様　式　Ｃ－１９、Ｆ－１９－１、Ｚ－１９　（共通）

# 科学研究費助成事業　　研究成果報告書

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研究課題名（和文）Effects of articulatory phonological training on frequency discrimination thresholds and pronunciation

研究課題名（英文）Effects of articulatory phonological training on frequency discrimination thresholds and pronunciation

研究代表者

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研究成果の概要（和文）：仏語学習者が日本において、特定の音声を聞き分けるのが苦手であることはよく知られている。しかし、具体的にどのように実施すればよいのか、教師に提供される解決策はほとんどない。本研究では、仏語の母音音素の学習の進捗を測定するツールを開発し、初級仏語を履修している大学生からデータを収集して分析した結果、日本語話者向けに特別に設計された調音学習を受けた学生は、従来の音声学的学習を受けた対照群に比べ、有意な改善状態を示した。このことから、日本人学習者に合わせた調音訓練を行うことは、難しい仏語の母音の知覚や識別を向上させるのに効果的であることが示唆される。

研究成果の学術的意義や社会的意義
国際化、外国語教育を推進する教育政策にも関わらず、日本においての仏語教育では、文法、語彙、翻訳を中心とした教育が行われているのが現状である。また、発音が苦手な学習者に対しては、どのような指導をすればよいのか分からず、口頭指導をあきらめることも少なくない。学習者のフランス語の音素識別に関する第二言語習得論（SLA）研究は、学習者が苦手とする特定の音について大きく発展してきたが、これらの問題を改善するための手段についてはほとんど研究されていない。本研究では、仏語の聞き取り及び発音を改善するための方策を明らかにし、日本における仏語の聞き取り能力に取り組む教師に指針を与えることを目的とする。

研究成果の概要（英文）：It is commonly known that Japanese learners of French have difficulties with discriminating certain sounds that do not exist in their mother tongue. However, few solutions are offered to instructors on how to specifically handle those problems. In this project, we created a tool to measure students' progress in learning French vowel phonemes. Data were collected and analysed from university students taking beginner French language courses, and the results showed that students who received articulatory training specifically designed for Japanese speakers showed significant improvement over the control group who followed traditional phonetical training. This suggest that using articulatory training tailored to Japanese learners is efficient in improving their perception and discrimination of difficult French vowels.

研究分野：第二言語習得論（SLA）

キーワード：frequency discrimination　phoneme discrimination　pronunciation　French Second Language　didactics　articulatory training　SLA

様　式　Ｃ－１９、Ｆ－１９－１、Ｚ－１９（共通）

## １．研究開始当初の背景

Various forms of auditory discrimination training contribute to improving children's language abilities (Merzenich et al., 1996; Tallal et al., 1996). Discrimination of a frequency difference between two sequentially presented pure tones has been the most widely used task in laboratory studies of auditory perceptual learning, probably because consistent and strong improvement has been observed in every study (Delhommeau et al., 2002; Demany & Semal, 2002). Stimuli used in these studies focus on recognizing differences of frequency through specifically training with pure- tone sounds. Our original key scientific question was whether articulatory phonological training can, as with pure-tone training, (1) improve frequency discrimination (perception of phonemes) as well as (2) improve pronunciation (production of phonemes) of Japanese learners of French.

## ２．研究の目的

This study focuses on the application of experimental phonetics (perceptual) to the didactics of foreign language phoneme discrimination and pronunciation. Due to the pandemic, direct contact with the students was not possible and frequency threshold levels could not be carried out. Consequently, the initial scope of the experiment was downscaled to key scientific question (1), to determine whether articulatory phonological training online may enhance proper perception of French vowels by non-native Japanese learners. To do so, we considered the following working hypotheses:

1. Learners' French perception naturally improves between the T0, T1 and T2 tests in all groups (within-subjects independent variable) ;
2. Articulatory training has a significant positive impact on the correct perception of French in the experimental group compared to the control group who receives the usual traditional pronunciation training in French (independent variable between subjects) ;
3. Musicians, who have an advantage in auditory information processing, should have a better perception of the new language than non-musicians, and whatever the group they belong to (experimental or control) (independent variable between subjects). We believe that articulatory training on subjects with a 'musician' profile will therefore have little or no effect (since musicians have lower pitch discrimination thresholds than non-musicians, Kishon-Rabin et al., 2001) ;
4. A final variable considered in this study was the learner's affiliation. Depending on the faculty from which the learners originate, their learning abilities are not identical. For example, students from medical schools are generally better at languages than students enrolled in the arts or sports faculties.

