanations for the tendencies.

Hillenbrand et al. (1995) conducted a study to investigate the acoustic characteristics of twelve English vowels /I, iy, ɛ, ey, æ, a, ɔ, o, u, ʊ, ʌ, ɝ/. In their study, forty-five men and forty-eight women produced the vowels in h-V-d syllables. Formant contours for F1- F4 for each vowel were measured from LPC spectra using a custom interactive editing tool for each gender. The results of the study reported that the average F1 frequencies for /I/ and /iy/ vs. /ɛ/ and /ey/ were 427/342 and 580/476 for the men, and 483/437 and 731/536 for the women. The average F2 frequencies for the same pairs of vowels were 2034/2322 and 1799/2089 for the men, and 2365/2761 and 2058/2530 for the women. Comparing the average difference in F1 frequency between /I/ and /iy/ for the men to their average difference in F1 frequency between /ɛ/ and /ey/, it could be seen that the acoustic difference between /I/ and /iy/ was more subtle (85 vs. 104). The same finding also appeared in the comparison of the women's average difference in F1 frequency between /I/ and /iy/ to their average difference in F1 frequency between /ɛ/ and /ey/ (46 vs. 195). In the light of the comparison of the average difference in F2 frequency between /I/ and /iy/ to the average difference in F2 frequency between /ɛ/ and /ey/, the acoustic difference between /I/ and /iy/ was still more subtle (Men: 288 vs. 290; Women: 396 vs. 472). Thus, it can be concluded that the English /I/ and /iy/ have more subtle acoustic differences than the English /ɛ/ and /ey/.[9]

Based on the conclusion above and the result of the current study that the earlier the EFL learners began learning English, the more accurately they were able to identify the English high front vowels (/I/

[9] The reason for only comparing F1 and F2 was that they are the means most often used to distinguish the quality of English vowels.

and /iy/) and that the more weekly instruction hours the students had received at school, the more precisely they were able to recognize the mid front vowels (/ɛ/ and /ey/), we can infer that when Taiwanese EFL learners learn English vowels, the onset age of receiving formal English instruction is more closely related to their advantage in perceptually acquiring the pair of vowels with more subtle acoustic differences, whereas the weekly amount of formal English instruction time at school is more closely associated with their advantage in acquiring the pair with larger acoustic differences. However, it is strongly suggested that further studies need to be done to verify these findings.

Aside from the aforementioned discussions, a closer examination of the correlations of the number of Taiwanese EFL learners' weekly English instruction hours prior to enrollment in university to their perception of the four English vowels displayed a further agreement with the earlier finding of this study—that there is a critical period for foreign language acquisition of perception of vowels. This agreement was based on the results of the Pearson Product-Moment Correlations that showed significant correlations for the participants' accuracy in perceiving the two mid front vowels in the case of their average number of hours of weekly English instruction in junior high school but no significant correlations with their instruction time in senior high school. The outcome suggests that the participants' perceptual accuracy of the English vowels was associated only with the amount of instruction they had received every week in junior high, not with that in senior high. Consequently, it seems that increasing the number of weekly English instruction hours at school would be helpful for the more accurate perception of (at least certain) English vowels, and that it needs to be started at an earlier stage of life.

Although the results of this research have provided evidence for the importance of age and amount of instruction time at school in perceiving English vowels in the FL context, there are a number of questions to which this research does not offer answers. First of all, while this study confirmed that early exposure to an FL corresponds to a more accurate perception of the sound system of the language, it did not tell us the optimal age for language learners to start learning an FL (i.e., the outset of the critical learning period for FLA). Second, owing to the fact that the new policy of English education requiring people in Taiwan to start learning English in elementary school had not been applied in the case of the participants in this study, some of them did not begin to receive

formal English instruction until the age of twelve or thirteen. This age was the age at which all Taiwanese EFL students at the time of the study were officially required to begin formal English instruction at school. As a result, it was the maximum age that the current research examined among the ages of the participants. In this case, the data of this project does not allow us to understand the actual state of perceptual acquisition of the same vowels by people starting formal English instruction after puberty (especially after age thirteen). Accordingly, such resolved questions might make good research topics for those who are interested in the exploration of the relationship between age and FLA. Also, it would be interesting to see whether the same variables (i.e., onset age and instruction time at school) have the same or similar relationships with EFL learners' pronunciation of the same vowels and whether there are other variables (such as hours spent outside school, hours that were particularly spent on sharpening students' listening identification, learning style, teaching methods, motivation, aptitude, cognition, and etc.) involved in the learners' perceptual/productive acquisition of the English vowels.

