



Effects of Phonological Gaps between English Terms and *Katakana* Equivalents: A Comparison of Visual and Auditory Modalities among Japanese Pharmacy Students

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1.0. Introduction

Katakana words in this study:

English loanwords, including German cognates

Many ***katakana* specialized terms in medical fields**

Previous research:

- L2 words resembling words in the learner's L1 are more easily learned. (Nation, 1990)
- *Katakana* words should be used in English education as an interlanguage. (Ito, 1991)
- The presence of loanwords increased vocabulary size test scores. (Laufer & McLean, 2016)

Utilization of *katakana* words in English vocabulary learning

Daulton (1998, 2008), Uno (2002), Takeuchi (2010), Shibuya (2012), Huynh (2013), Tsujimoto (2014), Hatanaka & Pannel (2016), Nishi (2019)

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1.0. Introduction

Results of Previous Studies (Smith et al. 2023, 2025, 2026)

- 1) High Comprehension of *Katakana* Terms:
Basic medical terms with *katakana* counterparts (e.g., allergy, alkali) show over 90% accuracy in meaning recognition.
- 2) Robustness Across Proficiency Levels:
This high accuracy (>90%) is consistent regardless of general English vocabulary proficiency (high- vs. low-level groups).
- 3) Modality Independence:
Katakana terms function as latent vocabulary in both reading and listening, maintaining >90% accuracy.

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1.1 Objectives of this study

Limitations of Previous Studies

Low Cognitive Load:

- Previous tests utilized only basic vocabulary.
- Multiple-choice format may have facilitated easy guessing.

Current Research Focus

Increasing Specialized Complexity:

Moving beyond basic terms to higher-level scientific terminology

In-depth Evaluation:

Using open-ended questions to assess depth of knowledge

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2. Methods

Participants (n = 100):

3rd-year pharmacy students.

Conditions:

Reading (Visual) condition: n = 50.

Listening (Auditory) condition: n = 50.

Testing:

30 fundamental terms from Chemistry and Biology.

Criteria: Terms that 3rd-year students are expected to know

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2. Methods: Test Format:
Reading and Listening Tasks

Reading test:
Written-response
identification of 30 scientific
terms (English to *Katakana*).

Listening test:
Written-response identification of
the same terms, played 3 times
each.

問題 1〜30の英単語（生物・化学用語）は、日本語でカタカナ語として使われているものです。英単語を読んで、対応する日本語をカタカナで書いてください。

	英語	カタカナ語
例	alanine	アラニン
1	endosome	
2	alkane	
3	xylene	
4	tyrosine	
5	ethylene	
6	paraffin	
7	acetylcholine	

問題 1〜30の音声で流れる英単語（生物・化学用語）は、日本語でカタカナ語として使われているものです。各単語の発音を3回聞いて、対応する日本語をカタカナで書いてください。

例) アラニン

1.	11.	21.
2.	12.	22.

Figure 1. The reading test format

Figure 2. The listening test format

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2. Methods

Categorization of Terms

Gap Size Groups:

*mora: a phonological unit in Japanese

Group **A**: Small phonological gap (one mora* difference or less)

Group **B**: Medium phonological gap (2 morae difference)

Group **C**: Large phonological gap (3 morae difference or more)

Analysis:

Two-way ANOVA (Modality x Gap Size)

Tukey' s post-hoc tests

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2. Methods: Classification Rules

Group A: Minor differences (e.g., 1 consonant/vowel or very similar)

asparagine 

アスパラギン (asuparagin)

enthalpy 

エンタルピー (entarupi:)

Group B: Moderate differences (e.g., 2 consonants/vowels or a diphthong)

cytosine 

シトシン (shitoshin)

chloroform 

クロロホルム (kurorohorumu)

Group C: Major differences (e.g., 3 consonant/vowels or more & diphthongs)

kinase 

キナーゼ (kina:ze)

cation 

カチオン (kachion)

Pronunciation source: Merriam-Webster/Howjsay

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3. Results: Statistical Findings

ANOVA Results:

Significant interaction found between presentation modality and phonological gap.

$$F(1.86, 182.53) = 43.52, p < .001.$$

Modality (Reading vs. Listening): Significant ($p < .001$)

Gap Size (A, B, C): Significant ($p < .001$)

Interaction (Modality $\times$ Gap): Significant ($p < .001$)

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3. Results: Reading vs. Listening

Table 1. Descriptive statistics for Reading and Listening modalities

Modality	n	Mean	SD
Reading	50	9.32	1.22
Listenig	50	1.72	1.82

Modality (Reading vs. Listening):
Significant ($p < .001$)

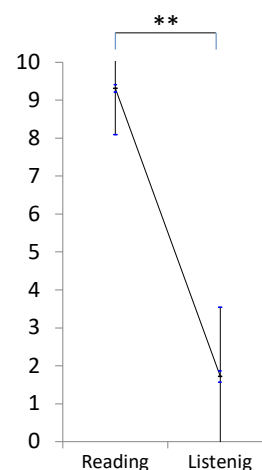


Figure 3. Comparison of performance between reading and listening modalities.