## ３．研究の方法

First year Japanese students from four identical Basic French courses at the University of Tsukuba answered a questionnaire (N=30). Over the 2021 academic year, two experimental classes were trained in articulatory phonology, the two other classes served as the control group. Students considered as musicians were trained or not depending on the class they belonged to.

Gathering of quantitative data consisted of a t0 pre-test (May 2021), a first training phase of 15 weeks followed by a t1 intermediate test (July 2021), a 2nd training period of 15 weeks followed by a final t2 test (January 2022).

The previous year, an online tool was developed with Archean Technologies for the tests. Evaluation focused on the perception of contrasts of minimal pairs which are problematic to Japanese students learning French vowels. The experiment specifically concerns the following set of vowels:

(1) /ø/ - /ʉ/; (2) /ʉ/ - /y/; (3) /ɑ̃/ - /ɔ̃/; (4) /ɛ̃/ - /ɑ̃/

The following syllabic structures were tested

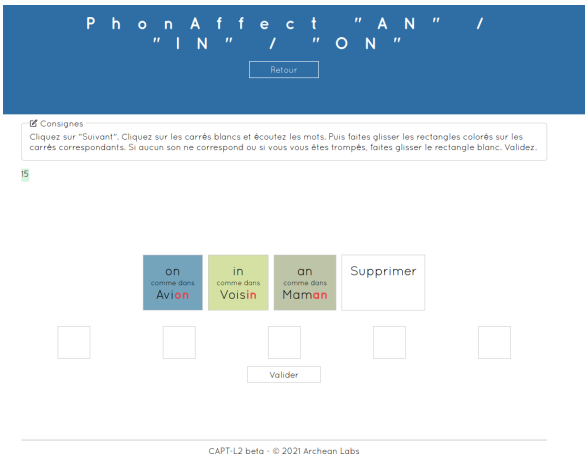
V (vowel only) ; CV (vowel consonant) ; CVCV ; CVCVC; CVCVCV.

C = in order to focus the study exclusively on the vowels, all French consonants used excluded those which present difficulties for Japanese speakers (r, l, f, b, v and semi-consonants).

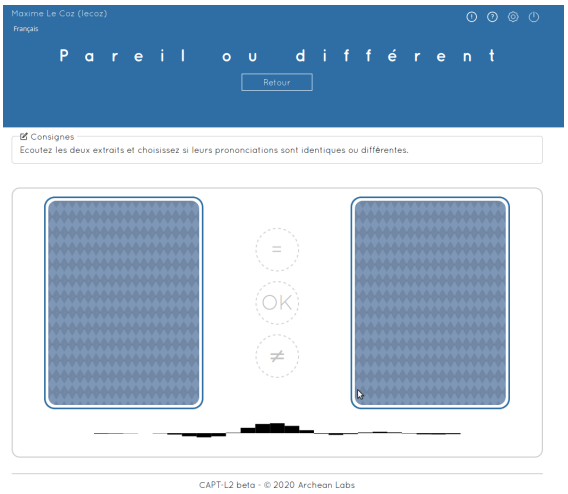
Example of structures explored for the pair: /u/ - /y/
a) structure /V/ : y, u
b) structure /CV/ : py, ty, ky, ... pu, tu, ku, ...
c) structure / CVCV / : məny, dəbu, boku, ...

3 distinct perceptual exercises were developed online to test each set of vowels:

1. Identification: recognition of sounds in a series of 4 samples and 1 distractor.




2. Discrimination 1 - between two sounds.




3. Discrimination 2 - logatomes AXB where X must be matched with either A or B.

４．研究成果

This study aimed to develop an online instrument to measure progress throughout one academic year in students' perception of minimal pair phonemes which are problematic for Japanese learners of French.

The analysis removed items with correlation coefficients below 0.39, which are considered low. Items with high correlations were retained. Moreover, outliers were observed in time responses on the high end for perceptual exercises 2 and 3 (Discrimination 1 and 2) and on both ends of the spectrum for exercise 1 Identification (time response range conserved: 10000ms-150000ms). Out of the initial 30 learners observed, only 17 had complete data, bringing the sample to a much smaller size than initially expected. However, research results show that learners across all classes progress throughout the year on all sets of vowels studied. In other words, learners' French perception naturally improves between the T0, T1 and T2 tests in all groups. Furthermore, we did find statistically significant results which reveal that articulatory training has a significant positive impact on the correct perception of French in the experimental group compared to the control group. As predicted, results from an independent samples t test on scores clearly showed that the participants who received articulatory training ($M = 5.89$, $SD = 233.6$, $N = 8$) compared to the participants in the control group ($M = 6.58$, $SD = 211.7$, $N = 9$) demonstrated significantly better scores ($t(522) = 2.55$, $p < .001$). However, there was no statistically significant results regarding the response times between the two groups ($p > .05$).