Last but not least, language acquisition is not only limited to the perception of the sound system of the target language. Other skills such as listening, speaking, reading and writing also need to be included. Therefore, to provide further support for the importance of the variables explored in this study in foreign language acquisition, future researchers should also base their studies on the examination of language learners' production of the sounds of the target language and their other language skills.

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APPENDIX

Appendix A. 英語學習歷程問卷

各位同學好:
我們想要了解您學習英文的經驗,麻煩您幫忙回答以下的問題。您提供的資料可以幫助我們研究、分析大家學習英文的方法與成就的關係，也可以進一步幫助您自己和我們的下一代更有效地學習英文。問卷大約 10 到 15 分鐘可以填完。請盡量不要漏填。謝謝您的合作！

研究者
XXX

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1. 姓名: _____ 2. 性別: □男 □女
3. 年紀: _____ 歲 4. 科系/年級: _____系/_____年級
5. 有無聽力障礙: □有 □無
6. 是否住過英語系國家或是在其他國家學過英文:
   □是，哪一個國家: _____
   □否
7. 你是否在持續說英文的環境中長大?
   □是 □否
8. **小學畢業以前**是否學過英語? (請勾選一個答案)
   □是 □否 (若選擇「否」,請直接跳至第 10 題)
9. **小學畢業以前**所上的英語課是哪種英語課? (**可複選**)
   (註: 請先勾選答案,在對您勾選的答案略加說明)
   □ (A) 美語幼稚園。
      a. □全美語幼稚園 □半天或有時上英文的幼稚園
      b. □外籍老師授課 □台籍老師授課 □外籍、台籍老師搭配授課
      c. 共上了 _____年 _____個月; 當時為_____歲
   □ (B) 補習班。
      a. □英語會話課/班 □國中英語先修班
      b. □外籍老師授課 □台籍老師授課
         □外籍、台籍老師搭配授課
      c. 共上了 _____年 _____個月; 當時為國小_____年級
   □ (C) 個別家教班 (老師自己在家開設之家教班)。
      a. □英語會話課/班 □國中英語先修班
      b. □外籍老師授課 □台籍老師授課
      c. 共上了 _____年 _____個月; 當時為國小_____年級

□ (D) 一對一家教。
a. □英語會話課　□國中英語先修
b. □外籍老師授課　□台籍老師授課
c. 共上了 _____年 _____個月; 當時為國小_____年級

□ (E) 其他: _____
a. □英語會話課/班 □國中英語先修班
b. □外籍老師授課　□台籍老師授課　□外籍、台籍老師搭配授課
c. 共上了 _____年 _____個月; 當時為國小_____年級

10. 所就讀的**國中**為公立或私立? □公立 □私立
11. 在**國中**時(在學校)平均每週上幾節英文課?
□3 節 □4 節 □5 節 □6 節 □7 節(以上)
12. 在**國中**時(在學校)是否有被外籍老師教導過?
□是, 共上了_____ 年_____個月
□否
13. 在**國中**時,是否參加校外英文補習或個別家教?
□是 □否 (若選擇「否」, 請直接跳至第 14 題)

□ (A) 補習班。
a. □英語會話課/班 □國中英語課程
b. □外籍老師授課 □台籍老師授課
□外籍、台籍老師搭配授課
c. 每週上_____小時; 共上了 _____年 _____個月; 當時為國中_____年級

□ (B) 個別家教班 (老師自己在家開設之家教班)。
a. □英語會話課/班 □國中英語課程
b. □外籍老師授課 □台籍老師授課
c. 每週上_____小時; 共上了 _____年 _____個\月; 當時為國中_____年級

□ (C) 一對一家教。
a. □英語會話課 □國中英語課程
b. □外籍老師授課 □台籍老師授課
c. 每週上_____小時; 共上了 _____年 _____個月; 當時為國中_____年級

