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VARIATION OF ARABIC SOUNDS PERCEPTION AMONG MALAY CHILDREN

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ABSTRACT

Variation of Arabic sound perception reflects the interlanguage speech intelligibility benefit. Hence, this study aims to identify the variations of assimilation in the perception of Arabic sound produced. Data were collected from 30 primary school pupils in Putrajaya. The method used was minimal pairs from 19 phonemes with counterparts respectively containing the target sound at the end of the word. The data analysis used was the descriptive analysis. The results of the study revealed that the variation of Arabic sound perception among Malay children consist of One-category assimilation (SC) which consist of six phonemes; /ð/, /r/, /z/, /s/, /h/ and /ʔ/, two-category assimilation (TC) which consist of four phonemes; /ħ/, /d/, /ɣ/ and /q/, and Category-goodness (CG) which consist of nine phonemes; /θ/, /t/, /x/, /sˤ/, /dˤ/, /tˤ/, /ðˤ/, /ʕ/ and /k/. These findings revealed the interlanguage speech intelligibility benefit and aligned with PAM. These results enhance the understanding of learning Arabic sounds through listening and repeating based on the Behaviorism theory by Celce-Murcia (1994). It showed that sound perception comes earlier than sound production. This study also provides new insight into how speech perception can eventually enhance speech production, particularly among Malay children.

Keywords: *Variation, assimilation, sound perception, Arabic sounds, Malay children.*

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INTRODUCTION

Sound perception is a process by which language sounds are heard, interpreted, and understood (Manan et al., 2013a; 2013b). To enhance our understanding of speech perception and its influencing factors, researchers have started examining the clarity of native and non-native speech as perceived by native and non-native listeners. Previous studies have identified two main categories of factors affecting intelligibility. The first category pertains to speaker-related factors, such as speech rate (Derwing & Munro, 2001), stress, pausing and intonation (e.g., Tajima et al., 1997; Trofimovich & Baker, 2006), neighborhood density (Imai et al., 2005), and word frequency (Bradlow & Pisoni, 1999). The second category involves listener-related factors, including language proficiency, neural plasticity, motor system and motor representations (Alain et al., 2018; Liberman et al., 1967; Liberman & Mattingly, 1985; Perron et al., 2024), working memory (Baddeley & Hitch, 1974) and familiarity with the speech (Hsieh & Tsao, 2022; Saito et al., 2019; Shehata, 2024).

Researchers have also highlighted the concept of an interlanguage linguistic system, which encompasses speech features distinct from the speaker's first and second languages (Selinker, 1972). This relates to the interlanguage speech intelligibility benefit, which refers to how well listeners can understand speech sounds from native or non-native speakers (Shehata, 2024). Understanding interlanguage is vital for successful communication in multilingual contexts, especially as globalization increases. There has been limited research on the Arabic language within second language acquisition (SLA) studies. Therefore, this article aims to fill that gap by investigating variations of sound assimilation perception types in the context of Arabic consonants in a Malay language setting, focusing on how the native sound of Arabic is perceived by Malay child speakers. This research will contribute to understanding L2 sound intelligibility and enhance the existing literature on L2 sound acquisition through sound perception-based.

LITERATURE REVIEW

Learning pronunciation is based on developing two speech abilities: perception and production. Flege (1995) comments that the development of perception precedes production, and accurate perception results in accurate production. According to Brown (2000), "successful acquisition of phonological representations requires accurate perception of phonemic contrast in the input" (p. 7). L2 sound perception studies show that listeners vary in terms of their experience with L2 speech. The phonemic inventory differs from one language to another, which creates difficulties in perception and production for L2 learners. Although the situation does not occur in all cases, L2 learners see target language sounds differently from native speakers (Guion et al., 2000), and each L2 learner responds to target language sounds differently compared to other L2 learners, based on the learners' linguistic knowledge and other individual variations (Mayr & Escudero, 2010).

According to Castles and Coldheart (2004), phonological awareness includes listening skills, syllable awareness, early-rhyme awareness and phonemic awareness tasks. Listening skills are the ability to identify and distinguish environmental sounds and speech from each other. These skills involve awareness skills (detecting certain sounds), discrimination (identifying the same or different sounds), memory (remembering sound patterns), sequence (identifying the order of what has been heard), isolation (isolating a sound from the background of other sounds), and perception (understanding the sounds heard).

