

Understanding Internal Relationships between Discriminative Performances of Different Types of Minimal Pairs from the Perspective of General Listening Proficiency

Hirokatsu KAWASHIMA

要 約

日本人英語学習者のミニマルペア（最小対立）の識別能力に関する調査を行い、総合的リスニング能力との関係ならびに15のミニマルペア（母音8、子音7）の識別力間に見られる関係の解明を試みた。データ分析の結果、平均点で見ると、総合的リスニング能力が高い学習者と低い学習者のミニマルペアの識別能力は殆ど差がないが、それぞれのミニマルペアの識別力の相関関係を調べると、両者の間には明確な違いがあることが分かった。

Background

Most books of English phonetics and pronunciation practice have sections of minimal pairs (e.g. Takebayashi et. al 1998 and Kawagoe 1999), and a number of textbooks which deal especially with minimal pairs have been published for Japanese learners of English (e.g. Tatsumi 1999 and Scheibner 2006). Although these facts do not necessarily suggest that minimal pairs are the most important element in teaching English pronunciation, it can be at least understood that their value is widely recognized. Scheibner (2006), for example, claims that listening is an essential part of language acquisition and that distinguishing minimal pairs can be one of the primary steps to enhance it.

It must be pointed out, however, that relatively little attention has been directed to the field of English minimal pairs (Tanabe 2002) and that much of the nature of learning and teaching English minimal pairs has not been fully explored or elucidated (e.g. Buck 2001, Rost 2002 and Flowerdew & Miller 2005). This research situation, as a whole, seems to more or less require English instructors to teach minimal pairs simply by trial and error, making it difficult for them to develop ways of teaching minimal pairs with confidence. If English instructors are aware beforehand of the nature of learning and teaching English minimal pairs, they would be greatly benefited.

In order to understand the nature of minimal pairs objectively and systematically, a number of investigations must be conducted from various points of view. One viewpoint, which is perhaps the most commonly employed, is to determine the discriminative difficulties in perceiving minimal pairs and to present their relative order of difficulty. Kawashima (2002) is an investigation conducted from such an angle, which reports, for example, that /l-/r/ is not the only difficult minimal pair for Japanese learners of English and that they feel it more difficult to discriminate the pair /d-/dz/ than /l-/r/.

It is true that this research viewpoint is essential for comprehending the nature of learning and teaching

minimal pairs, and that grasping learners' difficulties in discriminating minimal pairs is informative for English instructors, but in order to gain a deeper understanding of their nature, other research viewpoints must be also utilized. Unfortunately, however, a review of the literature (e.g. Takei 2002) shows the insufficiency of such research viewpoints. It is thus hoped at this moment: 1) that researchers will amass information about what aspects of the nature of learning and teaching minimal pairs are important to know, 2) that they will examine research viewpoints based upon that information, 3) that they will conduct investigations using such viewpoints, and 4) that the significance of their contributions toward elucidating the nature of learning and teaching minimal pairs will be verified.

Current Study

As an English instructor, the author has been using minimal pairs for several years in order to familiarize Japanese learners of English with the English sound system. Teaching a number of different types of English minimal pairs to students of varied English proficiency has offered two interesting and fundamental research viewpoints: 1) discriminative performances of various types of minimal pairs in terms of general listening proficiency and 2) internal relationships between such performances. In a class the author wondered, for instance, if learners, who were already good at discriminating the minimal pair /l/-/r/, were also capable of discriminating the minimal pair /b/-/v/. Another class caused him to wonder if such a relationship varies between low and high in general listening proficiency.

It seems that these kinds of relationships are informative for instructors: they may grasp learners' ability to discriminate a certain type of minimal pair indirectly by checking that of others, for example. The current study presents the results of an investigation which was conducted to understand these kinds of internal relationships possibly inherent in English minimal pairs. Its research design is summarized below, and some of the major findings are reported and then discussed:

1 Research Designs

1.1 Research Questions

The study, which deals with eight vowel and seven consonant minimal pairs¹⁾ (Nema 1986: /i/-/i:/, /æ/-/ɑ/, /ʌ/-/ɑ/, /æ/-/ʌ/, /ɔ:/-/ou/, /e/-/æ/, /ɔ:r/-/ɑ:r/, /ʌ/-/ɔ:r/, /b/-/v/, /f/-/h/, /s/-/θ/, /l/-/r/, /ʃ/-/s/, /dz/-/z/, and /n/-/ŋ/), includes two main research questions:

- 1) Is there any difference in discriminative performance of the target minimal pairs between learners with low and high general listening proficiency? If so, in which minimal pairs is such a difference perceived?
- 2) Which types of minimal pairs are significantly related to each other in discriminative performance at each of

the two levels of general listening proficiency referred to 1)?

1.2 Materials

In order to measure learners' general listening proficiency, the listening section of a standardized test (STEP Grade 2, administered in June 2000) was utilized.