□ (D) 其他: _____
a. □英語會話課/班 □國中英語課程
b. □外籍老師授課 □台籍老師授課 □外籍、台籍老師搭配授課
c. 每週上_____小時; 共上了 _____年 _____個月; 當時為國中_____年級

14. 所就讀的**高中/職**為公立或私立? □公立 □私立
15. 在**高中/職**時(在學校)平均每週上幾節英文課?
□3 節 □4 節 □5 節 □6 節 □7 節(以上)
16. 在**高中/職**時(在學校)是否有被外籍老師教導過?
□是, 共上了_____ 年_____個月
□否
17. 在**高中/職**時,是否參加校外英文補習或請人個別家教?
□是 □否 (若選擇「否」, 請直接跳至第 18 題)
□ (A) 補習班。
a. □英語會話課/班 □高中英語課程
b. □外籍老師授課 □台籍老師授課
□外籍、台籍老師搭配授課
c. 每週上_____小時; 共上了 _____年 _____個月; 當時為高中_____年級
□ (B) 個別家教班 (老師自己在家開設之家教班)。
a. □英語會話課/班 □高中英語課程
b. □外籍老師授課 □台籍老師授課
c. 每週上_____小時; 共上了 _____年 _____個月; 當時為高中_____年級
□ (C) 一對一家教。
a. □英語會話課 □高中英語課程
b. □外籍老師授課 □台籍老師授課
c. 每週上_____小時; 共上了 _____年 _____個月; 當時為高中_____年級
□ (D) 其他: _____
a. □英語會話課/班 □高中英語課程
b. □外籍老師授課 □台籍老師授課 □外籍、台籍老師搭配授課
c. 每週上_____小時; 共上了 _____年 _____個月; 當時為高中_____年級
18. **課後**是否有自己加強英文聽力(收聽英語廣播教學)? (音樂性節目不算)
18A. **國中**時: □有, 平均每週_____小時 □無
18B. **高中/職**時: □有, 平均每週_____小時 □無
19. 大一英文有無聽力訓練?
□有 □無

問卷結束。再次謝謝您的合作,祝您學業有成!

Appendix B. Language Background Questionnaire

Dear Participant,
We would like to understand your English learning experiences. Please help us by answering the following questions. The information you provide can help us research and analyze the relationship between the level of the proficiency of Taiwanese learners of English and the ways they learn English. The results from this research may help you and later generations of classmates learn English more effectively. The questionnaire will take 10~15 minutes for you to finish. Please try to give as many details as possible. Thanks for your time!

XXX
The Researcher

==========

1. Name: _____ 2. Gender: □male □female
3. Age: _____ years old
4. Major/grade:_____/_____
5. Do you have any hearing impediments? □Yes □No
6. Have you ever lived in an English-speaking country or learned English in another country?
   □Yes, which country: _____
   □No
7. Were you raised in an environment where English is consistently spoken?
   □Yes □No
8. Did you study English **before graduating from elementary school**?
   □Yes □No (if you choose "No", please jump to Question 10)
9. **Before you went to junior high school**, what kind of formal English instruction did you have? (Please check the **answer(s)** first and then provide the necessary information for the checked **answer(s)**.)

□ (A) Kindergarten
   a. Type: □All-English kindergarten □Kindergarten where English is taught sometimes or half of the day.
   b. Teacher: □native speaker of English □local Taiwanese instructor □native speaker of English + local Taiwanese instructor

c. Length of English learning: _____ years _____months; starting at the age of _____.

☐ (B) Cram School (Bu Xi Ban)

a. Type: ☐Focusing on English conversation ☐Focusing on preparation for 7th grade English

b. Teacher: ☐native speaker of English ☐local Taiwanese instructor □native speaker of English + local Taiwanese instructor

c. Length of English learning: _____ years _____months; starting at the _____ grade.

☐ (C) English class offered at the home of the teacher: (The business was run by the teacher.)

a. Type: ☐Focusing on English conversation ☐Focusing on the school English curriculum

b. Teacher: □native speaker of English ☐local Taiwanese instructor

c. Length of English learning: _____ years _____months; starting at the _____ grade.

☐ (D) One-on-one tutoring:

a. Type: ☐Focusing on English conversation ☐Focusing on preparation for 7th grade English

b. Teacher: ☐native speaker of English ☐local Taiwanese instructor

c. Length of English learning: _____ years _____months; starting at the _____ grade.

