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An analysis of English as a foreign language learners' perceptual confusions and phonemic awareness of English fricatives

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Abstract

This study investigates perceptual confusions of English fricatives among 121 Korean elementary school English as a foreign language (EFL) learners with shorter periods of learning English. The objective is to examine how they perceive English fricative consonants and to provide educational guidelines. Two sets of English fricative identification tasks—voiceless fricatives and voiced fricatives—were administered to participants in a High Variability Phonetic Training (HVPT) setting. Their phonemic awareness of the fricatives was visualized in perceptual confusion maps via multidimensional scaling analysis. The findings are explored in terms of the impacts of Korean EFL learners' L1 linguistic aspects and a comparison with L1 learners. Learners' phonemic awareness patterns are then compared with their relative importance in speech intelligibility based on a functional load hierarchy. The results indicated that Korean elementary EFL learners recognized English fricatives in a manner largely akin to L1 learners, suggesting their ongoing acquisition progress. Additionally, the findings demonstrated that the young EFL learners possess sufficient phonemic awareness for most high functional load segments but encounter some difficulties with one high and one low functional pair. The findings of this study offer suggestions for diagnosing language learners' phonemic awareness abilities, thereby aiding in the development of practical guidelines for language instructional design and helping educators make informed decisions regarding teaching priority in L2 classes.

Keywords: English as a foreign language (EFL) learner, elementary school learner, English fricative, High Variability Phonetic Training, perceptual confusion map, phonemic awareness

1. Introduction

When learning the sounds of a new language, English as a foreign language (EFL) learners might encounter difficulties perceiving them, as they do not have enough speech input. The ability to identify that speech is composed of a series of individual sounds is known as *phonemic awareness* (Yopp, 1988). It assists learners to listen to and process foreign speech as well as connect the sounds with alphabet orthography. Segmental features, encompassing vowels and consonants, are significant matters in producing English. They are a subset of pronunciation features along with stress, pitch, fluency, and tone choices (Kang & Pickering, 2013).

L1 background is known to affect the learners' starting points for acquiring new English phonemes (Iverson & Evans, 2009; Pruitt et al.,

2006). The disparities may be due to the nature of the interaction between the sounds in the learners' L1s and the sounds in the target languages. Previous study has found that EFL learners struggle to develop sensitivity to numerous English phonemic contrasts (Mueller, 2019). Several auditory factors separate the phonetic properties of fricatives in English and Korean. Firstly, in English, there are a total of nine fricatives which are divided into four categories based on their different articulation positions. However, in Korean, there are three fricatives and the articulation position of fricatives is only spoken in the alveolar sound (Lim & Jang, 2019). Secondly, unlike in English, where voicing contrast is a crucial auditory cue for phoneme classification, Korean has a separate mechanism for identifying phonemes, which is the aspiration (Lim & Jang, 2019). Thirdly, in English, the amplitude and length of the friction noise in the speech waveform differentiate sibilants. In Korean, the length of the friction noise serves as an auditory cue distinguishing the parasitic character of the Korean fricatives (Rhee et al., 2008). Due to these differences, English fricatives are considered to be one of the most challenging consonants for Koreans when learning English. Hence, it is critical to diagnose EFL learners' phonemic awareness skills in order to offer information on which sounds they are likely to find difficult.

In addition, a comparison with functional loading theory would give practical recommendations on where to concentrate instructional efforts. In the same vein, the present study aims to explore Korean speakers' perceptual confusions among some English consonants and to what extent Korean speakers are able to discriminate challenging English consonant contrasts.

1.1. Research Questions

The primary goal of this research is to provide an answer to the following research questions:

1. To what extent do Korean elementary EFL learners perceive English fricatives as distinct? How are their responses shown in perceptual space?
2. Does the phonemic awareness of Korean EFL learners differ according to the functional load hierarchy? If so, to what extent do their responses differ?

2. Literature Review

2.1. Phonemic Awareness

Phonemic awareness is the awareness that the speech stream consists of a sequence of sounds, specially phonemes, the smallest unit of sound that makes a difference in communication (Yopp & Yopp, 2000:30). For instance, those who are phonemically aware in English can identify the three sounds in the spoken word *push* (/p/-/ʊ/-/ʃ/) as well as mix phonemes altogether to form words (/p/-/ʊ/-/l/ is *pull*). Phonemic awareness is one component of phonological awareness which is a subset of metalinguistic awareness. It can be practiced without visual information as it focuses on auditory sounds of each phoneme (Mueller, 2019). It is crucial for L2 learners to be able to comprehend what they are hearing as well as read an alphabetic orthography. Phonemic awareness education should be linked with listening training in EFL situations since learners have difficulties discerning foreign phonemes (Lee, 2021). A meta-analysis of the effect of phonemic awareness on listening comprehension in English as a second or foreign language (ESL/

EFL) explored eight articles (Choe et al., 2020). The result revealed that it is especially beneficial for beginner or younger learners. As phonemic awareness teaching has been shown to benefit elementary school students, this study includes them as a study population.