Special care was taken to measure learners' performance in discriminating the 15 types of English minimal pairs accurately. Firstly, 75 sets of minimal pairs of different words were prepared (5 sets per pair). Secondly, four different combinations of three words were made for each set using these words, which were printed on the investigation sheets. Finally, in order to examine learners' sound discrimination ability, a combination of each set was chosen as the "answer", which was recorded onto CD by a native male speaker of American English (see Appendix).

1.3 Subjects

92 first-year students of the general education course at a university in Nagasaki Prefecture participated in this investigation.

1.4 Procedures

The subjects, who belonged to two separate classes, received general instructions and practice in the target 15 types of minimal pairs from the beginning of October to the middle of December in 2003. About twenty minutes of discrimination and pronunciation practice of several types of minimal pair was conducted in a ninety-minute lesson held once a week for two months. From observations of the learning attitude of them, the subjects appeared to have developed high awareness of similar English sounds.

Prior to the investigation, two tests, which also functioned as pre-investigations, were carried out, in which the subjects scored their own tests and grasped their discriminative performances objectively. It can be claimed that these two tests served to increase the subjects' consciousness of the target similar English sounds and to make them fully prepared for the investigation and its procedures.

The investigation was conducted in December 2003, at which time the subjects were first informed about its purpose to comprehend their general listening proficiency and discriminative performances of the 15 types of English minimal pairs after the two-month practice. The investigation took about forty minutes, and its main procedures can be summarized as follows:

- 1) The subjects were given an investigation sheet and instruction on the purposes and procedures of the investigation.
- 2) The subjects listened once to twenty English passages on CD and answered multiple-choice comprehension

questions on the investigation sheet. About fifteen minutes were allocated for this test.

3) The subjects, after a five-minute break, listened to 5 sets of the three-word combination of each of the eight vowel and seven consonant minimal pairs, respectively. A further fifteen minutes were allocated for this test.

2. Scoring and Processing of the Data

The investigation sheets were collected, scored and processed, and the data analyzed.

2.1 Two Levels of General Listening Proficiency

In order to obtain some basic information to set two levels of general listening proficiency, low and high, first, the mean score of the subjects' general listening proficiency (N = 92) was first calculated along with its standard deviation, maximum and minimum.²⁾ These are presented in Table 1, in which the full mark is twenty:

Table 1: General Listening Proficiency

	G. L. P.
N.	92
S.D.	3.05
Min.	2.00
Max.	18.00
Mean	8.39

G. L. P.: General Listening Proficiency

Next, in order to procure a benchmark for this purpose, careful attention was paid to the frequencies of the scores of general listening proficiency. These are presented in Table 2:

Table 2: Frequency of Scores of General Listening Proficiency

Score (1-10)	Frequency	Score (11-20)	Frequency
1	0	11	8
2	1	12	3
3	2	13	5
4	6	14	0
5	5	15	1
6	10	16	2
7	18	17	0
8	9	18	1
9	7	19	0
10	14	20	0

This table shows that the frequencies of scores of general listening proficiency are higher between 6 and 10. The current study, considering these frequencies and the mean score, 8.39 as in Table 1 and counterbalancing the statistically sufficient number of subjects, assumed that those who scored less than 8 (4, 5, 6, and 7) on the listening test had low general listening proficiency (N = 39) and those who scored more than 8 (9, 10, 11, and 13) had high general listening proficiency (N = 34). The difference in mean score between these two levels was proved by Welch T-test to be statistically significant [$t(66) = 15.87, p < .000$]. Basic descriptive information about this is presented in Table 3:

Table 3: Two Levels of General Listening Proficiency

	Subjects of Low G. L. P	Subjects of High G. L. P
N.	39	34
S.D.	1.10	1.24
Min.	4.00	9.00
Max.	7.00	13.00
Mean	6.03	10.47

G. L. P.: General Listening Proficiency

2.2 Discriminative Performances at the Two Levels of General Listening Proficiency

Discriminative performances of the 15 minimal pairs were examined at each of the two levels of general listening proficiency. First, each mean score of the subjects' discriminative performances of the eight vowel minimal pairs was calculated along with its standard deviation, maximum and minimum. This data is presented in Table 4, in which the full mark is five:

Table 4: Discriminative Performance of Vowel Minimal Pairs

		/i/-/i:/	/æ/-/ɑ/	/ʌ/-/ɑ/	/æ/-/ʌ/	/ɔ/-/ou/	/e/-/æ/	/ə:/-/ɑ:r/	/ʌ/-/ə:r/
S.D.	L.	0.64	1.03	0.92	1.16	1.16	1.01	1.37	1.08
	H.	0.59	0.70	0.84	0.91	1.16	0.99	1.24	0.81
Min.	L.	3.00	1.00	0.00	1.00	1.00	0.00	0.00	2.00
	H.	3.00	3.00	0.00	2.00	1.00	1.00	1.00	2.00
Max.	L.	5.00	5.00	3.00	5.00	5.00	5.00	5.00	5.00
	H.	5.00	5.00	3.00	5.00	5.00	5.00	5.00	5.00
Mean	L.	4.49	4.15	1.62	3.79	2.92	2.72	3.26	4.10
	H.	4.65	4.50	1.38	3.94	2.94	2.79	3.41	4.24

