Understanding Relationships between Discriminative Perception of English Minimal Pairs and General Listening Proficiency:a Pilot Study

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要　約

日本人英語学習者のミニマルペアー（最小対立）の識別能力と総合的リスニング能力との関係を解明するための調査を行った。分析の結果、１）両者の関係は複雑で、調査対象とした 15 タイプのミニマルペアーのうち、/l/–/r/ などとの間には統計的に有意な非線形的関係（３次曲線的）が認められ、２）相対的に母音より子音のミニマルペアーの識別能力の方が総合的リスニングに関与している可能性が高い、ことなどが明らかにされている。

Background

The value of minimal pairs as an important element in teaching listening and pronunciation is widely recognized in ESL/EFL (e.g., Avery & Ehrlich 1992 and Celce-Murcia et al. 1996). It must be pointed put, however, that the number of empirical studies in the field of English minimal pairs, at least targeting Japanese learners of English, is quite limited (Tanabe 2002 and Tsujioka 2005), 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). A review of Takanashi (1987), one of the few empirical studies, for example, outlines this research situation. It reports that phoneme discrimination is weakly related to general listening proficiency ($r = .328$, $p < .05$, $n = 62$), but the result is inconclusive and must be considered as tentative. One reason for this is that the number of subjects may not be enough to draw a certain research conclusion, but a more fundamental one is that this study presupposes that phoneme discrimination consists of one single unity and that every phoneme involves the same kind of discriminative property, failing to pay attention to differences in discrimination among types of phonemes. It is quite possible, considering the number and diversity of types of English phonemes, that some should be more difficult or easier to discriminate than others and that they are more or less related to general listening proficiency than others. The result would have been somewhat different if the investigation had been conducted selecting more suitable types of phonemes to discriminate. To date, it is not yet certain what exactly constitutes phoneme discrimination, but all that can be contended is that more studies, which also pay attention to differences in discrimination among types of phonemes, must be conducted.

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 during these durations has raised a fundamental question: how much do we know about relationships between discriminative perception of English minimal pairs and general listening proficiency? Unfortunately, little is understood about them as is mentioned above. In a class, the author wondered, for instance, if learners, who were good at discriminating the minimal pair /l/–/r/, were also good at general listening proficiency and vice versa, but such relationships have not been fully examined yet. The same thing is true of another class, in which he wondered how much general listening proficiency could be explained by the performance of discriminating the minimal pair /b/–/v/, but likewise, such an explanatory rate has not been thoroughly investigated yet.

It seems that these kinds of relationships are informative for instructors: they may grasp learners' general listening proficiency indirectly by checking the ability to discriminate certain types of minimal pairs, for example. The current study presents the results of an investigation which was conducted in order to clarify these kinds of relationships between discriminative perception of English minimal pairs and general listening proficiency. Its research designs are 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 types of vowel minimal pairs and seven types of consonant minimal pairs[1)] (Nema 1986: /i/–/i:/, /æ/－/ɑ/, /ʌ/－/ɑ/, /æ/–/ʌ/, /ɔ:/－/ou/, /e/–/æ/, /ə:r/–/ɑ:r/, /ʌ/–/ə:r/, /b/–/v/, /f/–/h/, /s/–/θ/, /l/–/r/, /i/–/si/, /dz/–/z/, and /n/–/ŋ/), includes two main research questions:

1) How strong is the relationship (linear) between the discriminative performance of each of the target minimal pairs and general listening proficiency?

2) Are non-linear relationships recognizable between them? If so, how strong are they?