☐ (E) Others: _____

a. Type: ☐Focusing on English conversation ☐Focusing on preparation for 7th grade English

b. Teacher: ☐native speaker of English ☐local Taiwanese instructor ☐native speaker of English + local Taiwanese instructor

c. Length of English learning: _____ years _____months; starting at the _____ grade.

10. Did you attend a public or private **junior** high school?

☐public ☐private

11. How many hours a week did you receive formal English instruction in your **junior** high school?
    ☐3 hours ☐4 hours ☐5 hours ☐6 hours ☐7 hours or more
12. When in **junior** high school, were you taught by a native speaker of English?
    ☐Yes, _____ years _____ months
    ☐No
13. When you were a **junior** high school student, did you have extra formal English instruction outside of regular school?
    ☐Yes ☐No (if you choose "No", please jump to Question 14)

☐ (A) Cram School (Bu Xi Ban)
- a. Type: ☐Focusing on English conversation ☐Focusing on the school English curriculum
- b. Teacher: ☐native speaker of English ☐local Taiwanese instructor ☐native speaker of English + local Taiwanese instructor
- c. Length of English learning: _____ years _____months; starting at the _____ grade.

☐ (B) English class offered at the home of the teacher: (The business was run by the teacher)
- a. Type: ☐Focusing on English conversation ☐Focusing on the school English curriculum
- b. Teacher: ☐native speaker of English ☐local Taiwanese instructor
- c. Length of English learning: _____ years _____months; starting at the _____ grade.

☐ (C) One-on-one tutoring:
- a. Type: ☐Focusing on English conversation ☐Focusing on the school English curriculum
- b. Teacher: ☐native speaker of English ☐local Taiwanese instructor
- c. Length of English learning: _____ years _____months; starting at the _____ grade.

□ (D) Others: _____

a. Type: □Focusing on English conversation □Focusing on the school English curriculum

b. Teacher: □native speaker of English □local Taiwanese instructor □native speaker of English + local Taiwanese instructor

c. Length of English learning: _____ years _____months; starting at the _____ grade.

14. Did you attend a public or private **senior** high school? □public □ private
15. How many hours a week did you receive formal English instruction in your **senior** high school? □3 hours □4 hours □5 hours □ 6 hours □7 hours or more
16. When in **senior** high school, were you taught by a native speaker of English?
    □Yes, _____ years _____ months
    □No
17. When you were a **senior** high school student, did you have extra formal English instruction outside of regular school? □Yes □No (if you choose "No", please jump to Question 18)

□ (A) Cram School (Bu Xi Ban)

a. Type: □Focusing on English conversation □Focusing on the school English curriculum

b. Teacher: □native speaker of English □local Taiwanese instructor □native speaker of English + local Taiwanese instructor

c. Length of English learning: _____ years _____months; starting at the _____ grade.

□ (B) English class offered at the home of the teacher: (The business was run by the teacher)

a. Type: □Focusing on English conversation □Focusing on the school English curriculum

b. Teacher: □native speaker of English □local Taiwanese

instructor

c. Length of English learning: _____ years _____months; starting at the _____ grade.

☐ (C) One-on-one tutoring:

a. Type: ☐Focusing on English conversation ☐Focusing on the school English curriculum

b. Teacher: ☐native speaker of English ☐local Taiwanese instructor

c. Length of English learning: _____ years _____months; starting at the _____ grade.

☐ (D) Others: _____

a. Type: ☐Focusing on English conversation ☐Focusing on the school English curriculum

b. Teacher: ☐native speaker of English ☐local Taiwanese instructor ☐native speaker of English + local Taiwanese instructor

c. Length of English learning: _____ years _____months; starting at the _____ grade.

18. Did you spend your free time improving your listening ability (i.e., listening to English teaching/learning programs on the radio)? (N.B. listening to English language music programs does not count.)

18A. When you were in **junior** high school:

☐Yes, _____ hours/per week

☐No

18B. When you were in **senior** high school:

☐Yes, _____ hours/per week

☐No

19. Did your first-year college English class include training in listening comprehension?

☐Yes

☐No

==========

This is the end of the questionnaire. Thanks again for your cooperation!