L.: low general listening proficiency H.: high general listening proficiency

Next, each mean score of the subjects' discriminative performances of the seven consonant minimal pairs was likewise calculated along with its standard deviation, maximum and minimum. Table 5 presents this data, in which the full mark is five, too:

Table 5: Discriminative Performance of Consonant Minimal Pairs

		/b/-v/	/f/-h/	/s/-θ/	/l/-r/	/ʃ/-s/	/dz/-z/	/n/-ŋ/
S.D.	L.	1.51	0.87	1.32	1.05	1.14	1.43	1.08
	H.	1.62	0.47	1.46	1.26	0.98	1.31	0.92
Min.	L.	0.00	2.00	0.00	0.00	1.00	0.00	0.00
	H.	0.00	3.00	0.00	0.00	2.00	0.00	0.00
Max.	L.	5.00	5.00	5.00	5.00	5.00	5.00	4.00
	H.	5.00	5.00	5.00	5.00	5.00	5.00	4.00
Mean	L.	3.23	4.38	3.82	2.64	3.69	2.31	2.28
	H.	3.12	4.79	3.59	2.44	3.97	2.53	2.26

L.: low general listening proficiency H.: high general listening proficiency

3. Data Analysis

3.1 Differences in Discriminative Performance between the Two Levels of General Listening Proficiency

In order to understand differences in discriminative performance between the two levels of general listening proficiency, the differences in mean score between them shown in Table 4 and Table 5 were statistically examined per minimal pair. Welch T-tests were also employed for this purpose. Table 6 presents the results of the tests for the vowel minimal pairs:

Table 6: Welch T-tests for Vowel Minimal Pairs

		/i/-i:/	/æ/-ɑ/	/ʌ/-ɑ/	/æ/-ʌ/	/ɔ:/-ou/	/e/-æ/	/ə:r/-ɑ:r/	/ʌ/-ə:r/
D (H.-L.)		0.16	0.35	- 0.23	0.15	0.02	0.08	0.16	0.13
df		71	67	71	70	70	70	71	69
t		1.10	1.68	1.11	0.60	0.07	0.32	0.50	0.59
p		0.27	0.10	0.27	0.55	0.95	0.75	0.62	0.56

D: difference L.: low general listening proficiency H.: high general listening proficiency

This table shows that there is no statistically significant difference in discriminative performance of any two of the eight vowel minimal pairs between the two levels of general listening proficiency. Table 7 shows the results of the tests for the consonant minimal pairs:

Table 7: Welch T-tests for Consonant Minimal Pairs

		/b/-v/	/f/-h/	/s/-θ/	/l/-r/	/ʃ/-s/	/dz/-z/	/n/-ŋ/
D (H.-L.)		- 0.11	0.41	- 0.23	- 0.20	0.28	0.22	0.02
df		68	60	67	64	71	71	71
t		0.30	2.52	0.70	0.72	1.11	0.68	0.07
p		0.76	0.01	0.49	0.48	0.27	0.50	0.94

D: difference L.: low general listening proficiency H.: high general listening proficiency

This table shows that no statistically significant difference is present in discriminative performance of the consonant minimal pairs between the two levels of general listening proficiency except for /f/-/h/ ($p = .01$).

3.2 Relationships between Discriminative Performances of Minimal Pairs at the Two Levels of General Listening Proficiency

3.2.1 Simple Regression Analysis

In order to explore relationships between discriminative performances of minimal pairs at the two levels of general listening proficiency, the present study conducted a simple regression analysis (Pearson's Product Correlation) as a standard procedure. First, simple correlation coefficients were computed between discriminative performances of the vowel minimal pairs at the low level of general listening proficiency. The results are shown in Table 8:

Table 8: Simple Correlation Coefficients between Discriminative Performances of the Vowel Minimal Pairs (G. L. P.: Low)

		/i/-/i:/	/æ/-/ɑ/	/ʌ/-/ɑ/	/æ/-/ʌ/	/ɔ:/-/ou/	/e/-/æ/	/ə:r/-/ɑ:r/	/ʌ/-/ə:r/
/i/-/i:/	r	1.00	0.16	-0.29	-0.21	-0.02	0.05	0.06	0.11
	p	-	0.33	0.07	0.19	0.91	0.74	0.71	0.49
/æ/-/ɑ/	r	0.16	1.00	-0.07	0.37	0.14	0.34	0.06	0.68
	p	0.33	-	0.66	0.02	0.40	0.04	0.70	0.00
/ʌ/-/ɑ/	r	-0.29	-0.07	1.00	0.19	-0.05	0.08	-0.08	-0.01
	p	0.07	0.66	-	0.25	0.76	0.65	0.61	0.94
/æ/-/ʌ/	r	-0.21	0.37	0.19	1.00	0.24	0.19	0.13	0.36
	p	0.19	0.02	0.25	-	0.15	0.24	0.43	0.02
/ɔ:/-/ou/	r	-0.02	0.14	-0.05	0.24	1.00	-0.17	0.19	0.01
	p	0.91	0.40	0.76	0.15	-	0.30	0.25	0.97
/e/-/æ/	r	0.05	0.34	0.08	0.19	-0.17	1.00	-0.11	0.26
	p	0.74	0.04	0.65	0.24	0.30	-	0.49	0.11
/ə:r/-/ɑ:r/	r	0.06	0.06	-0.08	0.13	0.19	-0.11	1.00	-0.05
	p	0.71	0.70	0.61	0.43	0.25	0.49	-	0.75
/ʌ/-/ə:r/	r	0.11	0.68	-0.01	0.36	0.01	0.26	-0.05	1.00
	p	0.49	0.00	0.94	0.02	0.97	0.11	0.75	-