1.2 Materials

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

Special care was taken to measure learners' performance in discriminating the 15 types of English minimal pairs accurately. Firstly, 150 sets of minimal pairs of different words were prepared (10 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

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

1.4 Procedures

The subjects received general instruction and practice in the target 15 types of minimal pairs from the beginning of October to the middle of December in 2005. 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 observation of the learning attitude of the subjects, the students 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 2005, 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 General Listening Proficiency

In order to measure the subjects' (N=49) general listening proficiency, the mean score was 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.
S.D.	10.33
Min.	4.00
Max.	18.00
Mean	11.31

G. L. P.: General Listening Proficiency

2.2 Discriminative Performances of the Target Minimal Pairs

Discriminative performances of the 15 minimal pairs were examined. First, the mean scores of the subjects' (N=49) discriminative performances of the eight vowel minimal pairs were calculated along with its standard deviation, maximum and minimum. This data is presented in Table 2, in which the full mark is ten:

Table 2: Descriptive Statistics for Discriminative Performances of Vowel Minimal Pairs

	/i/－/iː/	/æ/－/ɑ/	/ʌ/－/ɑ/	/æ/－/ʌ/	/ɔː/－/ou/	/e/－/æ/	/əːr/–/ɑːr/	/ʌ/–/əːr/
S.D.	1.35	0.87	5.43	2.25	3.80	2.54	5.22	2.91
Min.	6.00	6.00	0.00	5.00	3.00	0.00	2.00	4.00
Max.	10.00	10.00	9.00	10.00	10.00	7.00	10.00	10.00
Mean	8.86	9.31	2.86	8.69	6.86	3.78	7.08	8.06

Next, the mean scores of the subjects'(N=49) discriminative performances of the seven consonant minimal pairs were likewise calculated along with its standard deviation, maximum and minimum. Table 3 presents this data, in which the full mark is five:

Table 3: Descriptive Statistics for Discriminative Performances of Consonant Minimal Pairs

	/b/－/v/	/f/－/h/	/s/–/θ/	/l/－/r/	/i/－/si/	/dz/－/z/	/n/–/ŋ/
S.D.	2.84	2.84	7.57	3.45	9.32	5.11	2.05
Min.	2.00	3.00	1.00	1.00	0.00	1.00	1.00
Max.	8.00	10.00	10.00	9.00	10.00	9.00	7.00
Mean	4.65	8.37	6.35	4.76	6.10	5.31	3.51

3 Data Analysis

3.1 Simple Linear Regression Analysis

In order to explore relationships between discriminative performances of the target minimal pairs and general listening proficiency, the present study conducted a simple regression analysis (Pearson's Product Correlation) as a standard procedure. First, simple correlation coefficients were calculated between discriminative performances of the vowel minimal pairs and general listening proficiency. The results are shown in Table 4:

Table 4: Simple Correlation Coefficients between Discriminative Performances of the Vowel Minimal Pairs and General Listening Proficiency

		/i/－/i:/	/æ/–/ɑ/	/ʌ/–/ɑ/	/æ/–/ʌ/	/ɔ:/–/ou/	/e/－/æ/	/ə:r/–/ɑ:r/	/ʌ/–/ə:r/
	r	.08	.25	.11	.08	-.13	.23	.23	.30
G.L.P.	p	.57	.09	.45	.57	.36	.11	.11	.04
	s	ns	ns	ns	ns	ns	ns	ns	s

G. L. P.: General Listening Proficiency　r: correlation coefficient　p: probability　s: significant　ns: non-significant

This table shows that linear relationships between discriminative performances of the target vowel minimal pairs and general listening proficiency are weak as a whole and that only one type of vowel minimal pair, /ʌ/–/ə:r/ is significantly related to general listening proficiency (p = .04).

Next, simple correlation coefficients were likewise calculated between discriminative performances of the consonant minimal pairs and general listening proficiency. The results are shown in Table 5:

Table 5: Simple Correlation Coefficients between Discriminative Performances of the Consonant Minimal Pairs and General Listening Proficiency

		/b/－/v/	/f/－/h/	/s/–/θ/	/l/－/r/	/i/－/si/	/dz/－/z/	/n/–/ŋ/
	r	.02	.46	.30	.49	.14	.02	.18
G.L.P.	p	.91	.00	.04	.00	.35	.90	.22
	s	ns	s	s	s	ns	ns	ns

G. L. P.: General Listening Proficiency　r: correlation coefficient　p: probability　s: significant　ns: non-significant

This table shows that linear relationships between discriminative performances of the target consonant minimal pairs and general listening proficiency are stronger as a whole and that three types of consonant minimal pairs /f/–/h/, /s/–/θ/ and /l/–/r/ are significantly related to general listening proficiency (p = .00, .04, and .00 respectively).