Concerning musicians, only 1 out of 17 students matched all requirements to be considered having the profile of a musician, which usually provides an advantage in auditory information processing, offering better perception of the new language than non-musicians. Because only one student matched the criteria, running statistical comparisons could not bear relevantly significant results. A larger sample of students with a musical profile will be necessary to come to any relevant conclusion.

The final variable considered was the learner's affiliation. Leaners being from much too diverse faculty backgrounds ($N=8$), no significant result could be reached as to the effect of affiliation on French phoneme learning. As for musicians, we will need a much larger sample of students to draw any valid conclusions in this respect.

In this project, we were able to create a tool to measure students' progress in learning French vowel phonemes. The results of the data analysis clearly show progress over all groups and a very significant improvement for the experimental group. The results of the data analysis confirm the validity of using articulatory training to improve Japanese learners' perception and discrimination of difficult French vowels. The results of this research have been and will continue to be widely disseminated through oral presentations, workshops, and publications. The online tool developed with Archean Technologies will be further developed to examine if similar effects may be observed with French consonants difficult to learn for Japanese. Further data collection using the tool is currently underway. Future research will collect more data and draw more far-reaching conclusions about how to overcome difficulties Japanese learners experience when learning French both in perception and production. Based on these findings, we aim to clarify the learning process of French language pronunciation and promote articulatory training as a pronunciation teaching method that can help build awareness among instructors around the difficulties encountered by Japanese learners of French and the means to overcome them.

５．主な発表論文等

〔雑誌論文〕　計2件（うち査読付論文　2件／うち国際共著　0件／うちオープンアクセス　2件）

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| １．著者名<br>Jactat Bruno Daniel Philippe | ４．巻<br>45 |
| ２．論文標題<br>Effects of articulatory phonological training on discrimination of minimal vowel pairs in French | ５．発行年<br>2022年 |
| ３．雑誌名<br>Studies in Foreign Language Education | ６．最初と最後の頁<br>in press |
| 掲載論文のDOI（デジタルオブジェクト識別子）<br>なし | 査読の有無<br>有 |
| オープンアクセス<br>オープンアクセスとしている（また、その予定である） | 国際共著<br>－ |

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|---|---|
| １．著者名<br>Jactat Bruno | ４．巻<br>10 |
| ２．論文標題<br>Mechanics of the Peripheral Auditory System: Foundations for Embodied Listening Using Dynamic Systems Theory and the Coupling Devices as a Metaphor | ５．発行年<br>2021年 |
| ３．雑誌名<br>F1000Research | ６．最初と最後の頁<br>193～211 |
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| オープンアクセス<br>オープンアクセスとしている（また、その予定である） | 国際共著<br>－ |

〔学会発表〕　計3件（うち招待講演　1件／うち国際学会　2件）

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| １．発表者名<br>Jactat Bruno Daniel Philippe |
| ２．発表標題<br>Lowering auditory resistance thresholds in struggling learners: a model for opening up listening and improving French pronunciation. |
| ３．学会等名<br>XV World Congress of the International Federation of Teachers of French（国際学会） |
| ４．発表年<br>2021年 |

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| １．発表者名<br>Jactat Bruno Daniel Philippe |
| ２．発表標題<br>La Discrimination Frequentielle : portail du cortex auditif de l ’ apprenant. |
| ３．学会等名<br>Journee pedagogique de la langue francaise 2020 |
| ４．発表年<br>2020年 |

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| １．発表者名<br>Jactat Bruno, Daniel Philippe |
| ２．発表標題<br>Frequency Discrimination: gateway to the learner’s listening brain? |
| ３．学会等名<br>3rd CEGLOC Conference, University of Tsukuba, Japan（招待講演）（国際学会） |
| ４．発表年<br>2019年 |

〔図書〕　計0件

〔産業財産権〕

〔その他〕

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６．研究組織

| | 氏名<br>（ローマ字氏名）<br>（研究者番号） | 所属研究機関・部局・職<br>（機関番号） | 備考 |
|---|---|---|---|

７．科研費を使用して開催した国際研究集会

〔国際研究集会〕　計0件

８．本研究に関連して実施した国際共同研究の実施状況

| 共同研究相手国 | 相手方研究機関 |
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