The Contrastive Analysis Hypothesis (CAH) has contributed to the field of second language acquisition (SLA) by developing methods to compare L1 and L2 by questioning the relationship between the two languages (Brown, 2000). The L2 sound perception model supports CAH by validating the role of L1 in L2 acquisition by helping to predict difficulties that occur from L1 influence. Proponents of CAH have claimed that L2 learners' errors are predictable, according to the presence and absence of sounds in the native and target languages. Proponents of CAH may not be able to explain exactly how L1 affects L2, but they have opened up a new approach to developing research on L2 acquisition (Brown, 2000). Therefore, three models have been developed to study the learnability of L2 sound perception based on students' L1, namely the Speech Learning Model (SLM) (Flege, 1995; Flege et al., 2003), the Perceptual Assimilation Model (PAM) (Best, 1995) and its extension to L2 learning (PAM-B2) (Best & Tyler, 2007).

Language acquisition is at a higher level than language learning. In the context of children, they learn language initially through the sense of hearing (Çakıroğlu, 2019; Hong, 2024; Werker, 2018). Their brains receive all speech sounds from speakers regardless of language, which is known as language processing (Kuhl, 2010, 2011; Skeide & Friederici, 2016). According to the theory of children's brain development or native language magnet (Kuhl, 2004; Kuhl et al., 2007; Romeo et al., 2018), their brains begin to process language sounds as soon as they are born into the world. However, an early assumption on a critical period matter of a language associated with the work of Lenneberg in Critical Period Hypothesis (1967) postulated that children begin to process language sounds at the age of 2 years until puberty. Once they reach the age of 10-12, they can no longer acquire a language except through a language-learning process that is not natural (Lamb, 2004; Snow & Hoefnagel-Hohle, 1978; Tomasello, 2000). This theory is grounded in the relationships between language development milestones and childrens' anatomical and physiological growth (Vyshedskiy et al., 2017). It suggests that as the neural organization undergoes qualitative changes, there is a corresponding decline in language learning ability with age, leading to biological constraints on language acquisition (Birdsong, 2018; Gunnar, 2024). Therefore, foreign language sound perception skills are crucial for developing their psychological cognitive skills, thus facilitating language acquisition, especially Arabic in a non-native speaker setting.

METHODOLOGY

This study used an experimental design. Arabic speech sound data was obtained from sound recordings conducted in a phonetics laboratory at the Faculty of Social Sciences and Humanities, National University of Malaysia. A perception test for Arabic consonants was conducted on 30 study subjects aged 10 to 12. This Arabic consonant is the sound of the target segment at the end of the word for each item that is heard and presented in the answer sheet of the perception test. The main purpose of the perception test conducted in this study is to assess the extent to which Malay children can discriminate Arabic sounds that are heard in the form of words that contain the target consonant sound at the end of the word. 19 target consonant sounds have a minimum pair of each selected as an instrument for the Arabic sound perception test in this study. Through this perception test, the study subjects must choose a word based on what they perceive from the recording of a native Arabic speaker (stimulus material). In other words, they have to choose words that contain the same final sound as the recording they heard. These spoken words contain fricative, plosive and nasal sounds at the end of the word, either paired (i.e., voiced and voiceless pairs) or unpaired (e.g., glottal stops).

The method of the sound perception test in this study is designed to identify the subjects' ability to discriminate Arabic sounds they perceive. Additionally, this method is used to collect data to identify Arabic sounds that present difficulties for Malay children. A list of 45 Arabic words was selected in minimal pair format for the perception test. Each word contains one target segment sound located only at the end of the word. All target sounds were arranged in line with the list of words used in the sound production test. On the day of the test, before the testing session, the researcher repeated the test procedures and reminded each subject about the main objectives of the assignment and the importance of staying focused as long as they were comfortable during the test. Subjects were asked to listen carefully and then circle the best option according to their perception of the target segment sound. The audio recordings for the perception test were obtained from a native Arabic speaker, a professor in the Arabic language field at UIAM. Each sound was played five times, with a 1-2 second interval between each repetition, to allow the subjects to adapt to the rhythm and consistency of the task. A speaker measuring 1 foot by 3 feet was connected to a laptop and placed in the center of the classroom at KAFA AL-Amin, Putrajaya. The distance from the speaker to all subjects was approximately 5 feet. The sound equalizer was set according to the portable speaker category. Specifically, they were asked to discriminate between three-word choices where the target segment sound was at the end of the word. Throughout the perception test, monitoring was conducted by three teachers to ensure the testing process proceeded smoothly without any unwanted issues. Finally, a pencil and two forced-choice answer sheets were distributed about 10-15 minutes before each session began.