3.2 Simple Non-Linear Regression Analysis

The simple linear regression analysis above has examined if there is a statistically significant relationship between the discriminative performance of each of the target minimal pairs and general listening proficiency, and showed its strength. It must be pointed out, however, that even if such a relationship is not recognizable, it does not always mean that there is no relationship between the two variables, because the analysis presupposes that relationships between discriminative performances of minimal pairs and general listening proficiency are linear and because it fails to recognize non-linear relationships, such as quadratic ones. In order to better understand relationships between the discriminative performances of minimal pairs and general listening proficiency, they must be viewed also from the perspective of non-linearity. There are a number of ways to explore the non-linearity of relationships between two variables. As a first step, the current study has focused upon exploring quadratic and cubic relationships between the discriminative performances of minimal pairs and general listening proficiency.

3.2.1 G.L.P. and Vowel Minimal Pairs

First, simple coefficients of determination in quadratic relationships between discriminative performances of the vowel minimal pairs and general listening proficiency were calculated. The results are shown in Table 6:

Table 6: Simple Coefficients of Determination in Quadratic Relationships between Discriminative Performances of the Vowel Minimal Pairs and General Listening Proficiency

		/i/－/iː/	/æ/–/ɑ/	/æ/–/ɑ/	/æ/–/ʌ/	/ɔː/–/ou/	/e/–/æ/	/əːr/–/ɑːr/	/ʌ/–/əːr/
	$R^{2'}$	.09	.07	.06	.01	.07	.05	.07	.01
G.L.P.	p	.65	.18	.22	.82	.20	.29	.21	.06
	s	ns	ns	ns	ns	ns	ns	ns	ns

G. L. P.: General Listening Proficiency $R^{2'}$: coefficient of determination adjusted for the degree of freedom p: probability
s: significant ns: non-significant

This table shows that quadratic relationships do not exist at all between discriminative performances of the target vowel minimal pairs and general listening proficiency, as linear ones do not.

Likewise, cubic relationships were examined, in which simple coefficients of determination were calculated between discriminative performances of the vowel minimal pairs and general listening proficiency. The results are shown in Table 7:

Table 7: Simple Coefficients of Determination in Cubic Relationships between Discriminative Performances of the Vowel Minimal Pairs and General Listening Proficiency

		/i/–/iː/	/æ/–/ɑ/	/ʌ/–/ɑ/	/æ/–/ʌ/	/ɔː/–/ou/	/e/–/æ/	/əːr/–/ɑːr/	/ʌ/–/əːr/
	$R^{2'}$	.03	.09	.02	.01	.08	.06	.05	.14
G.L.P.	p	.74	.22	.29	.93	.08	.14	.15	.02
	s	ns	ns	ns	ns	ns	ns	ns	s

G. L. P.: General Listening Proficiency $R^{2'}$: coefficient of determination adjusted for the degree of freedom p: probability
s: significant ns: non-significant

This table shows that relationships between discriminative performances of the target vowel minimal pairs and general listening proficiency are not cubic as a whole and that although there is a cubic relationship recognizable between the vowel minimal pairs /ʌ/–/əːr/ and general listening proficiency (p=.02), it is not strong ($R^{2'}$=.14)

3.2.2 G.L.P. and Consonant Minimal Pairs

Next, simple coefficients of determination in quadratic relationships between discriminative performances of the consonant minimal pairs and general listening proficiency were calculated. The results are shown in Table 8:

Table 8: Simple Coefficients of Determination in Quadratic Relationships between Discriminative Performances of the Consonant Minimal Pairs and General Listening Proficiency

		/b/–/v/	/f/–/h/	/s/–/θ/	/l/–/r/	/i/－/si/	/dz/–/z/	/n/–/ŋ/
	$R^{2'}$	.00	.19	.05	.20	.01	.04	.00
G.L.P.	p	.98	.00	.11	.00	.29	.15	.39
	s	ns	s	ns	s	ns	ns	ns

G. L. P.: General Listening Proficiency $R^{2'}$: coefficient of determination adjusted for the degree of freedom p: probability
s: significant ns: non-significant

This table shows that although they are not very strong, quadratic relationships are recognizable between the discriminative performances of two types of consonant minimal pairs (/f/–/h/ and /l/–/r/) and general listening proficiency (both are p=.00).