2.2. High Variability Phonetic Training

The term *High Variability Phonetic Training* (HVPT) first appear in research by Iverson et al. (2005), as a method for answering theoretical issues concerning the nature of second language speech learning. It refers to perceptual training, most commonly concentrating on segments, in which auditory training stimuli contain many samples produced by multiple speakers in a variety of phonetic settings (Thomson, 2018b). It evolved as a technique that can provide concentrated and high-quality experiences, resulting in demonstrable changes in the perceptual systems of late L2 learners, who had previously long been considered resistant to change, particularly after the first year of exposure (Thomson, 2018b). Logan et al. (1991) trained six Japanese listeners fifteen 40-minute HVPT sessions to distinguish English /l/ from /r/. They were substantially better at distinguishing phonemes, and this phonemic awareness could be transferred to new words as well as with new voices. Previous research investigated on the effect of HVPT and its generalizability. According to Lively et al. (1993), training with several speakers resulted in generalization to new words produced by new speakers, but training with a single speaker resulted in failure to transfer to unfamiliar words provided by the training speaker. Wong (2014) discovered that teaching Chinese speakers to distinguish English /i/-/I/ helped identifying same sounds in new contexts. Overall, the literature reports on the effect of HVPT as a training tool. The current study assesses learners' phonemic awareness using high variability of inputs.

2.3. Speech Learning Model

It is commonly accepted that infants can identify a wide range of phonetic contrasts until the age of six months (Best et al., 1988; Eimas et al., 1971). The formation of the first language (L1) speech sound inventory influences the learning of new sounds later in life, often causing difficulty in both perception and production of the foreign speech sounds (Georgiou, 2019). Flege (1987) proposed speech learning model (SLM), which states that two phonetic subsystems (L1, L2) are cognitively represented in a single phonological space and affect each other. According to SLM, new sound categories are created during L2 learning when L2 sounds differ sufficiently from L1 category. If an L2 sound is found to be similar to an existing L1 sound, the L1–L2 categories are merged. This might result in incorrect L2 speech production. The SLM suggested that as L2 learners gain experience using L2 in daily life, they will eventually discern the variations between L1 and L2 phonetics (Flege & Bohn, 2021). However, it did not offer a way to gauge how much phonetic input is required to accelerate the development of new L2 phonetic categories. The revised SLM (SLM-r) defines the phonetic input as the sensory input related to L2 speech sounds that are heard and seen during the production by others of L2 utterances in meaningful conversations (Flege & Bohn, 2021:32). Furthermore, while SLM proposed that the accuracy of L2 segmental perception limits the accuracy with which L2 sounds are produced, the SLM-r hypothesis proposes that there is a strong bidirectional connection between production and perception. In the same vein, it will be meaningful to explore what EFL learners

struggle with in discriminating certain pairs of English, as it can be linked to their production of English.

When target language phonemes are new when compared to their native language, L2 learners might find it hard to acquire foreign phonemes. For instance, Korean EFL learners have difficulties in producing English fricatives which are not in the inventory of Korean and consequently tend to replace English fricatives with stops (Cho, 2010). Contrasts of ambiguous sounds that are not contrastive in the L2 learner's native language are especially difficult to identify (Escudero, 2005; Flege et al., 1997; Morrison, 2003). Mueller (2019) showed that as Japanese EFL learners do not have a separate contrasting fricatives, they often perceive English /h/ and /f/ as the same sound. Moreover, Lambacher et al. (2001) showed that Japanese EFL learners find it hard to distinguish *seat* and *sheet*, as Japanese has sound similar to English /s/ and /ʃ/, but they do not form a contrast within the Japanese phonemic inventory when they precede the vowel /i:/.

Previous studies that investigate the perception of English by Korean EFL learners mainly examined adult learners (e.g., Cho, 2010; Cho & Jeong, 2011). Cho (2010) analyzed anterior coronal consonants. Cho & Jeong (2011) explored perceptions of some English stops and fricatives /θ, ð, s, z, t, d/. Johnson (2011) analyzed only voiceless English fricatives by Japanese EFL learners. The purpose of this study is to examine the confusion among voiced and voiceless English fricatives using perceptual data from young EFL learners. Despite the fact that young learners are thought to acquire a foreign language with less effort than adults (Snow, 2014), they were chosen to see if they encounter difficulties discriminating new consonants. This is because young learners benefit most from segmental feature teachings (Choe et al., 2020), and it necessitates a more urgent exploration of their perceptions.