G. L. P.: General Listening Proficiency

This table shows that there are four combinations of two of the discriminative performances of the vowel minimal pairs which are significantly related to each other: between /æ/-/ɑ/ & /æ/-/ʌ/ ($p = .02$), /æ/-/ɑ/ & /e/-/æ/ ($p = .04$), /æ/-/ɑ/ & /ʌ/-/ə:r/ ($p = .00$), and /æ/-/ʌ/ & /ʌ/-/ə:r/ ($p = .02$).

Next, simple correlation coefficients were likewise computed between discriminative performances of the consonant minimal pairs at the low level of general listening proficiency. The results are shown in Table 9:

Table 9: Correlation Coefficients between Discriminative Performances of the Consonant Minimal Pairs (G. L. P.: Low)

		/b/-/v/	/f/-/h/	/s/-/θ/	/l/-/r/	/ʃ/-/s/	/dz/-/z/	/n/-/ŋ/
/b/-/v/	r	1.00	0.30	0.12	0.26	0.13	0.31	0.20
	p	-	0.06	0.45	0.11	0.43	0.05	0.23
/f/-/h/	r	0.30	1.00	0.04	0.32	0.04	0.09	0.29
	p	0.06	-	0.82	0.05	0.80	0.58	0.07
/s/-/θ/	r	0.12	0.04	1.00	-0.01	0.00	0.14	-0.22
	p	0.45	0.82	-	0.95	0.99	0.40	0.19
/l/-/r/	r	0.26	0.32	-0.01	1.00	0.23	0.14	0.18
	p	0.11	0.05	0.95	-	0.16	0.39	0.28
/ʃ/-/s/	r	0.13	0.04	0.00	0.23	1.00	0.11	-0.24
	p	0.43	0.80	0.99	0.16	-	0.52	0.14
/dz/-/z/	r	0.31	0.09	0.14	0.14	0.11	1.00	0.06
	p	0.05	0.58	0.40	0.39	0.52	-	0.72
/n/-/ŋ/	r	0.20	0.29	-0.22	0.18	-0.24	0.06	1.00
	p	0.23	0.07	0.19	0.28	0.14	0.72	-

G. L. P.: General Listening Proficiency

This table shows that no combinations of two of the discriminative performances of the consonant minimal pairs are significantly related to each other except for the pair *f/-/h/* & *l/-/r/* ($p = .05$).

The same kind of computation was carried out between the discriminative performances of the vowel and consonant minimal pairs at the low level of general listening proficiency. Table 10 shows the results:

Table 10: Simple Correlation Coefficients between Discriminative Performances of the Vowel and Consonant Minimal Pairs (G. L. P.: Low)

		/i/-/i:/	/æ/-/ɑ/	/ʌ/-/ɑ/	/æ/-/ʌ/	/ɔ:/-/ou/	/e/-/æ/	/ə:r/-/ɑ:r/	/ʌ/-/ə:r/
/b/-/v/	r	-0.06	0.31	0.03	0.16	0.07	0.13	0.21	0.38
	p	0.70	0.06	0.87	0.33	0.68	0.44	0.21	0.02
/f/-/h/	r	0.13	0.28	0.15	0.16	0.26	0.24	0.09	0.15
	p	0.45	0.08	0.35	0.35	0.11	0.14	0.59	0.36
/s/-/θ/	r	-0.39	-0.26	0.07	0.23	-0.01	-0.35	-0.05	0.01
	p	0.02	0.10	0.67	0.16	0.96	0.03	0.78	0.94

/l/-/r/	r	0.15	0.31	0.04	0.15	0.02	0.19	0.33	0.39
	p	0.37	0.05	0.80	0.36	0.91	0.24	0.04	0.01
/ʃ/-/s/	r	0.07	0.19	0.06	0.15	0.02	-0.03	0.18	-0.06
	p	0.69	0.24	0.72	0.37	0.90	0.85	0.27	0.73
/dz/-/z/	r	0.09	-0.01	0.17	0.38	0.11	0.08	0.26	0.13
	p	0.59	0.93	0.31	0.02	0.52	0.64	0.11	0.44
/n/-/ŋ/	r	-0.09	-0.02	0.21	-0.06	0.04	0.28	0.05	-0.02
	p	0.60	0.92	0.20	0.74	0.82	0.08	0.74	0.88

G. L. P.: General Listening Proficiency

This table shows that there are six combinations of two of the discriminative performances of the vowel and consonant minimal pairs which are significantly related to each other: between /i/-/i:/ & /s/-/θ/ (p = .02), /æ/-/ɑ/ & /l/-/r/ (p = .05), /æ/-/ʌ/ & /dz/-/z/ (p = .02), /e/-/æ/ & /s/-/θ/ (p = .03), /ʌ/-/ə:r/ & /b/-/v/ (p = .02), and /ʌ/-/ə:r/ & /l/-/r/ (p = .01).