Appendix C. Stimuli Produced by the Native English Speaker in the Recording

Minimal Sets			
/iy/	/I/	/ey/	/ɛ/
For explanation of the test procedure:			
reek	Rick	rake	wreck
For familiarization with the test:			
1. seat	sit	sate	set
2. mean	min.[10]	main	men
For the test:			
1. read	rid	raid	red
2. feel	fill	fail	fell
3. meet	mitt	mate	met
4. beat	bit	bait	bet
5. lead	lid	laid	led
6. seal	sill	sail	sell
7. gene	gin	Jane	Jen
8. keen	kin	cane	Ken
9. seek	sick	sake	sec.[11]
10. teal	till	tail	tell
11. reap	rip	rape	rep[12]
12. heel	hill	hail	hell
13. meal	mill	male	Mel
14. deal	dill	dale	dell
15. bean	bin	bane	Ben
16. deed	did	Dade	dead
17. teak	tick	take	tech[13]
18. wheel	will	wail	well
19. Pete	pit	pate	pet
20. lean	Lin	lane	Len

[10] Min. is the abbreviation of minute.

[11] Sec. is the abbreviation of second.

[12] Rep is the abbreviation of representative.

[13] Tech is the abbreviation of technician.

Appendix D. Answer Sheet

Name:_____

The answer cues are composed of different minimal sets. In each minimal set, words are in the /CVC/ syllable. They are different from each other only by the vowel. Please listen carefully and select the correct answer cue according to what you hear.

Session 1

1. (A) seat /iy/	(B) sit /I/	(C) sate /ey/	(D) set / ɛ /
2. (A) seat /iy/	(B) sit /I/	(C) sate /ey/	(D) set / ɛ /
3. (A) seat /iy/	(B) sit /I/	(C) sate /ey/	(D) set / ɛ /
4. (A) seat /iy/	(B) sit /I/	(C) sate /ey/	(D) set / ɛ /
5. (A) mean /iy/	(B) min. /I/	(C) main /ey/	(D) men / ɛ /
6. (A) mean /iy/	(B) min. /I/	(C) main /ey/	(D) men / ɛ /
7. (A) mean /iy/	(B) min. /I/	(C) main /ey/	(D) men / ɛ /
8. (A) mean /iy/	(B) min. /I/	(C) main /ey/	(D) men / ɛ /

Session 2

1. (A) seek /iy/	(B) sick /I/	(C) sake /ey/	(D) sec. / ɛ /
2. (A) gene /iy/	(B) gin /I/	(C) Jane /ey/	(D) Jen / ɛ /
3. (A) reap /iy/	(B) rip /I/	(C) rape /ey/	(D) rep / ɛ /
4. (A) heel /iy/	(B) hill /I/	(C) hail /ey/	(D) hell / ɛ /
5. (A) meal /iy/	(B) mill /I/	(C) male /ey/	(D) Mel / ɛ /
6. (A) teal /iy/	(B) till /I/	(C) tail /ey/	(D) tell / ɛ /
7. (A) reap	(B) rip	(C) rape	(D) rep