Thus, the researcher chose a forced-choice perception test in which the study subject was required to listen to an Arabic stimulus sound spoken by a native Arabic speaker and then choose an answer from three answer options in the form of a minimal pair of target sound segments at the end of the word.

Instrument

The sound perception test in this study was designed and used per the procedures and guidelines from the ABX Discrimination Task. The ABX Test design is adapted and shaped according to the study's accessibility. The researcher adapted the ABX Discrimination Task into three forced-choice answers to increase the minimal difficulty level in the Arabic sound perception test. The three forced-choice answers were developed based on their minimal pair sounds merely at the end of the word. Based on previous research findings as well, the researcher took into account three major aspects of Arabic pronunciation errors that are always made by L2 learners: place of articulation, manner of articulation, and voicing. It was also aligned with the Speech Learning Model (1995), stating that the closest L2 sounds to each other would be very challenging to L2 learners. This test was designed to identify the level of Malay children's ability to respond to Arabic sounds. In addition, this test is used to identify the most difficult Arabic sounds among Malay children.

The researcher did a screening process on 28 Arabic letter sounds and found that there are only 19 sounds that have a minimal pair. Therefore, the researcher made 19 Arabic sounds possessing only minimal pairs and tested them in the sound perception test in two and three forced-choice answers. The word list above includes 19 target sounds possessing a minimum pair of each and are formed into 45 question items. The purpose of this is to identify the level of ability of the study subjects to discriminate the perceived sounds while undergoing a sound perception test. The target sound contained in the word is at the end of the word only to achieve parallelism with the list of words used for the sound production test. The target sound characteristic at the end of the word consists of fricative, plosive, either voiced or voiceless. 19 target segments are contained in the list of 45-word lists, totaling 1350 tokens (45-word lists x 30 study subjects).

The list of 45-word lists selected in the form of minimal pairs is mixed without order according to each pair. This aims to slightly increase the difficulty level, randomize and make the perception test more original. In the list, there are two additional foreign words (dummy) at the beginning of the list and two at the end to provide a time interval for the stability and readiness of the study subjects (the foreign words are not involved as test data).

The list of words for the sound perception test can be seen in the table below:

Table 1: List of Arabic Words in Perception Test

1	A. فَلَخْ	B. فَلَح	C. فَلَه
2	A. حَضِيْدْ	B. حَضِيْضْ	
3	A. بَاسْ	B. بَاصْ	C. بَذْ
4	A. شَرَهْ	B. شَرَحْ	C. شَرَخْ
5	A. سَمَاء	B. سَمَعْ	C. سَمَكْ
6	A. فَلَكْ	B. فَلَخْ	C. فَلَقْ
7	A. فَسَقْ	B. فَسَخْ	C. فَسَحْ
8	A. بَزْ	B. بَذْ	C. بَاسْ
9	A. حَيْذ	B. حِيْس	C. حَيْث
10	A. عُكَّاذْ	B. عُكَّازْ	C. عُكَّاظْ
11	A. شَوْكْ	B. شَوْقْ	C. شَوءْ
12	A. شَوْكْ	B. شَوْقْ	C. شَوخْ

13	A. حَدِيْذْ	B. حَضِيْضْ	C. حَضِيْذْ
14	A. بَذْ	B. بَاسْ	C. بَاصْ
15	A. هَمَصْ	B. هَمَسْ	
16	A. شَرَحْ	B. شَرَهْ	C. شَرَخْ
17	A. سَمَاء	B. سَمَعْ	C. سَمَكْ
18	A. فَلَكْ	B. فَلَخْ	C. فَلَقْ
19	A. فَسَقْ	B. فَسَخْ	C. فَسَحْ
20	A. بَزْ	B. بَذْ	C. بَاسْ
21	A. حِيْزْ	B. حِيْس	C. حِيْص
22	A. عُكَّاذْ	B. عُكَّازْ	C. عُكَّاظْ
23	A. سَقَطْ	B. سَكَت	C. سَقَتْ
24	A. أَصْوَات	B. أَسْوَدْ	C. أَسْوَضْ
25	A. أَسَازْ	B. أَسَاثْ	C. أَسَاسْ
26	A. فَظْ	B. فَذْ	C. فَزْ
27	A. حَيْذ	B. حَيْث	C. حَيْز
28	A. اسمَح	B. اسمَعْ	C. اسمَك
29	A. حَرَسْ	B. حَرَذْ	C. حَرَزْ
30	A. فَرَح	B. فَرَخْ	C. فَرَغْ
31	A. سَمَاء	B. سَمَعْ	C. سَمَكْ
32	A. مُرُوزْ	B. مُرُوغْ	
33	A. سَمَاء	B. سَمَعْ	C. سَمَكْ
34	A. سَقَطْ	B. سَقَتْ	
35	A. أَصْوَت	B. أَصْوَذْ	C. أَصْوَضْ
36	A. أَنَاسْ	B. أَنَاثْ	
37	A. فَظْ	B. فَذْ	C. فَزْ
38	A. حَيْذ	B. حَيْث	C. حَيْز
39	A. اسمَح	B. اسمَعْ	C. اسمَك
40	A. حَرَسْ	B. حَرَذْ	C. حَرَزْ