Simple correlation coefficients were likewise computed at the high level of general listening proficiency. Table 11 shows the results for the vowel minimal pairs:

Table 11: Simple Correlation Coefficients between Discriminative Performances of the Vowel Minimal Pairs (G. L. P.: High)

		/i/-/i:/	/æ/-/ɑ/	/ʌ/-/ɑ/	/æ/-/ʌ/	/ɔ:/-/ou/	/e/-/æ/	/ə:r/-/ɑ:r/	/ʌ/-/ə:r/
/i/-/i:/	r	1.00	-0.22	0.09	0.02	0.06	0.08	-0.04	0.05
	p	-	0.22	0.60	0.93	0.75	0.67	0.81	0.77
/æ/-/ɑ/	r	-0.22	1.00	-0.33	0.33	0.18	-0.06	0.14	-0.05
	p	0.22	-	0.06	0.06	0.30	0.72	0.44	0.77
/ʌ/-/ɑ/	r	0.09	-0.33	1.00	0.07	-0.22	0.06	0.07	0.08
	p	0.60	0.06	-	0.70	0.22	0.74	0.67	0.64
/æ/-/ʌ/	r	0.02	0.33	0.07	1.00	0.25	0.08	-0.08	0.02
	p	0.93	0.06	0.70	-	0.16	0.63	0.64	0.92
/ɔ:/-/ou/	r	0.06	0.18	-0.22	0.25	1.00	0.14	0.12	-0.20
	p	0.75	0.30	0.22	0.16	-	0.42	0.50	0.24
/e/-/æ/	r	0.08	-0.06	0.06	0.08	0.14	1.00	0.26	-0.05
	p	0.67	0.72	0.74	0.63	0.42	-	0.14	0.78
/ə:r/-/ɑ:r/	r	-0.04	0.14	0.07	-0.08	0.12	0.26	1.00	0.05
	p	0.81	0.44	0.67	0.64	0.50	0.14	-	0.78
/ʌ/-/ə:r/	r	0.05	-0.05	0.08	0.02	-0.20	-0.05	0.05	1.00
	p	0.77	0.77	0.64	0.92	0.24	0.78	0.78	-

G. L. P.: General Listening Proficiency

This table shows that no combinations of two of the discriminative performances of the vowel minimal pairs are significantly related to each other at the high level of general listening proficiency.

Table 12 shows the simple correlation coefficients between the discriminative performances of the consonant minimal pairs at the same level:

Table 12: Simple Correlation Coefficients between Discriminative Performances of the Consonant Minimal Pairs (G. L. P.: High)

		/b/-/v/	/f/-/h/	/s/-/θ/	/l/-/ɾ/	/ʃ/-/s/	/dz/-/z/	/n/-/ŋ/
/b/-/v/	r	1.00	0.45	0.68	0.29	0.00	0.10	-0.06
	p	-	0.01	0.00	0.10	0.99	0.59	0.73
/f/-/h/	r	0.45	1.00	0.26	0.15	0.18	-0.11	0.06
	p	0.01	-	0.13	0.39	0.32	0.54	0.74
/s/-/θ/	r	0.68	0.26	1.00	0.34	0.28	0.16	0.02
	p	0.00	0.13	-	0.05	0.11	0.37	0.93
/l/-/ɾ/	r	0.29	0.15	0.34	1.00	0.27	0.39	0.00
	p	0.10	0.39	0.05	-	0.12	0.02	1.00
/ʃ/-/s/	r	0.00	0.18	0.28	0.27	1.00	0.33	0.11
	p	0.99	0.32	0.11	0.12	-	0.06	0.55
/dz/-/z/	r	0.10	-0.11	0.16	0.39	0.33	1.00	0.03
	p	0.59	0.54	0.37	0.02	0.06	-	0.87
/n/-/ŋ/	r	-0.06	0.06	0.02	0.00	0.11	0.03	1.00
	p	0.73	0.74	0.93	1.00	0.55	0.87	-

G. L. P.: General Listening Proficiency

This table shows that there are four combinations of two of the discriminative performances of the consonant minimal pairs which are significantly related to each other: between /b/-/v/ & /f/-/h/ ($p = .01$), /b/-/v/ & /s/-/θ/ ($p = .00$), /s/-/θ/ & /l/-/ɾ/ ($p = .05$), and /l/-/ɾ/ & /dz/-/z/ ($p = .02$).