	/iy/	/I/	/ey/	/ ɛ /
8.	(A) heel	(B) hill	(C) hail	(D) hell
	/iy/	/I/	/ey/	/ ɛ /
9.	(A) meal	(B) mill	(C) male	(D) Mel
	/iy/	/I/	/ey/	/ ɛ /
10.	(A) deal	(B) dill	(C) dale	(D) dell
	/iy/	/I/	/ey/	/ ɛ /
11.	(A) bean	(B) bin	(C) bane	(D) Ben
	/iy/	/I/	/ey/	/ ɛ /
12.	(A) deed	(B) did	(C) Dade	(D) dead
	/iy/	/I/	/ey/	/ ɛ /
13.	(A) wheel	(B) will	(C) wail	(D) well
	/iy/	/I/	/ey/	/ ɛ /
14.	(A) meal	(B) mill	(C) male	(D) Mel
	/iy/	/I/	/ey/	/ ɛ /
15.	(A) teal	(B) till	(C) tail	(D) tell
	/iy/	/I/	/ey/	/ ɛ /
16.	(A) reap	(B) rip	(C) rape	(D) rep
	/iy/	/I/	/ey/	/ ɛ /
17.	(A) teak	(B) tick	(C) take	(D) tech
	/iy/	/I/	/ey/	/ ɛ /
18.	(A) meet	(B) mitt	(C) mate	(D) met
	/iy/	/I/	/ey/	/ ɛ /
19.	(A) beat	(B) bit	(C) bait	(D) bet
	/iy/	/I/	/ey/	/ ɛ /
20.	(A) heel	(B) hill	(C) hail	(D) hell
	/iy/	/I/	/ey/	/ ɛ /
21.	(A) deal	(B) dill	(C) dale	(D) dell
	/iy/	/I/	/ey/	/ ɛ /
22.	(A) bean	(B) bin	(C) bane	(D) Ben
	/iy/	/I/	/ey/	/ ɛ /
23.	(A) deed	(B) did	(C) Dade	(D) dead
	/iy/	/I/	/ey/	/ ɛ /
24.	(A) teak	(B) tick	(C) take	(D) tech
	/iy/	/I/	/ey/	/ ɛ /
25.	(A) read	(B) rid	(C) raid	(D) red
	/iy/	/I/	/ey/	/ ɛ /
26.	(A) Pete	(B) pit	(C) pate	(D) pet
	/iy/	/I/	/ey/	/ ɛ /

27. (A) lean /iy/	(B) Lin /I/	(C) lane /ey/	(D) Len / ε /
28. (A) read /iy/	(B) rid /I/	(C) raid /ey/	(D) red / ε /
29. (A) feel /iy/	(B) fill /I/	(C) fail /ey/	(D) fell / ε /
30. (A) meet /iy/	(B) mitt /I/	(C) mate /ey/	(D) met / ε /
31. (A) teak /iy/	(B) tick /I/	(C) take /ey/	(D) tech / ε /
32. (A) lead /iy/	(B) lid /I/	(C) laid /ey/	(D) led / ε /
33. (A) seal /iy/	(B) sill /I/	(C) sail /ey/	(D) sell / ε /
34. (A) teal /iy/	(B) till /I/	(C) tail /ey/	(D) tell / ε /
35. (A) keen /iy/	(B) kin /I/	(C) cane /ey/	(D) Ken / ε /
36. (A) teal /iy/	(B) till /I/	(C) tail /ey/	(D) tell / ε /
37. (A) reap /iy/	(B) rip /I/	(C) rape /ey/	(D) rep / ε /
38. (A) heel /iy/	(B) hill /I/	(C) hail /ey/	(D) hell / ε /
39.(A) Pete /iy/	(B) pit /I/	(C) pate /ey/	(D) pet / ε /
40.(A) lean /iy/	(B) Lin /I/	(C) lane /ey/	(D) Len / ε /
41.(A) seek /iy/	(B) sick /I/	(C) sake /ey/	(D) sec. / ε /
42. (A) read /iy/	(B) rid /I/	(C) raid /ey/	(D) red / ε /
43. (A) feel /iy/	(B) fill /I/	(C) fail /ey/	(D) fell / ε /
44. (A) meal /iy/	(B) mill /I/	(C) male /ey/	(D) Mel / ε /
45. (A) gene /iy/	(B) gin /I/	(C) Jane /ey/	(D) Jen / ε /
46. (A) bean	(B) bin	(C) bane	(D) Ben