41	A. فَرَح	B. فَرَخْ	C. فَرَغْ
42	A. سَمَاء	B. سَمَعْ	C. سَمَكْ
43	A. مُرُوخْ	B. مُرُوغْ	
44	A. سَمَاء	B. سَمَعْ	C. سَمَكْ
45	A. فَلَه	B. فَلَح	C. فَلَخْ

Table 2: List of Target Sounds

/ض/ ,/ص/ ,/س/ ,/ز/ ,/ر/ ,/ذ/ ,/د/ ,/خ/ ,/ح/ ,/ث/ ,/ت/
/ط/ ,/ظ/ ,/ع/ ,/غ/ ,/ق/ ,/ك/ ,/ء/ ,/ه/

Table 3: Distribution of Arabic Manner of Articulation in Perception Test

No	Manner	Voiced	Token	Voiceless	Token
1	Fricative	8	240	20	600
2	Plosive	1	30	3	90
3	Stop	2	60	7	210
4	Nasal	3	90	-	-
5	Africate	1	30	-	-

Table 3 above shows the distribution of the manner of articulation for all sounds in the Arabic language register in this study. The fricative sound is the dominant sound, with as many as eight items of voiced sounds and 20 items of unvoiced sounds. Followed by plosive sounds with one voiced sound item and three voiceless sound items.

RESULTS

The research findings from this perception test also highlight a discovery from perceptual assimilation. Based on PAM (Best et al., 1988), there are six types of perceptual assimilation among non-native speakers. Therefore, the researcher concluded that the perceptual assimilation that occurs among Malay children for the Arabic sounds tested in the sound perception test is different as in the table below:

Table 4: Assimilation Type (Variation) of Arabic Sound Perception in Malay Children

No.	Target Consonant Sound	Assimilation Type
1	/ت/-/t/	Category goodness (CG)
2	/ث/-/θ/	Category goodness (CG)
3	/ح/-/ ħ /	Two-category (TC)
4	/خ/-/x/	Category-goodness (CG)

5	/د/-/d/	Two-category (TC)
6	/ذ/-/ð/	One category (SC)
7	/ر/-/r/	One category (SC)
8	/ز/-/z/	One category (SC)
9	/س/-/s/	One category (SC)
10	/ص/-/sˤ/	Category goodness (CG)
11	/ض/-/dˤ/	Category goodness (CG)
12	/ط/-/tˤ/	Category goodness (CG)
13	/ظ/-/ðˤ/	Category goodness (CG)
14	/ع/-/ʕ/	Category goodness (CG)
15	/غ/-/ɣ/	Two-category (TC)
16	/ق/-/q/	Two-category (TC)
17	/ك/-/k/	Category goodness (CG)
18	/ء/-/ʔ/	One category (SC)
19	/ه/-/h/	One category (SC)

Table 4 shows the results of the study revealed that the variation of Arabic sound perception among Malay children consist of One-category assimilation (SC) which consist of six phonemes; /ð/, /r/, /z/, /s/, /h/ and /ʔ/, two-category assimilation (TC) which consist of four phonemes; /ħ/, /d/, /ɣ/ and /q/, and Category-goodness (CG) which consist of nine phonemes; /θ/, /t/, /x/, /sˤ/, /dˤ/, /tˤ/, /ðˤ/, /ʕ/ and /k/. The output or results of the sound perception test are conducted by researchers guided by PAM (Best, 1988). The findings of the perception test conducted by the researcher can reflect on the position of problems that occur among Malay children. This finding is also clearly helpful in providing new information to other researchers who conduct studies particularly related to sound perception. This information may provide an initial overview for researchers to relate to the current problems occurring among L2 speakers, whether in English or Arabic. Thus, the findings from the descriptive analysis of this perception test can highlight the research gap that exists in the context of Arabic sound perception among Malay children.