Finally, simple correlation coefficients were computed between the discriminative performances of the vowel and consonant minimal pairs at the high level of general listening proficiency. The results are shown in Table 13:

Table 13: Simple Correlation Coefficients between Discriminative Performances of the Vowel and Consonant Minimal Pairs (G. L. P.: High)

		/i/-/i:/	/æ/-/ɑ/	/ʌ/-/ɑ/	/æ/-/ʌ/	/ɔ:/-/ou/	/e/-/æ/	/ə:r/-/ɑ:r/	/ʌ/-/ə:r/
/b/-/v/	r	0.47	-0.18	-0.12	0.06	-0.06	0.23	-0.11	0.34
	p	0.00	0.30	0.50	0.72	0.74	0.18	0.53	0.05
/f/-/h/	r	0.27	0.04	-0.17	-0.10	-0.18	0.04	-0.01	0.05
	p	0.13	0.80	0.33	0.58	0.30	0.84	0.97	0.78
/s/-/θ/	r	0.52	-0.06	-0.06	0.16	0.09	0.45	-0.12	0.31
	p	0.00	0.74	0.72	0.37	0.61	0.01	0.51	0.08
/l/-/r/	r	0.21	-0.18	-0.08	0.18	-0.34	0.17	-0.21	0.19
	p	0.23	0.30	0.67	0.32	0.05	0.35	0.23	0.29
/ʃ/-/s/	r	-0.12	0.15	-0.31	0.20	-0.16	0.08	0.06	-0.07
	p	0.50	0.40	0.08	0.27	0.38	0.64	0.74	0.71
/dz/-/z/	r	-0.02	0.10	-0.13	0.40	0.16	0.13	0.06	-0.09
	p	0.89	0.59	0.46	0.02	0.38	0.47	0.72	0.61
/n/-/ŋ/	r	0.28	0.25	0.14	0.16	-0.01	0.12	0.34	-0.20
	p	0.11	0.15	0.44	0.36	0.94	0.48	0.05	0.25

G. L. P.: General Listening Proficiency

This table shows that there are six combinations of two of the discriminative performances of the vowel and consonant minimal pairs which are significantly related to each other: between /i/-/i:/ & /b/-/v/ ($p = .00$), /i/-/i:/ & /s/-/θ/ ($p = .00$), /æ/-/ʌ/ & /dz/-/z/ ($p = .02$), /e/-/æ/ & /s/-/θ/ ($p = .01$), /ə:r/-/ɑ:r/ & /n/-/ŋ/ ($p = .05$), and /ʌ/-/ə:r/ & /b/-/v/ ($p = .05$).

3.2.2 Partial Regression Analysis

The relationships between discriminative performances of the target minimal pairs which simple regression analysis has clarified above may be superficial and unstable. It is possible that they are mere reflections of some unrevealed relationships (known as pseudo correlations), subsistent in the nature of the English minimal pairs. The present study has also administered partial regression analysis in order to determine combinations of any given two of the direct relationships between discriminative performances of the fifteen minimal pairs while eliminating the influences of the rest.

First, partial correlation coefficients were computed between discriminative performances of the target fifteen minimal pairs at the low level of general listening proficiency. The results show that four relationships are statistically significant: 1) /æ/-/ɑ/ & /ʌ/-/ə:r/ ($p = .05$), 2) /i/-/i:/ & /s/-/θ/ ($p = .00$), 3) /ʌ/-/ə:r/ & /l/-/r/ ($p = .05$), and 4) /ʌ/-/ə:r/ & /ʃ/-/s/ ($p = .04$). They are summarized in Table 14:

Table 14: Significant Relationships between Discriminative Performances of the Minimal Pairs Based upon Partial Correlation Coefficients (G. L. P.: Low)

		r	p
<u>Within V. M. P.</u>			
/æ/-/ɑ/	-	/ʌ/-/ə:r/	-0.40
<u>Between V. M. P. and C. M. P.</u>			
/i/-/i:/	-	/s/-/θ/	0.61
/ʌ/-/ə:r/	-	/l/-/r/	0.40
/ʌ/-/ə:r/	-	/ʃ/-/s/	-0.42

G. L. P.: General Listening Proficiency V. M. P.: Vowel Minimal Pair C. M. P.: Consonant Minimal Pair

Next, partial correlation coefficients were similarly computed between discriminative performances of the target fifteen minimal pairs at the high level of general listening proficiency. The results show that twelve relationships are statistically significant: 1) /æ/-/ɑ/ & /ʌ/-/ɑ/ (p = .02), 2) /æ/-/ɑ/ & /æ/-/ʌ/ (p = .05), 3) /ʌ/-/ɑ/ & /ɔ:/-/ou/ (p = .04), 4) /e/-/æ/ & /ə:r/-/ɑ:r/ (p = .04), 5) /b/-/v/ & /f/-/h/ (p = .04), 6) /b/-/v/ & /s/-/θ/ (p = .01), 7) /s/-/θ/ & /ʃ/-/s/ (p = .00), 8) /l/-/r/ & /dz/-/z/ (p = .04), 9) /i/-/i:/ & /s/-/θ/ (p = .02), 10) /ʌ/-/ɑ/ & /ʃ/-/s/ (p = .04), 11) /i/-/si/ & /l/-/r/ (p = .04), and 12) /e/-/æ/ & /s/-/θ/ (p = .01). They are tabulated in Table 15:

Table 15: Significant Relationships between Discriminative Performances of the Minimal Pairs Based upon Partial Correlation Coefficients (G. L. P.: High)

		r	p
<u>Within V. M. P.</u>			
/æ/-/ɑ/		/ʌ/-/ɑ/	-0.49
/æ/-/ɑ/		/æ/-/ʌ/	0.44
/ʌ/-/ɑ/		/ɔ:/-/ou/	-0.46
/e/-/æ/		/ə:r/-/ɑ:r/	0.45
<u>Within C. M. P.</u>			
/b/-/v/		/f/-/h/	0.45
/b/-/v/		/s/-/θ/	0.54
/s/-/θ/		/ʃ/-/s/	0.61
/l/-/r/		/dz/-/z/	0.45
<u>Between V. M. P. and C. M. P.</u>			
/i/-/i:/		/s/-/θ/	.052
/ʌ/-/ɑ/		/ʃ/-/s/	-0.45
/ʃ/-/s/		/l/-/r/	-0.45
/e/-/æ/		/s/-/θ/	0.55

G. L. P.: General Listening Proficiency V. M. P.: Vowel Minimal Pair C. M. P.: Consonant Minimal Pair

4. Summary & Discussion

There are several major findings of the above analysis, some of which may offer educational suggestions to English instructors and pique researchers' interests.

4.1 Differences in Discriminative Performance of the Minimal Pairs

As far as the discriminative performances of the eight vowel minimal pairs are concerned, statistically significant differences were not recognized between subjects with low general listening proficiency and those with high general listening proficiency. The same kind of result was obtained with regard to the discriminative performances of the target consonant minimal pairs except /f/-/h/. Overall, subjects with high general listening proficiency did not differ from those with low general listening proficiency in discriminative performances of the consonant minimal pairs.

These results may represent one aspect of the nature of perception of English minimal pairs. If this view is taken, it is possible to maintain as a whole that general listening proficiency does not have much to do with discriminative performances of minimal pairs and that subjects with low general listening proficiency and those with high general listening proficiency show the same kind of discriminative performance. Moreover, it would be possible to inform English instructors, for example, that they should consider that learners with low general listening are not always poor at discriminating English minimal pairs.

This stance, which seems to be rather striking, may be hard to accept, however. There are generally and experientially held views that those of good listening proficiency should be able to show good performances in discriminating minimal pairs. Obviously, these are odds with the above results. One possible explanation for this may be that the minimal pairs they discriminated were too easy or difficult and that the floor and ceiling effects failed to make differences in discriminative performance between the two different levels of general listening proficiency.

In order to be conclusive about these two interpretations of the results of the investigation, further studies must be conducted, controlling such experimental factors as floor and ceiling effects. The current study employed two levels of general listening proficiency. The setting of such levels will be important for future studies. If three levels of general listening proficiency are employed, for example, the results may be somewhat different.

4.2 Internal Relationships between Discriminative Performances of the Minimal Pairs

Partial regression analysis has revealed a number of informative and interesting aspects of the nature of perception of English minimal pairs. As far as the discriminative performances of the minimal pairs by the subjects of low general listening proficiency are concerned, four significant internal relationships between them have been found: 1) /æ/-/ɑ/ & /ʌ/-/ə:r/ ($p = .05$), 2) /i/-/i:/ & /s/-/θ/ ($p = .00$), 3) /ʌ/-/ə:r/ & /l/-/r/ ($p = .05$), and 4) /ʌ/-/ə:r/ & /ʃ/-/s/ ($p = .04$). As Table 14 shows, these relationships were recognized within the group of

the vowel minimal pairs and between the group of the vowel minimal pairs and that of the consonant minimal pairs, not within the group of the consonant minimal pairs. Internal relationships may not be formed between discriminative performances of the consonant minimal pairs at the low level of general listening proficiency.

A closer look at these four internal relationships shows that the pair /ʌ/-/ə:r/ is related with the others multiply while they are related singly. Although it is difficult to interpret the negative relationships between the pair /æ/-/ɑ/ & /ʌ/-/ə:r/ ($r = -.40$) and between /ʌ/-/ə:r/ & /ʃ/-/s/ ($r = -.42$), it is conceivable that they are simply characteristic of learners at the low level of general listening proficiency and that the pair /ʌ/-/ə:r/ has certainly some kind of important role.