2.4. Functional Load Theory

Brown (1988) and Catford (1987) proposed a ranking of segmental differences in terms of *Functional Load Principle* in English pronunciation. The functional loads of segments (vowels and consonants) are investigated and listed segmental contrasts that are ranked based on their communicative value. These contrasts were developed from minimal pairs in frequently used words, the degree of neutralization among regional English dialects, and the segmental position within a word (Suzukida & Saito, 2021). The consonants are differentiated by their syllable locations, which are beginning and final. According to related research, segmental characteristics can have a significant impact on understanding (Fayer & Krasinski, 1987), but not all segmental mistakes are equally weighted (Kang & Moran, 2014). According to the Functional Load Hypothesis, some segmental mistakes are worse than others; that is, they are more likely to impede listeners' understanding. Intelligibility would not be reduced if L2 speakers pronounce *they* as *dey*. The replacement of /b/, on the other hand, has a higher functional load, and saying *bit* instead of *pit* is likely to influence intelligibility. The functional loads of segments (vowels and consonants) are investigated, and segmental contrasts are identified and rated according to their communicative significance.

Kang & Moran (2014) categorized 120 nonnative speakers'

speech segments with their error types according to the positions in syllables (word initial, medial, and final) and classified them as high function load versus low functional load, following Catford (1987). The segments ranked 0% to 50% are coded as low functional load, whereas the segments ranked 50% to 100% are coded as high functional load (Kang & Moran, 2014). The results from Kang & Moran (2014) discovered that when comparing proficiency level groups, high low functional load segmental speech errors dropped dramatically among high proficiency level learners, compared to low functional load errors. It demonstrated that among segmental and syllable errors in speech productions, significant differences were observed mainly in the high low functional load errors between different proficiency groups. How Korean EFL learners at their beginning stage in English perceive the phonemes and the comparison with the functional load hierarchy are still yet to be known. The present study aims to examine Korean elementary EFL learners' phonemic awareness and compare if they reflect the functional load hierarchy.

3. Methodology

3.1. Target Population

The study recruited 121 Korean elementary EFL learners from a single school in Gyeonggi Province, where English is learned in the EFL context. Participants were in grades 3rd to 4th and ranged in age from 8 to 10 years old (mean age=9 years). Some outliers were excluded, such as students with developmental disabilities or those who had previously attended an English-speaking international school or kindergarten for more than one year. The participants' native language is Korean, and they reported no hearing or language issues. Two experiments were taken in different days and participants were the same except that two students[1] were absent on the Experiment 1. Table 1 describes the participants' distribution.

Table 1. Participant distribution

	Grade 3	Grade 4	Total
Male	24	29	53
Female	36	32	68
Total	60	61	121

Table 2 illustrates a distribution of the participants' English listening proficiency (Section 3.2.1. provides a detailed description of the testing instruments). Fourth-graders have higher average listening scores compared to third-graders, who start their English education in public schools. Although the standard deviation is higher for third-graders, both grades show somewhat similar score distribution patterns, with standard deviations ranging from 20 to 25.

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[1] A third-grade girl, and a fourth-grade boy were absent on the second experiment.

	N	min	Max	Mean	SD	σ²
Grade 3	60	75	170	142.87	24.76	612.93
Grade 4	61	86	170	151.87	21.86	477.68
Total	121	75	170	147.41	23.68	560.63

3.2. Material

3.2.1. Listening proficiency test

Test of Practical English Language (TOPEL) was used to group children' English listening proficiency levels. This examination was developed by the Korea Competency Development Evaluation Institute, a non-profit organization operating under the Seoul Metropolitan Office of Education in South Korea. The full test assesses the four key language skills: listening, speaking, reading, and writing. This research specifically inspects the listening component only of the Junior Level 3 examination. The listening assessment segment of the examination is designed to systematically and progressively evaluate candidates' proficiency in understanding spoken English. This assessment spans approximately 30 minutes and comprises a total of 33 items, with a maximum attainable score of 132 points. These items encompass a diverse range of question types[2] to gauge various aspects of listening comprehension. During the time this research was conducted, students took the examination as part of their end-of-semester diagnostic assessment in their regular English curriculum. The researcher accessed the examination data to differentiate students' proficiency levels within the listening domain.

3.2.2. Phoneme identification test

The tests were consisted of phoneme identification of voiceless fricatives (Experiment I) and voiced fricatives (Experiment II). Each task lasted 25 minutes overall. They were administered on a separate day considering the concentration span of the young participants.

The stimuli are composed of a total of 40 nonsense syllables[3] in a consonant-vowel (CV) type. They are consisted of two categories: voiceless and voiced fricatives. In the first experiment, the syllables are five voiceless fricatives (/f, s, ʃ, θ, h/) with a varied-vowel environment (/i, ɛ, a, o, u/) by different native speakers of English. In the second experiment, syllables are made up of three voiced fricatives (/v, ð, z/) with the same vowel environment. Given the age of the participants, the phonetic symbols might be challenging and uninteresting. As a result, the symbols are presented in the form of friendly cartoon characters, Alphablocks (2013) as shown in Figure 1. The speech samples are obtained by recording them from a publicly accessible website that offers HVPT stimuli, *English Accent Coach*[4] (Thomson, 2018a). It features nearly all English sounds, allowing individual students to easily assess their phonemic awareness and get customized training tasks. The stimuli are collected from *level 1* (initial consonant with /a/), *2b* (initial consonant with /i, u/), *3a* (initial consonant with /o/), and *3b* (initial

