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The Covert Contrast in the Acquisition of /u/-/u:/: Production evidence from non-Arabic Speakers

Mohammad Aljutaily[1], Raghad Alqweefl[2]

Abstract

Covert contrast refers to the phenomenon in which speakers produce a statistically significant acoustic difference, but native listeners do not perceive it. This study investigates phonemic Arabic vowel contrast (/u/ - /u:/) as produced by native Indonesian and Filipino speakers that is not present in their L1. Through an in-depth analysis of 84 participants, the paper investigates how L2 speakers navigate these phonemes, examining the presence of covert contrast, the relationship between proficiency level and covert contrast. Based on acoustic analysis and native Arabic speakers' identification, the findings indicated that approximately 35% of participants (58 out of 168 cases) exhibited covert contrast in producing target vowels. This discovery supports the notion that covert contrast constitutes an inherent aspect of the L2 acquisition process. Notably, a positive correlation between proficiency levels and covert contrast suggests a diminishing occurrence of covert contrast with increasing proficiency, leading to a more pronounced presence of overt contrast. This observation supports the proposition that the acquisition process follows a graduated trajectory in the realization of /u:/, which is absent in their L1. The finding also offers specific insights into how L1 impacts L2 phonemic acquisition. Lastly, the reliable acoustic cue that L2 speakers relied on was the vowel duration rather than F1 and F2. The findings have implications for language acquisition, underscoring the importance of recognizing the presence of covert contrast in L2 acquisition as a crucial intermediate stage for achieving phonological mastery. Moreover, the findings align cohesively with both the Speech Learning Model (Flege, 1995), highlighting the overarching influence of NL characteristics on challenges encountered by L2 speakers in L2 acquisition.

Keywords: *Covert contrast, Acquisition, Overt contrast, Adult, Vowel contrast.*

1. Introduction

Language acquisition is a fascinating and complex process through which humans develop the ability to communicate using a system of sounds, words, symbols, and grammatical rules. This intricate journey begins at birth and continues throughout human's lives as they learn to express their thoughts, feelings, and ideas to each other's. The study of language acquisition seeks to understand how humans acquire the capacity to speak, read, and write in one or more languages. It also investigates the factors that

[1] Department of English Language and Translation, College of Arabic Language and Social Studies, Qassim University, Saudi Arabia mjtiely@qu.edu.sa

[2] Postgraduate Student at the Department of English Language and Translation, College of Arabic Language and Social Studies, Qassim University, Saudi Arabia

influence this development. Language acquisition has two primary aspects: first language (L1) acquisition and second language (L2) acquisition. (De Villiers, 1978).

Several theories explain the process of language acquisition, and these can be broadly categorized into two groups: nativist and empiricist. Nativist theories, such as Noam Chomsky's Universal Grammar, propose that humans possess an innate language faculty that enables them to acquire any human language (Cook & Newson, 2007). In contrast to nativist theories, empiricist theories assert environmental factors, including exposure to language and social interactions predominantly influence language acquisition. For instance, Behaviorism, as proposed by Skinner, posits that language learning occurs through operant conditioning, wherein children develop linguistic abilities by receiving reinforcement for accurate responses to linguistic prompts. Another example is Lev Vygotsky's Social Interactionist Theory, which underscores the importance of social interaction in language acquisition and posits that children acquire language skills through communicative exchanges with caregivers and peers (Gass, 2013).

One of the well-known theories and the basic assumption in L2 acquisition is the Interlanguage theory (IL), which was developed by Selinker in the 1970s. The IL theory has been influential in the field of L2 acquisition, as it highlights the importance of understanding speakers' processes of language acquisition and the role of speakers' L1 and previous language learning experiences in shaping their IL (Tarone, 2018; Selinker, 1972). It suggests that L2 speakers develop a unique and dynamic linguistic system as they attempt to acquire the L2. According to IL theory, speakers develop an IL that is neither the L1 nor the L2 but a system that is unique to the speakers. This IL is influenced by the speaker's L1, as well as by their previous language learning experiences and their cognitive and learning styles. The IL system is seen as transitional, meaning that speakers' linguistic knowledge and abilities are in constant flux and development as they progress toward the L2.

Various factors influence the rate and success of L2 acquisition, including cognitive development, social context, and individual differences. The critical period hypothesis, for example, suggests that there is a window of time during which language acquisition is most efficient, typically before puberty (Tikofsky, 1968). Additionally, motivation, aptitude, the impact of speakers' L1 and learning style all play a role in determining how quickly and effectively an individual acquires a language (Khasinah,2014).