As far as the discriminative performances of the minimal pairs by the subjects of high general listening proficiency are concerned, twelve significant internal relationships between them have been found: 1) /æ/-/ɑ/ & /ʌ/-/ɑ/ ($p = .02$), 2) /æ/-/ɑ/ & /æ/-/ʌ/ ($p = .05$), 3) /ʌ/-/ɑ/ & /ɔ:/-/ou/ ($p = .04$), 4) /e/-/æ/ & /ə:r/-/ɑ:r/ ($p = .04$), 5) /b/-/v/ & /f/-/h/ ($p = .04$), 6) /b/-/v/ & /s/-/θ/ ($p = .01$), 7) /s/-/θ/ & /ʃ/-/s/ ($p = .00$), 8) /l/-/r/ & /dz/-/z/ ($p = .04$), 9) /i/-/i:/ & /s/-/θ/ ($p = .02$), 10) /ʌ/-/ɑ/ & /ʃ/-/s/ ($p = .04$), 11) /ʃ/-/s/ & /l/-/r/ ($p = .04$), and 12) /e/-/æ/ & /s/-/θ/ ($p = .01$). As Table 15 shows, these relationships were recognized within the group of the vowel minimal pairs, within the group of the consonant minimal pairs, and between the group of the vowel minimal pairs and that of the consonant minimal pairs. It can be noted that this recognition pattern, which involves more minimal pairs, has much to do with the high level of general listening proficiency and that, in particular, the four relationships in the group of consonant minimal pairs, /b/-/v/ & /f/-/h/ ($r = .45$), /b/-/v/ & /s/-/θ/ ($r = .54$), /s/-/θ/ & /ʃ/-/s/ ($r = .61$), and /l/-/r/ & /dz/-/z/ ($r = .45$) may represent an important aspect of the nature of perception of minimal pairs at higher levels of general listening proficiency.

A closer look at these twelve internal relationships shows that there are both “multi-related” and “single-related” minimal pairs, which develop certain relationships between their performances. The four recognized relationships in the group of the vowel minimal pairs show, for example, that the pair /ʌ/-/ɑ/, which is multi- and negatively related with the others [e.g. /æ/-/ɑ/ & /ʌ/-/ɑ/ ($r = -.49$),] may have a significant position at the high level of general listening proficiency. Likewise, the four recognized relationships between the groups of the vowel and consonant minimal pairs show, for example, that the pair /ʃ/-/s/, which is multi and negatively related with the others [e.g. /ʃ/-/s/ & /l/-/r/ ($r = -.45$),] may also have a significant position at the high level of general listening proficiency.

At this stage, it is not easy to systematically understand all the internal relationships between discriminative performances of the minimal pairs, especially negative relationships, and all that can be stated is that such relationships are extremely complicated when viewed individually. It seems possible, however, to claim that the differences in such relationships between the two levels of general listening proficiency cause are quite striking: 4 and 12 internal relationships at high and low general listening proficiency, respectively. It is true that the number at each level is not markedly great in comparison with the total number of combinations of any given two of the fifteen minimal pairs (56), but these conspicuous differences may suggest that the number of internal relationships between discriminative performances of minimal pairs can be a good predictor to differentiate between those with high and low general listening proficiency. The number of such internal relationships intrinsic in higher general listening proficiency, for example, may exceed the number noted above (12).

It may be even conceivable that this kind of number will get closer to the total number (56) if general listening proficiency approaches the level of native speakers of English. Further studies are needed to obtain a clear apprehension of the relationships between general listening proficiency and the number of internal relationships between discriminative performances of minimal pairs.

Concluding Remarks

The results of the current study could offer some insights into the perception of English minimal pairs, though they fail to provide English instructors with useful information which can be of direct use in the classroom. For example, it has been claimed that discriminative abilities of English minimal pairs may not have a great deal to do with general listening proficiency. Another example is that discriminative performances of consonant minimal pairs by learners at a higher level of general listening proficiency tend to be closely related to each other.

The results of the current study, however, should be viewed as tentative and must be reexamined from several experimental perspectives. Firstly, as was mentioned above, control of such experimental factors as floor and ceiling effects is needed, and careful attention must also be paid to the setting of the levels of general listening proficiency. Secondly, more subjects must be used, and their backgrounds should be considered in terms of familiarity with the English sound system. Thirdly, positions of target phonemes in words must be taken into account throughout the minimal pairs: for example, the pair /l/-r/ is generally claimed to be difficult to discriminate when both phonemes are at the beginning of words. Finally, the speed at which the subjects listened to combinations of three words must be controlled. A higher speed is considered to make it difficult for learners to discriminate minimal pairs. Further studies, taking these points into account, will take us closer to a complete map of the nature of perception of English minimal pairs.

Notes

- 1) These fifteen pairs were chosen, because each of them includes more than five minimal pairs of words which are actually used, and because they can be therefore compared with each other under the same conditions.
- 2) The software used for basic data processing is *EXCEL STATISTICS* (Version 5.0: Esumi Inc.) and *EXCEL TAHENRYOUKAISEKI* (Version 5.0: Esumi Inc.), and *SPSS* (Version 12.0: SPSS Inc.)

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Appendix (partial example)

テープから聞こえてくる単語の組み合わせを選び、該当するものに○をつけなさい。

best best vest ()

best vest best ()

vest vest best ()

vest best vest ()