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3. Results (1):

Table 2. Descriptive statistics for each group across reading and listening conditions

Modality	Word Group	n	Mean	SD
Reading	Group A	50	9.50	0.86
	Group B	50	9.28	1.23
	Group C	50	9.18	1.48
Listening	Group A	50	3.36	1.95
	Group B	50	0.90	0.93
	Group C	50	0.90	1.15

(Reading condition: $p = .236$,
Listening condition: $p < .001$)

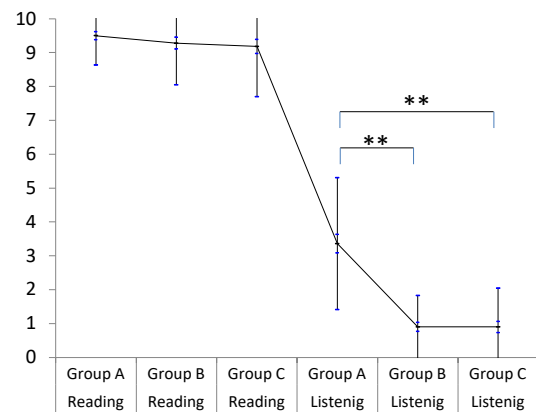


Figure 4. Performance across modalities and word groups. Error bars represent standard deviations

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3. Results (2): Performance Breakdown

Reading Condition:

Maintained high accuracy (Mean > 9.0) across all groups.

⇒ High proficiency in written terminology.

Listening Condition:

Group A (Mean 3.36) vs. Group B or C (Mean 0.90):

Drastic decline ($p < .001$)

Group B (Mean 0.90): vs. Group C (Mean 0.90):

No significant difference ($p = .961$)

⇒ Critical Threshold:

Gap with 2 moras or more leads to a "Floor Effect"

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4. Discussion

1. Japanese pharmacy students have mastered English terminology as “textual information.”
2. The "phonological gap" acts as a significant barrier to listening.

Limitations

1. No generalization due to the small number of words handled
2. Need more detailed analysis with phonological gaps (consonants, vowels, diphthongs, word stress)
3. German cognates vs. English cognates

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5. Conclusion & Implications

Conclusion:

Phonetic gaps are a major barrier to auditory recognition, regardless of the student's academic background.

Future Pharmaceutical English Education:

Current education relies heavily on **textual acquisition**.

→ Need to incorporate **audio-focused training**.

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Group A Word list

English	<i>Katakana</i> word	Romanization
asparagine	アスパラギン	asuparagin
acetylcholine	アセチルコリン	asechirukorin
glucose	グルコース	guruko:su
endosome	エンドソーム	endoso:mu
uracil	ウラシル	urashiru
benzene	ベンゼン	benzen
ketone	ケトン	keton
paraffin	パラフィン	parafin
enthalpy	エンタルピー	entarupi:
chromatography	クロマトグラフィー	kuromatogurafi:

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Group B Word list

English	<i>Katakana</i> word	Romanization
glycine	グリシン	gurishin
cytosine	シトシン	shitoshin
ethylene	エチレン	echiren
cortisol	コルチゾール	koruchizo:ru
peptide	ペプチド	pepuchido
alkyne	アルキン	arukin
alkane	アルカン	arukan
butane	ブタン	butan
lithium	リチウム	richium
chloroform	クロロホルム	kurorohorumu

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Group A Word list

English	<i>Katakana</i> word	Romanization
methionine	メチオニン	mechionin
tyrosine	チロシン	chiroshin
kinase	キナーゼ	kina:ze
protease	プロテアーゼ	purotea:ze
nucleotide	ヌクレオチド	nukureochido
cation	カチオン	cachion
acetaldehyde	アセトアルデヒド	asetoarudehido
germanium	ゲルマニウム	gerumaniumu
xylene	キシレン	kisiren
nicotinamide	ニコチンアミド	nikochinamido