DISCUSSION

Specifically, a perception test was conducted to test the extent to which Malay children could discriminate one of the sound contrasts at the end of words in Arabic. The perception test conducted in this study is the trigger for the production test and the subsequent objectives. The data collected from the perception test confirmed a high percentage of perception in discriminating plosive and fricative contrasts at the end of Arabic words produced by native Arabic speakers. The research findings from the perception test also revealed that there are variations in the influence of not only the sound system of the mother tongue but also the area of articulation, the way of articulation, pronunciation, and Interlanguage also become a strong influence in Malay children for the process of perceiving the sounds of the Arabic language. Out of the 19 Arabic consonant sounds in the form of minimal pairs that were tested in the perception test, some sounds are in line with Flege's theory (1995) about the concept of similar and dissimilar, namely the sounds /θ/, /ħ/, /ð/, /z/, /ʕ /, /h/, /ʔ/, /tˤ/, /ðˤ/, some sounds

are consistent with the theory of Lado (1957) and Best (1988) regarding language transfer (influence or disruption of the mother tongue), namely the sounds /k/, / q/, /d/, /t/, /s/, /sˤ/, /dˤ/ as well as some sounds such as /x/, /ʕ/, /ɣ/ and /r/ are in line with the theory of Interlanguage (Selinker, 1972) concerning the students' mistakes which are in the form of their system.

The same sound perception difficulty can also be seen among Malay children in distinguishing /z/ and /ð/ as 'different', where this sound is perceived as /z/. Therefore, the findings confirm that Malay children experience difficulty discriminating L1 and Arabic sounds if these sounds are perceptually assimilated into their Malay phonetic system. In the context of this /z/ sound, we can see that this sound is commonly used in any word that contains the letter 'z', including Arabic loanwords in the Malay language. Problems start to arise when the letter 'z' is embedded in a loan word, such as the word *izin*, for example. Malay speakers, including children, must pronounce the letter 'z' with the /z/ sound instead of the /ð/ sound. After all, the Malay sound system assimilates the sound /ð/ to /z/ from the beginning (lexical level). As a result, it can be said that all Malay speakers pronounce the Malay word *izin* with the /z/ sound on the letter 'z'. For this issue, relatively high L2 phonological knowledge is essential. Likewise, the Malay word *zalim,* this Arabic loan word has been assimilated to /z/ compared to its original sound /ðˤ/.

The findings also show that a small proportion of Malay children also face problems in responding to Arabic sounds that are not in the Malay sound system even though they are counterpart sounds. Some sounds such as /x/, /ʕ/, /ɣ/ and /r/ encourage Malay children to tend towards 'interlanguage' as per the theory of Selinker (1972). In the case of the perceptual test conducted in this study, the stimulus sound recording was speech produced by a native Arabic speaker. The researcher assumes that Malay listeners (Malay children) may find it difficult to detect existing phonetic cues (such as the strength of release burst values and differences in vowel duration or closing phase) in such contexts (final position) because they have never learned to follow these systematically. The results showed that their L2 phonological knowledge largely influenced their response patterns.

The findings described in this chapter have confirmed that when a particular phonetic realization is associated with two different phonemes across L1 and L2, perceptual data show that listeners tend to assimilate this to a single L1 sound. For example, Malay /p/ and Arabic /b/ may be considered by Malays as /p/ because both sounds have a similar MMS pattern (short lag VOT). This can result in a strong 'misperception' for Malay students, as per the data discussed here. The 'misconceptions' of similar sounds, which are, in fact, two different phonemes, can affect the mutual intelligibility of the speaker-listener interaction.

The researcher believes that if the ability to see different phonetic differences is present in a group of Malay students, then performance will improve. Final /d/, /t/ and /k/, when produced by native speakers of Arabic, could be an example where the long VOT lag may have been perceived as significantly different from the L1 pattern and, therefore, not prone to be assimilated. The results, to some extent, show that final /d/, /t/ and /k/ are perceived as 'different' in native Arabic speech, with a high percentage of correct responses. Therefore, the researcher suggests that well-designed Arabic listening materials for Malay students that focus on the problem areas as identified will significantly improve perception and production skills. The teaching manual should also support the instructor in this regard.