Likewise, cubic relationships were examined, in which simple coefficients of determination were calculated between discriminative performances of the consonant minimal pairs and general listening proficiency. The results are shown in Table 9:

Table 9: Simple Coefficients of Determination in Cubic Relationships between Discriminative Performances of the Consonant Minimal Pairs and General Listening Proficiency

		/b/–/v/	/f/–/h/	/s/–/θ/	/l/–/r/	/i/–/si/	/dz/–/z/	/n/–/ŋ/
	$R^{2'}$	.00	.19	.03	.27	.00	.02	.00
G.L.P.	p	.85	.01	.22	.00	.40	.28	.51
	s	ns	s	ns	s	ns	ns	ns

G. L. P.: General Listening Proficiency $R^{2'}$: coefficient of determination adjusted for the degree of freedom
p: probability s: significant ns: non-significant

This table shows that cubic relationships are recognizable between the discriminative performances of two types of consonant minimal pairs (/f/–/h/ and /l/–/r/) and general listening proficiency (p=.01 and p=.00, respectively) and that the cubic relationship between the discriminative performance of the minimal pair (/l/–/r/) and general listening proficiency is relatively strong ($R^{2'}$ =.27).

4 Discussion

It was claimed at the outset that some types of English minimal pairs might be more difficult or easier to discriminate than others and that they might be more or less related to general listening proficiency than others. It seems that such a claim is experientially understood by English instructors and researchers, but the above analyses have offered some empirical evidence that this claim may be reasonable and acceptable.

4.1 Linear Relationships

According to the single linear regression analysis, four types of English minimal pairs out of 15 have been

found to have statistically significant linear relationships with general listening proficiency: /ʌ/–/ə:r/ (r=.30, p=.05, and N=49), /f/–/h/ (r=.46, p=.00, and N=49) , /s/–/θ/ (r=.30, p=.04, and N=49), and /l/–/r/ (r=.49, p=.00, and N=49). It may be difficult at this stage to determine whether this number 4 should be viewed as small or big, but it must be at least noted that there do exist several types of English minimal pairs whose discriminative performances are significantly related to general listening proficiency.

These four types of English minimal pairs involve two major features. First, the strength of the relationship between the discriminative performance of each of them and general listening proficiency is not so strong, in which approximately 9% to 24% of the variance of general listening proficiency can be accounted for by the discriminative performance. This interpretation needs careful attention, but this may be quite natural considering that such a discriminative performance is a single, independent, self-inclusive one, which does not require many other abilities. Even more important may be to understand the range of these coefficients of determination in itself, though more empirical studies are needed to confirm it.

Second, consonant minimal pairs are dominant in number: one vowel minimal pair (/ʌ/–/ə:r/) and three consonant minimal pairs (/f/–/h/, /s/–/θ/ and /l/–/r/) are significantly related to general listening proficiency. This may reflect something essential about the relationship between general listening proficiency and sub-skills of listening, but it is unclear why this ratio of 1 to 3 exists (not 2 to 4, for instance). It may be possible, however, to say that the discrimination of consonant minimal pairs is more related to general listening proficiency than that of vowel minimal pairs.

4.2 Non-Linear Relationships

According to the single non-linear regression analysis, three types of English minimal pairs out of 15 have been found to have statistically significant non-linear relationships with general listening proficiency: /ʌ/–/ə:r/ [cubic relationship (R=.14, p=.02 and N=49)], /f/–/h/ [quadratic relationship (R=.19, p=.00, and N=49) and cubic relationship (r=.19, p=.01, and N=49)], /l/–/r/ [quadratic relationship (R=.20, p=.00, and N=49) and cubic relationship (R=.27, p=.01, and N=49)]. Likewise, the present evidence fails to determine whether this number 3 is small or big, but it must be at least noted that there do exist several types of English minimal pairs whose discriminative performances have significant non-linear relationships with general listening proficiency.