consonant with /ɛ/) from the website. The stimuli are repeated three times, making a total of 120 tokens (3 times×40 stimuli). Only minimal pairs that consonants differ in the beginning position of the syllables are selected considering the perception levels of young learners.
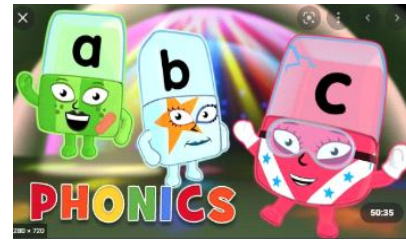

Figure 1. Alphablocks (2013).
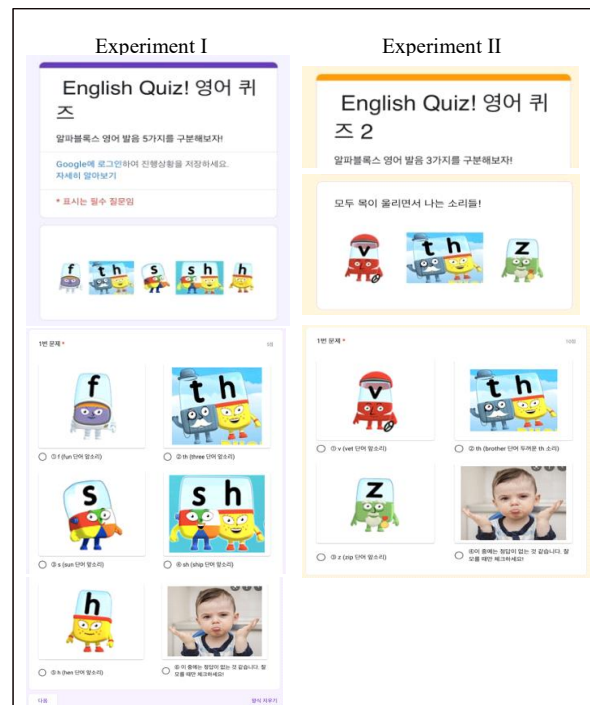Note. Each character represents the English phonetic symbol.

Figure 2. Phoneme identification test online worksheet.

Figure 2 depicts the online worksheet screen for the phoneme identification test in which participants are participating. They have previously learned phonemic symbols as *Alphablocks* cartoon characters (Figure 1) in their regular English school lessons. For the answer choices, the characters are provided next to the phonemic symbols, along with words that include the phonemes, making it easy for young learners to identify the phonemes. If participants found it difficult to determine the sound, they were encouraged to

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[2] Question types were matching spoken words, phrases, or sentences with corresponding images; responding to questions based on audio conversations; selecting appropriate images based on audio narratives; choosing suitable responses to spoken sentences; describing images based on oral prompts; and understanding the flow of natural conversations.

[3] 40 syllables are made of five voiceless fricatives with five vowels, and three voiced fricatives with five vowel environments (5×5+3×5).

[4] https://www.englishaccentcoach.com

choose the *other* option with a photo of a baby expressing curiosity rather than selecting any random answer. After listening to the auditory cues and clicking on the answer, participants proceed to the screen where they can provide answers to the next question by clicking the next button. The screen layout remains the same for all other questions. During the experiment, some participants were observed quietly articulating the phonemes after listening to the auditory cues.

3.3. Data Collection

A researcher who is also a teacher obtained approval from the Institutional Review Board (SNU IRB No. 2301/002-002) for recruitment. The researcher explained the process of the experiment to the students and also promoted it to the parents in order to recruit students who wished to participate in the experiment. Then, the researcher obtained consent from the students' guardians for those who wished to participate in the experiment. The participation period lasted for two days, with a maximum of 30 minutes each, scheduled immediately after regular classes. The phoneme identification test was conducted in a quiet room while sitting at a sufficient distance. The room was located in the school that had audio facilities and internet access available. Participants listened to audio and submitted their responses to an online questionnaire using school-owned tablets. As compensation for participating in the experiment, detailed individual diagnostic reports and a small token snack were provided.

First, participants were given instructions on each phonetic character and how they sound in order for them to recognize each character. The participants had already been introduced to each phoneme through characters and animations in their regular English class. As a result, they might find it less challenging to identify phonemes through familiar cartoon characters. Then, they were asked to select the correct phonetic character on online worksheets after listening to the audio cues. The count is made with all the correct answers and errors that participants make.

3.4. Data Analysis

The identification test answers are summarized in confusion matrices in Tables 3 and 4. They are then projected into a perceptual map using multidimensional scaling analysis in Figures 3 and 4.