Four sounds show a low level of perceptual ability for the study subjects, namely /ð/, /z/, /h/ and /ʔ/. If you look more closely, all these sounds are not from the category of pharyngeal sounds or pharyngealization. As stated in the findings of previous studies, pharyngeal sounds and pharyngealization are the most difficult sounds for non-native Arabic speakers. However, the findings are from the point of view of sound production. On the other hand, the findings of this study reflect Malay children's sound-perceiving ability. In the context of the /ʔ/ sound, if examined in more detail, as many as 33.33% chose the /ʕ/ sound, while another 25% chose the /k/ sound for the /ʔ/ sound heard at the end of Arabic words. Revealing from the aspect of the area of articulation, the sound /ʕ/ is in the pharyngeal, where it is next to the position of the sound /ʔ/, which is in the glottal. These two sounds do not have a category in the Malay language but share a sign in the Malay language, which is the (') sign. This indicates that very close articulation areas also contribute to difficulties in sound perception. This finding aligns

with the research done by Hajar Binasfour (2018), who said that the sound /ʔ/ is part of the sound that causes great difficulty for non-native Arabic speakers.

The research findings for this objective also show that the difficulty of each sound is misaligned in perception and sound production. As for the sound /h/, the findings show a low level of ability for this sound among Malay children. The findings align with Azidan (2004), who stated that the sound /h/ also causes difficulties for the Malays. Even so, the research findings for the /ħ/ sound do not align with previous studies. This study found that the sound /ħ/ does not cause difficulties in Malay children's sound perception. Research on articulating between these two sounds indeed has a significant and clear difference. Native speakers say with a perfect articulation between these two sounds where they do inhalation (inhalation) for the sound /ħ/ and exhalation (exhalation) for the sound /h/. Thus, Malay children could discriminate this sound well without being affected by other minimal pairs.

The results of the sound perception test conducted in this study have shown a research gap in the perception of Arabic sounds among Malay children. As a result of the descriptive analysis of the perception test, this study states three out of six types of assimilation that occur among Malay children towards pronouncing Arabic sounds. The types of assimilation are such as One Category Assimilation (SC), Two Category Assimilation (TC) and Absolute Difference Category (CG). This finding highlights the problem of the perception of Arabic sounds among Malay children. This is parallel, as stated by Best (1988) through PAM.

Through the sound perception test conducted in this study, the researcher was able to issue a hypothesis regarding the type of assimilation that occurs among Malay children towards the perception of Arabic sounds. Based on the PAM theory by Best (1988), the researcher outlined that three of the six types of assimilation that occur among Malay children regarding the perception of Arabic sounds are Single Category Assimilation (SC), Two Category Assimilation (TC) and Difference Category Absolute (CG).

Implications for practice when the findings underline that 3 types of perceptual assimilation occur among Malay children towards the perception of Arabic sounds; One-Category Assimilation, Two-Category Assimilation and Absolute Difference Categories. Assimilation of One Category means that the difference between two sounds, in contrast, L2 will be difficult to perceive if the sound B2 is mapped onto one category L1 with the same level of goodness. For example, Malay listeners hear the Arabic sound [ħ] which is no better than the sound [h], so they cannot discriminate the two sounds well. Next, the type of Assimilation of Two Categories brings the meaning of two different sounds in L2, so it is easy to discriminate. For instance, the sounds [m] and [n]. So is the Absolute Difference Assimilation type where both sounds fall into the same category in the native sound, but one of the sounds is better/good and closer to the L1 phoneme. For instance, the sounds [k] and [t], look the same in Arabic and Malay but are slightly different in Arabic when these sounds have a little aspiration.

Next, this study on theory implies that the findings improve and strengthen the theory of speech chain process as proposed by Hayward (2000). The findings also reveal an implication towards the practices in Muslim society where the learning process, particularly in the context of Arabic sound, entails learning engagement like the method of sound perception test in this study. It trains the listeners to keep on paying attention to the lesson learnt. This is aligned with the procedures that are taught in religion, which is *khusyuk* during performing prayers or even learning. The findings of this study also give implications to the PAM theory by Best (1988) when adding to the understanding of the concept of perceptual assimilation after the PAM theory by Best (1988) can be proven to affect the level of perception of Arabic sounds among Malay children.

CONCLUSION

In sound perception for any language including Arabic, there is one type of phonological processing known as phonological memory. Phonological memory is crucial in sound perception (Wagner & Torgesen, 1987). In other words, the higher the level of phonological memory, the better the level of sound perception of a student. The sound perception test is done through the hearing test method. Listening skills require high focus and attention as well as speed in responding and remembering the sounds produced. The process of remembering the sounds

produced is also stated in the Working Memory Model (1974), which is the skill of remembering sounds in a short period.