These three types of English minimal pairs have something in common with those mentioned in 4.1. Although the total number itself may be too small to make a meaningful comparison, it could be claimed that the number of consonant minimal pairs (/f/–/h/ and /l/–/r/) whose discriminative performances have significant relationships with general listening proficiency is still greater than that of vowel minimal pairs (/ʌ/–/ə:r/) whose discriminative performances have the same relationships. Little is understood about this ratio of 1 to 2, but it may be possible to say that the discrimination of consonant minimal pairs is more related to general listening proficiency than that of vowel minimal pairs when a non-linear view is taken.

There is a difference between these three types of English minimal pairs and the above four types. A comparison of their data shows that the strength of the relationship between the discriminative performance of each of them and general listening proficiency is as a whole stronger, in which approximately 20% to 27% of the variance of general listening proficiency can be accounted for by the discriminative performance. This interpretation also needs careful

attention, but it can be claimed again that the discrimination of consonant minimal pairs has more to do with general listening proficiency than that of vowel minimal pairs when a non-linear view is taken.

4.3 Linear vs. Non-Linear Relationships

It must be pointed out that statistically significant relationships do not always agree with the true nature of the "real world" and that the relationships discussed in 4.1 and 4.2 are not something absolute. Generally speaking, in order to be conclusive about such relationships, a number of empirical studies must be conducted and their results compared and integrated, even though they have proved to be statistically significant. One important element in such a research procedure is to examine and evaluate targeted relationships objectively. The current study employed the strength of the coefficient of determination between each of the discriminative performances of the minimal pairs and general listening proficiency as an objective criterion

As far as the vowel minimal pair /ʌ/–/ə:r/ is concerned, the simple linear regression analysis and the simple non-linear one show that its coefficients of determination are .09 and .14 respectively. This difference (0.5) shows that the relationship between the discriminative performance of /ʌ/–/ə:r/ and general listening proficiency can be explained better when a non-linear view is taken.

As far as the consonant minimal pair /f/–/h/ is concerned, the simple linear regression analysis and the simple non-linear one show that its coefficients of determination are .21(linear relationship), .19 (quadratic relationship) and .19 (cubic relationship), respectively. It is not easy to interpret the differences among these three relationships systematically, but it may be possible to say that the relationship between the discriminative performance of /f/–/h/ and general listening proficiency can be explained better when a linear view is taken.

As far as the consonant minimal pair /l/–/r/ is concerned, the simple linear regression analysis and the simple non-linear one show that its coefficients of determination are .24 (linear relationship), .20 (quadratic relationship) and .27 (cubic relationship), respectively. It is not easy, either, to interpret the differences among these three relationships systematically, but it may be possible to say that the relationship between the discriminative performance of /l/–/r/ and general listening proficiency can be explained better when a non-linear view is taken.

4.4 Summary of the Main Findings

The above analyses have disclosed several unfamiliar aspects of relationships between discriminative performances of English minimal pairs and general listening proficiency. The following summarize the main findings:

1) Relationships between discriminative performances of English minimal pairs and general listening proficiency can vary across their types.

2) The discrimination of consonant minimal pairs may be more related to general listening proficiency than that of vowel minimal pairs.

3) There do exist several types of English minimal pairs whose discriminative performances have significant non-linear relationship with general listening proficiency, such as the consonant minimal pair /l/–/r/.

Concluding Remarks

The current study was conducted as a pilot one, and the results should be viewed as tentative and must be reexamined from several experimental perspectives. Firstly, more subjects and other different minimal pairs must be used. Secondly, 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. Thirdly, 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. More importantly, theoretical attention should also be paid to differences in discriminative perception between vowel and consonant minimal pairs. Further studies, taking these points into account, will take us closer to a complete map of the nature of discriminative 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 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.)

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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 , 該当するものに〇をつけなさい。

best best vest ( )

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