3.4.1. Data coding procedures

In order to conduct tests in a HVPT environment, participants were presented with combinations of five vowels and five voiceless fricatives, as well as three voiced fricatives, in randomized sequences over three sessions.

Firstly, each column in the matrix corresponds to one of the listener responses, and each row corresponds to one of the test syllables both in Tables 3 and 4. Correct responses are categorized as *hits*, whereas inaccuracies are labeled as *false-alarms*, and responses marked as 'I don't know' were classified as *the other*. The first row of the confusion matrix shows that /f/ has been demonstrated 595 times, properly identified as /f/ 336 times and erroneously as /θ/ 119 times.

Table 3. Voiceless fricative confusion matrix

	f	θ	s	ʃ	h	Other	Total
f	336	119	35	48	21	36	595
θ	240	153	79	69	22	32	595
s	40	84	263	165	15	28	595
ʃ	18	35	122	387	13	20	595
h	28	56	9	85	396	21	595

Note. Rows indicate the audio cues and columns represent response values.

Table 4. Voiced fricative confusion matrix

	v	ð	z	Other	Total
v	313	247	34	11	605
ð	223	170	203	9	605
z	35	59	500	11	605

Note. Rows indicate the audio cues and columns represent response values.

Secondly, a submatrix of response proportions for phoneme contrasts was assembled. This matrix indicates the ratio of correctly identified phonemes within the total responses for each individual phoneme.

Thirdly, similarity of confusions was computed using Shepard (1972)'s method. The formula for this calculation is as follows (Figure 3).

$$S_{ij} = \frac{p_{ij} + p_{ji}}{p_{ii} + p_{jj}}$$

Figure 3. Formula for similarity of confusions [Johnson (2011:120)].
Note. S_{ij} indicates the similarity between categories *i* and *j*.

Lastly, a confusion map was visualized using a 9-point scale. These analyses were performed separately for both voiceless fricatives and voiced fricatives in two distinct experimental contexts. The confusion maps were generated for visualization purposes by using an Excel sheet from the publicly accessible website, *Perceptual Maps*[5] (Fripp, 2023), which provides Multidimensional Scaling Analysis.

3.4.2. Comparison with functional load theory

The phoneme identification test results are then compared to the functional load theory. Catford (1987) categorized relative function load of segments ranging from 50% to 100%. Referring to Kang & Moran (2014)'s classification codes of relative functional loads, phoneme pairs with percentages of 50 or higher are classified as high functional load and those with percentages below 50 are marked as low functional load.

Table 5. Phoneme pairs classified with functional load

	Phoneme pairs	Number
High	f/s, f/h, s/ʃ, s/h, ʃ/h	5
Low	f/θ, s/θ, v/ð, v/z, ð/z	5

Not every phonemic pair could be classified. Prior research did not list functional load for all phonemic pairings. This study, in

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particular, conducted separate investigations based on the presence of vocal fold vibration (i.e., voiceless or voiced) and in initial consonants, resulting in classifications of only nine pairs.

4. Result and Discussion

The Figures 4 and 6 below show results to answer the first research question (To what extent do Korean elementary EFL learners perceive English fricatives as distinct? How are their responses shown in perceptual space?). The figures are visualizations of confusion matrix of the phonemes with their relative distance in the perception. The ones that are far apart are not really competing, as they are perceived to be quite different. The closer the phoneme is to the other one, the stronger the association with it.

4.1. Voiceless Fricative

The perceptual confusion map of voiceless fricatives (Figure 3) provides insights into the degree of challenge or uncertainty students face when trying to discern voiceless fricative phonemes. A hierarchical cluster analysis found two levels of commonality among the sounds. In the perceptual map, /f/ and /θ/ cluster together at the first level of clustering, while /h/ and /ʃ/ cluster together. Meanwhile, /s/ exists at a distance.
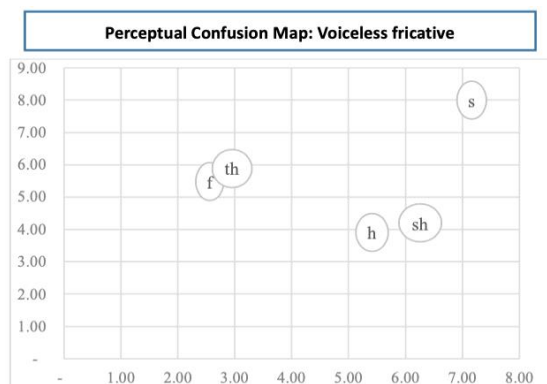

Figure 4. Perceptual confusion map of voiceless fricatives.
Note. th indicates /θ/ and sh indicates /ʃ/.