To sum up, this study has shown the significance of accurately defining early perceptual abilities and how it has been linked with sound acquisition and assimilation theories. Also, this study has highlighted the key elements underlying speech perception of any language. Through all the previous studies that have been carried out, this study therefore explores the variation in Arabic sound perception of assimilation among Malay children, and the result was better than expected. Emphatic, also known as pharyngealized sounds, did not appear as difficult as expected, and it showed that the result aligned with the Perceptual Assimilation Model (Best, 1988) and Speech Learning Model (Flege, 1995).

REFERENCES

Alain, C., Du, Y., Bernstein, L. J., Barten, T., & Banai, K. (2018). Listening under difficult conditions: An activation likelihood estimation meta-analysis. *Human Brain Mapping, 39*(7), 2695–2709. https://doi.org/10. 1002/hbm.24031

Baddeley A., Hitch G. (1974). Working memory. *Psychol. Learn. Motiv, 8,* 47–89. https://doi.org/10.1016/j.cub.2009.12.014

Best, C. T. (1995). A direct realist view of cross-language speech perception. In W. Strange (Ed.), *Speech perception and linguistic experience: Issues in cross-language research*. New York Press.

Best, C. T. & Tyler, M. D. (2007). Non-native and second language speech perception: Commonalities and complementarities. In M. J. Munro & O. S. Bohn (Eds.), *The role of language experience in speech learning* (pp. 13-34). John Benjamin.

Birdsong, D. (2018). Plasticity, variability and age in second language acquisition and bilingualism. *Frontiers in Psychology*, *9*. https://doi.org/10.3389/fpsyg.2018.00081

Bradlow, A.R., & Pisoni, D.B. (1999). Recognition of spoken words by native and non-native listeners: Talker-, listener-, and item-related factors. *Journal of the Acoustical Society of America, 106*, 2074–2085.

Brown, H. D. (2000). *Principles of language learning and teaching* (4th ed.). Pearson Education.

Çakıroğlu, A. (2019). The language acquisition approaches and the development of literacy skills in children. *International Electronic Journal of Elementary Education*, *11*(2), 201–206. https://doi.org/10.26822/iejee.2019248600

Castles, A., & Coltheart, M. (2004). Is there a causal link from phonological awareness to success in learning to read? *Cognition*, *91*(1), 77–111. https://doi.org/10.1016/s0010-0277(03)00164-1

Derwing, T.M., & Munro, M.J. (2001). What speaking rates do non-native listeners prefer? *Applied Linguistics*, *22*, 324–337.

Flege, J. E. (1995). Second language speech learning theory, findings and problems. In W. Strange (Ed.), *Speech perception and linguistic experience: Issues in cross-language research* (pp. 233-277). New York Press.

Flege, J. E., Schirru, C. & MacKay, I. R. A. (2003). Interaction between the native and second language phonetic subsystems. *Speech Communication, 40*, 467-491.

Guion, S.G., Flege, J.E., Akahane-Yamada, R., & Pruitt, J.C. (2000). An investigation of current models of second language speech perception: The case of Japanese adults' perception of English consonants. *Journal of the Acoustical Society of America*, *107*, 2711–2724.

Gunnar, N. (2024). First-language interference without bilingualism? Evidence from second language vowel production in international adoptees. *Applied Psycholinguistics*, 1–19. https://doi.org/10.1017/s0142716424000237

Hong, S. (2024). On child language acquisition: Theoretical basis for language development. *Convergence English Language & Literature Association, 9*(2), 109-128. https://doi.org/10.55986/cell.2024.9.2.109

Hsieh, Y.L., & Tsao, F.M. (2022). The effect of speech familiarity and phonetic similarity on the acquisition of Mandarin Chinese vowels by English-speaking learners. *Second Language Research*, 38, 111–135.

Imai, S., Walley, A.C., & Flege, J.E. (2005). Lexical frequency and neighbourhood density effects on the recognition of native and Spanish-accented words by native English and Spanish listeners. *Journal of the Acoustical Society of America*, 117, 896–907.