	/iy/	/I/	/ey/	/ ɛ /
47.	(A) deed	(B) did	(C) Dade	(D) dead
	/iy/	/I/	/ey/	/ ɛ /
48.	(A) beat	(B) bit	(C) bait	(D) bet
	/iy/	/I/	/ey/	/ ɛ /
49.	(A) wheel	(B) will	(C) wail	(D) well
	/iy/	/I/	/ey/	/ ɛ /
50.	(A) Pete	(B) pit	(C) pate	(D) pet
	/iy/	/I/	/ey/	/ ɛ /
51.	(A) wheel	(B) will	(C) wail	(D) well
	/iy/	/I/	/ey/	/ ɛ /
52.	(A) lean	(B) Lin	(C) lane	(D) Len
	/iy/	/I/	/ey/	/ ɛ /
53.	(A) feel	(B) fill	(C) fail	(D) fell
	/iy/	/I/	/ey/	/ ɛ /
54.	(A) meet	(B) mitt	(C) mate	(D) met
	/iy/	/I/	/ey/	/ ɛ /
55.	(A) beat	(B) bit	(C) bait	(D) bet
	/iy/	/I/	/ey/	/ ɛ /
56.	(A) lead	(B) lid	(C) laid	(D) led
	/iy/	/I/	/ey/	/ ɛ /
57.	(A) wheel	(B) will	(C) wail	(D) well
	/iy/	/I/	/ey/	/ ɛ /
58.	(A) gene	(B) gin	(C) Jane	(D) Jen
	/iy/	/I/	/ey/	/ ɛ /
59.	(A) keen	(B) kin	(C) cane	(D) Ken
	/iy/	/I/	/ey/	/ ɛ /
60.	(A) seek	(B) sick	(C) sake	(D) sec.
	/iy/	/I/	/ey/	/ ɛ /
61.	(A) deal	(B) dill	(C) dale	(D) dell
	/iy/	/I/	/ey/	/ ɛ /
62.	(A) bean	(B) bin	(C) bane	(D) Ben
	/iy/	/I/	/ey/	/ ɛ /
63.	(A) deed	(B) did	(C) Dade	(D) dead
	/iy/	/I/	/ey/	/ ɛ /
64.	(A) teak	(B) tick	(C) take	(D) tech
	/iy/	/I/	/ey/	/ ɛ /
65.	(A) seal	(B) sill	(C) sail	(D) sell
	/iy/	/I/	/ey/	/ ɛ /

66. (A) Pete /iy/	(B) pit /I/	(C) pate /ey/	(D) pet / ε /
67. (A) lean /iy/	(B) Lin /I/	(C) lane /ey/	(D) Len / ε /
68. (A) read /iy/	(B) rid /I/	(C) raid /ey/	(D) red / ε /
69. (A) feel /iy/	(B) fill /I/	(C) fail /ey/	(D) fell / ε /
70. (A) meet /iy/	(B) mitt /I/	(C) mate /ey/	(D) met / ε /
71. (A) beat /iy/	(B) bit /I/	(C) bait /ey/	(D) bet / ε /
72. (A) lead /iy/	(B) lid /I/	(C) laid /ey/	(D) led / ε /
73. (A) seal /iy/	(B) sill /I/	(C) sail /ey/	(D) sell / ε /
74. (A) deal /iy/	(B) dill /I/	(C) dale /ey/	(D) dell / ε /
75. (A) keen /iy/	(B) kin /I/	(C) cane /ey/	(D) Ken / ε /
76. (A) lead /iy/	(B) lid /I/	(C) laid /ey/	(D) led / ε /
77. (A) seal /iy/	(B) sill /I/	(C) sail /ey/	(D) sell / ε /
78. (A) gene /iy/	(B) gin /I/	(C) Jane /ey/	(D) Jen / ε /
79. (A) keen /iy/	(B) kin /I/	(C) cane /ey/	(D) Ken / ε /
80. (A) seek /iy/	(B) sick /I/	(C) sake /ey/	(D) sec. / ε /

This is the end of the test. Thanks for your time!

起始年齡及在校授課時數與台灣英語學習者對英語母音感受精確度之關聯性

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本研究旨在探討學習英語之起始年齡及國高中每週在校教授英語之時數與台灣大學生對四個英文母音(/I/, /iy/, /ɛ/, /ey/)感受能力之關聯性。研究對象乃北台灣一所國立大學 104 位非英語系之大一學生。透過研究者所設計之英語母音聽力測驗以及改編自 Cheung (2006)及 Kuo (2001)之語言學習背景問卷來評估受試者對於受測母音之感受精確度和調查其開始學習英語之年齡及國高中時期每週在校接受英語課程之時數等資訊。俟所有相關資料收集完畢，一系列之皮爾森積差相關係數被計算。其結果顯示，起始年齡及國高中每週在校英語授課時數兩因素皆與受試者對某些受測母音之感受能力有顯著之關聯性。因此，本研究發現，關鍵時期此假說是存在於外語母音感受之習得的。此外，如果要延長學習者在校授課時數以增進其外語能力，時間上是愈早實施，效果會愈好。

關鍵詞：年齡、時數、母音、感受、外語習得、第二語習得