In the realm of voiceless fricatives, similar outcomes to previous research were observed, yet one notably distinct pattern emerged. Using Miller & Nicely (1955)'s confusion data by L1 English adult learners, Johnson (2011) showed clustering patterns with a perceptual confusions map (Figure 6).
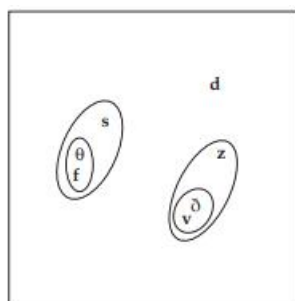

Figure 5. Perceptual map of fricatives and [d] in English.
Note. Adapted from Johnson (2011:122).

Commonalities include the clustering of the voiceless labiodental fricative /f/ with the voiceless postalveolar fricative /θ/, and the proximity of the voiceless glottal fricative /h/ to the voiceless postalveolar fricative /ʃ/. However, a difference arises in the positioning of the voiceless alveolar fricative /s/. While in Miller & Nicely (1955) targeting L1 learners, /s/ clustered closely with /f/ and /θ/, in present study targeting EFL learners, /s/ is positioned somewhat distantly. This discrepancy could be attributed to the influence of the participants' native language system. That is, for Korean learners, /θ/ may be perceived differently from /s/, because /θ/ is a new and unfamiliar sound that doesn't exist in Korean.

4.2. Voiced Fricative

Figure 4 shows the perceptual confusion map of voiced fricatives of the participants. Clustering of /v/ and /ð/ for voiced fricatives is tightly linked with a perceptual dimension, leaving /z/ behind. It implies that if the alternation between /ð/ and /z/ is evident in the learners' speech, it may not be solely driven by auditory or perceptual similarity; there will likely be other variables at play (Johnson, 2011).
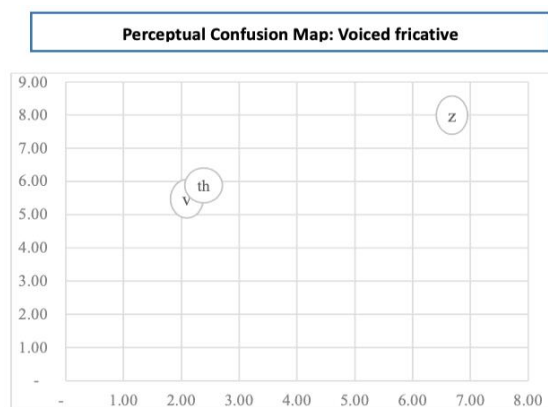

Figure 6. Perceptual confusion map of voiced fricatives.
Note. th indicates /ð/.

An intriguing aspect is the resemblance between the findings for voiced fricatives in Experiment 2 and Miller & Nicely (1955). Both studies reveal proximity between the voiced labiodental fricative /v/ and the voiced interdental fricative /ð/, while the voiced alveolar fricative /z/, a sibilant sound, remains relatively distant.

4.3. Phonemic Awareness from Functional Load Theory Perspective

Comparison of Figures 3 and 4 with Table 5 answers the second research question (Does the phonemic awareness of Korean EFL learners differ according to the functional load hierarchy? If so, to what extent do their responses differ?). When examining the classification of high or low functional load phonemes and their positions in the perceptual confusion map, the results are quite intriguing. Firstly, regarding voiceless fricatives, young Korean EFL learners effectively distinguished most of the high functional load sound pairs (e.g., f/s, f/h, s/ʃ, and s/h). These four sound pairs are located in significantly distant positions on the perceptual confusion map, indicating the learners' successful differentiation of high functional load sounds. This suggests that due to the characteristics

of young learners, acquisition and learning occur concurrently. Secondly, for one pair, ʃ/h, it was observed to be in very close proximity on the confusion map, indicating that learners had difficulty distinguishing between these two sounds. Considering that mispronunciations of these sounds can greatly affect speech clarity and how learners' proficiency is perceived (Kang & Moran, 2014), it underscores the crucial need to cultivate phonemic awareness among Korean EFL learners, especially concerning the challenging ʃ/h consonant pair. Thirdly, despite being categorized as low functional load, the f/θ pair highlighted learners' struggles in distinguishing them due to their proximity on the perceptual map. This suggests challenges in discerning the sounds /f/ and /θ/.

Finally, regarding voiced fricatives, all pairs (v/ð, v/z, and ð/z) could be labeled as either high or low functional load. An interesting observation is that all three voiced fricative pairs were classified as low functional load. Notably, on the perceptual confusion map, the v/ð pair is positioned closely, indicating that the participants had difficulty distinguishing this pair. Hence, it indicates the need for specific guidance on the classification of these phonemes. Analyzing the results of experiments allowed for the exploration of the roles of phonemes in language instruction, categorizing them based on their functional significance to identify key aspects within the teaching method.

5. Conclusion

The findings of this study contribute to a deeper comprehension of the linguistic aspects involved in Korean elementary EFL learners' auditory processing for speech perception. An essential aspect lies in the construction of a perceptual confusion inventory of English phonemes among Korean EFL learners, a hitherto unexplored area. Additionally, this study sheds lights on the developmental progress of young learners in the early stages of their learning journey.