Kuhl, P. K. (2011). Early language learning and literacy: Neuroscience implications for education. *Mind, Brain, and Education, 5*(3), 128-142. https://doi.org/10.1111/j.1751-228x.2011.01121.x

Kuhl, P. K. (2004). Early language acquisition: Cracking the speech code. *Nature Reviews Neuroscience*, *5*(11), 831–843. https://doi.org/10.1038/nrn1533

Kuhl, P. K. (2007). Is speech learning "gated" by the social brain? *Developmental Science*, *10*(1), 110–120. https://doi.org/10.1111/j.1467-7687.2007.00572.x

Kuhl, P. K. (2010). Brain mechanisms in early language acquisition. *Neuron*, *67*(5), 713–727. https://doi.org/10.1016/j.neuron.2010.08.038

Lamb, M. (2004). "It depends on the students themselves": Independent language learning at an Indonesian State School. *Language, Culture and Curriculum*, *17*(3), 229–245. https://doi.org/10.1080/07908310408666695

Liberman, A. M., Cooper, F. S., Shankweiler, D. P., & Studdert-Kennedy, M. (1967). Perception of the speech code. *Psychological Review, 74*(6), 431–461. https://doi.org/10.1037/h0020279

Liberman, A. M., & Mattingly, I. G. (1985). The motor theory of speech perception revised. *Cognition, 21*(1), 1–36. https://doi.org/10.1016/ 0010-0277(85)90021-6

Manan, H. A., Yusoff, A. N., Franz, E. A., & Mukari, S. Z. M. (2013a). Early and late shift of brain laterality in STG, HG, and cerebellum with normal aging during a short-term memory task. *ISRN Neurology*, 1-13. http://dx.doi.org/10.1155/2013/892072

Manan, H. A., Yusoff, A. N., Franz, E. A., & Mukari, S. Z. M. (2013b). The effects of background noise on brain activity using speech stimuli on healthy young adults. *Neurology Psychiatry and Brain Research, 19*(4), 207-215.

Mayr, R., & Escudero, P. (2010). Explaining individual variation in L2 perception: Rounded vowels in English learners of German. *Bilingualism: Language and Cognition, 13*(03), 279-297.

Perron, M., Vuong, V., Grassi, M. W., Imran, A., & Alain, C. (2024). Engagement of the speech motor system in challenging speech perception: Activation likelihood estimation meta-analyses. *Human Brain Mapping*, 1-26. https://doi.org/10.1002/hbm.70023

Perron, M., Liu, Q., Tremblay, P., & Alain, C. (2024). Enhancing speech perception in noise through articulation. *Annals of the New York Academy of Sciences*, *1537*(1), 140–154. https://doi.org/10.1111/nyas.15179

Romeo, R. R., Leonard, J. A., Robinson, S. T., West, M. R., Mackey, A. P., Rowe, M. L., & Gabrieli, J. D. E. (2018). Beyond the 30-million-word gap: Children's conversational exposure is associated with language-related brain function. *Psychological Science*, *29*(5), 700–710. https://doi.org/10.1177/0956797617742725

Saito, K., Tran, M., Suzukida, Y., et al. (2019). How do L2 listeners perceive the comprehensibility of foreign-accented speech? Roles of L1 profiles, L2 proficiency, age, experience, familiarity and metacognition. *Studies in Second Language Acquisition*, *41*, 113

Selinker, L. (1972). Interlanguage. *International Review of Applied Linguistics in Language Teaching, 10*(3), 219-231.

Shehata, A. (2024). Arabic speech intelligibility: Perception of spoken Arabic by native and non-native speakers. *Language Teaching Research,* 1-16, https://doi.org/10.1177/13621688241231628.

Skeide, M. A., & Friederici, A. D. (2016). The ontogeny of the cortical language network. *Nature Reviews Neuroscience*, *17*(5), 323–332. https://doi.org/10.1038/nrn.2016.23

Tajima, K., Port, R., & Dalby, J. (1997). Effects of temporal correction on intelligibility of foreign-accented English. *Journal of Phonetics*, *25*, 1–24.

Tomasello, M. (2000). Do young children have adult syntactic competence? *Cognition*, *74*(3), 209–253. https://doi.org/10.1016/s0010-0277(99)00069-4

Trofimovich, P., & Baker, W. (2006). Learning second-language suprasegmentals: Effect of L2 experience on prosody and fluency characteristics of L2 speech. *Studies in Second Language Acquisition*, *28*, 1–30.

Vyshedskiy, A., Mahapatra, S., & Dunn, R. (2017). Linguistically deprived children: Meta-analysis of published research underlines the importance of early syntactic language use for normal brain development. *Research Ideas and Outcomes*, *3*, e20696. https://doi.org/10.3897/rio.3.e20696

Wagner, R. K., & Torgesen, J. K. (1987). The nature of phonological processing and its causal role in the acquisition of reading skills. *Psychological Bulletin, 101*, 192-212.

Werker, J. F. (2018). Perceptual beginnings to language acquisition. *Applied Psycholinguistics*, *39*(4), 703–728. https://doi.org/10.1017/s0142716418000152