This study has some educational implications. To begin, it shows that the phoneme identification test can be used as a diagnostic tool to better understand learners' phonemic awareness. It might highlight how learners use their auditory cues in the perception of phonemes. It will serve as a resource for determining what and why Korean EFL learners have difficulty perceiving or producing English fricatives. Secondly, the comprehensive examination of young EFL learners' phonemic awareness is approached within the framework of the functional load theory (Brown, 1988; Catford, 1987). On the educational standpoint, the findings will help in determining which phonemes will be included as instructional goals or in teaching materials. Furthermore, it will aid in prioritizing what to teach first for segmental characteristics in L2 teaching. To sum, the findings of the current study could serve as valuable pedagogical insights in the language curriculum and instruction development. Finally, it calls for the future research comparing elementary school students who are fairly capable of both learning and acquisition of a second language, with adults who may rely more on learning itself. Further research would provide valuable insights into the distinct language acquisition and learning processes in age groups.

Although current studies provide some important implications, there are some limitations. Firstly, as Derwing & Munro (2015) point out, even learners of the same L1 background might differ in terms of what L2 sounds they find difficult. Hence, a solution to further address learner differences is needed. Diagnosing individual learners with their confusions across multiple categories to determine where they need improvement can be the solution. Secondly, only young learners who had just begun learning English took part in this study. Although they can give implications in the beginning stages of the learning process, older learners with more years of studying English might help understand the process in a different way. Thirdly, because this study is focusing on young learners, only the initial positions of the syllables are examined. Phonemic awareness in the other positions in syllables (e.g., word medial or word final) would provide insights into a different view. Future research could also delve into the impact of various vowel combinations with differing degrees of distinctiveness. Finally, distinct experimental conditions were established based on voicing in the current study, considering participants' age and cognitive load. However, conducting research that integrates these conditions in one experiment could potentially yield further insights and provide a more comprehensive understanding of the phonemic awareness of EFL learners. Additional research is needed to broaden this study beyond fricatives and include a wider spectrum of phonemes.

References

Alphablocks. (2013). *Alphablocks: Learning is fun with learning blocks: CBeebies shows.* Alphablocks BBC B. https://www.learning blocks.tv/alphablocks/home

Best, C. T., McRoberts, G. W., & Sithole, N. M. (1988). Examination of perceptual reorganization for nonnative speech contrasts: Zulu click discrimination by English-speaking adults and infants. *Journal of Experimental Psychology: Human Perception and Performance*, *14*(3), 345-360.

Brown, A. (1988). Functional load and the teaching of pronunciation. *TESOL Quarterly*, *22*(4), 593-606.

Catford, J. C. (1987). Phonetics and the teaching of pronunciation: A systemic description of English phonology. In J. Morley (Ed.), *Current perspectives on pronunciation: Practices anchored in theory* (pp. 87-100). Teachers of English to Speakers of Other Languages.

Cho, M. H. (2010). Confusion in the perception of English anterior coronal consonants by Korean EFL students. *The Journal of the Korea Contents Association*, *10*(5), 460-466.

Cho, M. H., & Jeong, S. (2011, May). Perception and confusion of English vowels. *Proceedings of the 2011 Spring Korea Contents Association Conference* (pp. 353-354).

Choe, S., Lee, K., & So, Y. (2020). The effects of phonemic awareness instructions on L2 listening comprehension: A meta-analysis. *The Journal of Asia TEFL*, *17*(4), 1158-1546.

Derwing, T. M., & Munro, M. J. (2015). *Pronunciation fundamentals: Evidence-based perspectives for L2 teaching and research* (Vol. 42). John Benjamins.

Eimas, P. D., Siqueland, E. R., Jusczyk, P., & Vigorito, J. (1971). Speech perception in infants. *Science*, *171*(3968), 303-306.

Escudero, P. (2005). *Linguistic perception and second language acquisition: Explaining the attainment of optimal phonological categorization*. Netherlands Graduate School of Linguistics.

Fayer, J. M., & Krasinski, E. (1987). Native and nonnative judgments of intelligibility and irritation. *Language Learning*, *37*(3), 313-326.

Flege, J. E. (1987). The production of "new" and "similar" phones in a foreign language: Evidence for the effect of equivalence classification. *Journal of Phonetics*, *15*(1), 47-65.

Flege, J. E., & Bohn, O. S. (2021). The revised speech learning model (SLM-r). In R. Wayland (Ed.), *Second language speech learning: Theoretical and empirical progress* (pp. 3-83). Cambridge University Press.

Flege, J. E., Frieda, E. M., & Nozawa, T. (1997). Amount of native-language (L1) use affects the pronunciation of an L2. *Journal of Phonetics*, *25*(2), 169-186.

Fripp, G. (2023). *Overall similarities (OS) perceptual maps template*. PerceptualMaps. https://www.perceptualmaps.com

Georgiou, G. P. (2019). Bit and beat are heard as the same: Mapping the vowel perceptual patterns of Greek-English bilingual children. *Language Sciences*, *72*, 1-12.

Iverson, P., & Evans, B. G. (2009). Learning English vowels with different first-language vowel systems II: Auditory training for native Spanish and German speakers. *The Journal of the Acoustical Society of America*, *126*(2), 866-877.

Iverson, P., Hazan, V., & Bannister, K. (2005). Phonetic training with acoustic cue manipulations: A comparison of methods for teaching English /r/-/l/ to Japanese adults. *The Journal of the Acoustical Society of America*, *118*(5), 3267-3278.

Johnson, K. (2011). *Acoustic and auditory phonetics*. Wiley-Blackwell.

Kang, O., & Moran, M. (2014). Functional loads of pronunciation features in nonnative speakers' oral assessment. *TESOL Quarterly*, *48*(1), 176-187.

Kang, O., & Pickering, L. (2013). Acoustic and temporal analysis for assessing speaking. *The Companion to Language Assessment*, *2*, 1047-1062.

Lambacher, S., Martens, W., Nelson, B., & Berman, J. (2001). Identification of English voiceless fricatives by Japanese listeners: The influence of vowel context on sensitivity and response bias. *Acoustical Science and Technology*, *22*(5), 334-343.

Lee, K. (2021). *Effects of phonemic awareness instruction on listening comprehension for EFL learners in a Korean elementary school* [Unpublished master's thesis]. Seoul National University.

Lim, Y., & Jang, W. (2019). Speech perception of English fricatives by Korean young learners of English based on L2 acquisition theories. *The Linguistic Association of Korea Journal*, *27*(1), 88-111.

Lively, S. E., Logan, J. S., & Pisoni, D. B. (1993). Training Japanese listeners to identify English /r/ and /l/. II: The role of phonetic environment and talker variability in learning new perceptual categories. *The Journal of the Acoustical Society of America*, *94*(3), 1242-1255.

Logan, J. S., Lively, S. E., & Pisoni, D. B. (1991). Training Japanese listeners to identify English /r/ and /l/: A first report. *The Journal of the Acoustical Society of America*, *89*(2), 874-886.

Miller, G. A., & Nicely, P. E. (1955). An analysis of perceptual confusions among some English consonants. *Journal of the Acoustic Society of America, 27*, 338-352.

Morrison, G. S. (2003, August). Perception and production of Spanish vowels by English speakers. *Proceedings of the 15th International Congress of Phonetic Sciences* (pp. 1533-1536).

Mueller, C. M. (2019). Which English sounds are difficult? Japanese EFL learners' intuitions versus their performance. *The Language Teacher*, *43*(2), 3-8.

Pruitt, J. S., Jenkins, J. J., & Strange, W. (2006). Training the perception of Hindi dental and retroflex stops by native speakers of American English and Japanese. *The Journal of the Acoustical Society of America*, *119*(3), 1684-1696.

Rhee, S. C., Chang, J. W., Kim, T. K., Kim, J., Jang, Y. J., Sung, J. H., Rhim, S. K., & Kim, C. (2008). A comparative study on distribution of acoustic cues for Korean /ㅅ/ and /ㅆ/ distinction by native and non-native speakers of Korean. *The Journal of Studies in Language*, *24*(2), 261-280.

Shepard, R. N. (1972). Psychological representation of speech sounds. In E. E. David, & P. B. Denes (Eds.), *Human communication: A unified view* (pp. 67-113). McGraw-Hill.

Snow, C. (2014). Relevance of the notion of a critical period to language acquisition. In M. H. Bornstein (Ed.), *Sensitive periods in development: Interdisciplinary perspectives* (pp. 201-228). Psychology Press.

Suzukida, Y., & Saito, K. (2021). Which segmental features matter for successful L2 comprehensibility? Revisiting and generalizing the pedagogical value of the functional load principle. *Language Teaching Research*, *25*(3), 431-450.

Thomson, R. I. (2018a). *English accent coach*. EnglishAccentCoach. https://englishaccentcoach.com

Thomson, R. I. (2018b). High variability [pronunciation] training (HVPT): A proven technique about which every language teacher and learner ought to know. *Journal of Second Language Pronunciation*, *4*(2), 208-231.

Wong, J. W. S. (2014, September). The effects of high and low variability phonetic training on the perception and production of English vowels /ɪ/ and /iː/ by Cantonese ESL learners with high and low L2 proficiency levels. *Proceedings of the 15th Annual Conference of the International Speech Communication Association* (pp. 524-528).

Yopp, H. K. (1988). The validity and reliability of phonemic awareness tests. *Reading Research Quarterly*, *23*(2), 159-177.

Yopp, H. K., & Yopp, R. H. (2000). Supporting phonemic awareness development in the classroom. *The Reading Teacher*, *54*(2), 130-143.

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