In general, language acquisition involves mastering a specific language's sounds (i.e., consonants and vowels), vocabulary, and grammatical rules. Jakobson (1968) posited that the initial step in language acquisition is mastering its sounds since speech serves as the primary means for human communication and comprehension. In the absence of speech, individuals must rely on alternative forms of language, such as sign language. This significantly differs from spoken language in that it relies on visual-gestural communication using handshapes, movements, and facial expressions rather than the auditory processing of sounds and vocal articulations. The process of acquiring the phonological system of an L2 differs significantly from that of an L1. L2 speakers typically have a fully developed phonological system in their L1, which can both facilitate and hinder the acquisition of the phonological system of the L2. Facilitation occurs because the L2 speaker already has knowledge of the phonetic and phonological patterns of their L1 and can draw upon this knowledge to help them acquire the phonological system of the L2 (Flege, 1995). For example, L2 speakers may use their knowledge of phonemes and their distribution in their L1 to identify similar patterns in the L2. On the other hand, this knowledge can also hinder L2 acquisition because the L2 speakers may transfer their L1's phonological patterns and rules to the L2, even if they are not applicable (Fikkert, 2007). For example, a native Arabic speaker learning English might struggle with the English /p/ sound, as it does not exist in Arabic. As a result, they might substitute the /p/ sound with the /b/ sound, which is more familiar to them from

their L1. This transfer of phonological patterns from one's L1 can lead to phonological errors and difficulties in producing the sounds of the L2 correctly (Ashour,2017).

The Speech Learning Model (SLM) (Flege, 1987) and the Perception Assimilation Model (PAM) (Best, 1995) contributed to a better understanding of the reasons behind speakers' difficulties in producing and perceiving certain sounds in L2. The central idea presented by these two frameworks is that the L2 speakers perceive L2 sounds in terms of the phonemic inventory of their L1 (Best, 1995; Flege, 1987). As described by Swain (1985), L2 phonological acquisition can be divided into three stages:

1. Initial state: In the initial stage of L2 phonological acquisition, speakers rely heavily on their L1 phonological system to perceive and produce the sounds of the L2. This stage is characterized by a strong foreign accent and difficulty in understanding and producing unfamiliar phonemes and phonotactic patterns.

2. System building: As speakers gain more exposure to the L2 and receive feedback on their production of L2 sounds, they begin to develop a separate phonological system for the L2. During this stage, speakers may still struggle with some phonemes and prosodic features but gradually improve their production of L2 sounds.

3. System refinement: At the final stage of L2 phonological acquisition, speakers fine-tune their production of L2 sounds by focusing on more subtle aspects of the L2's phonological system, such as allophonic variations and complex stress patterns. Some speakers may achieve near-native realization, while others may retain a foreign accent to varying degrees.

Over the past few decades, numerous research efforts have explored the development of phonological systems across various languages, including English (Anderson, 2004), English-Arabic bilinguals (Sawsan, 2017), Persian (Zarifian & Fotuhi, 2020), Ammani Arabic (Mashaqba et al., 2022) and Mandarin (Ma et al., 2022). These studies have focused on both L1 and L2 acquisition processes. Most prior studies have documented speakers' progress in acquiring L2 phonology through sound identifications by native speakers, which are used to analyze the characteristics of the interlanguage (IL) phonological system that speakers have acquired (Eckman et al., 2014). Until approximately 40 years ago, research on L1 acquisition also relied heavily on sound identification by adult speakers. However, the fact that adult speakers perceive phonemic differences categorically has been demonstrated (Liberman et al., 1957). Thus, adult listeners cannot perceive sounds that differ in the relevant acoustic cues as belonging to different categories because these acoustic cues fall within the exact perceptual boundaries.

Based on such limitations, researchers (e.g., Goldinger, 1996; Liberman et al., 1957) have concluded that adult/native listeners' perception of the speaker's production of sounds does not always reflect the L1/ L2 speaker's ability to produce the sound (Mar, 2016). As a result, several researchers (e.g., Forrest et al., 1990; Gibbon & Lee, 2017; Macken & Barton, 1980; Scobbie, 1998) have begun to use acoustic measurements in addition to adult speakers' sound identification to analyze speaker's productions. Such approaches have led researchers to discover the existence of a covert contrast in the phonological acquisition system.

The term "covert contrast" describes two different concepts. The first one refers to situations in which two phonetic categories in a language appear to be acoustically similar (impressionistically homophonous) but can be reliably distinguished at the phonetic level. For instance, some English dialects might pronounce "cot" and "caught" with the same vowel sound, but a detailed phonetic analysis might reveal a slight difference in vowel quality or duration (Kirby, 2014). This is important for understanding language acquisition and dialect variation because it can reveal underlying differences that are not immediately apparent. The second concept of "covert contrast" refers to a stage in

language acquisition when native (or adult) speakers cannot perceive a significant difference in the production of certain sounds produced by non-native (or children) speakers (Eckman et al., 2015; Macken & Barton 1980). This happens when the difference between the two productions is subtle. A classic example of covert contrast in phonology is found in Scobbie et al. (1996) who explore covert contrast as a stage in the development of speech production. They focus on acquiring the English stop voiced/voiceless /t/, /d/ contrast by monolingual children. Scobbie et al. (1996) found that even when children appeared to have merged the two sounds in their speech, detailed phonetic analysis revealed a covert contrast between them. This suggests the children were in a transitional stage in acquiring phonemic contrast. According to Scobbie (1998), covert contrasts refer to the idea that phonological systems may be acquired independently of how they are phonetically implemented. In addition, Barrow et al. (2019) define covert contrast as a consistent and quantifiable distinction between two speech sounds that remain indistinguishable to the listener. Scholars have hypothesized that this stage is intermediate between a speaker's inability to distinguish between contrasting L2 segments and the ability to phonetically implement contrasts that are sufficiently perceived by native speakers of the L2 (Eckman et al., 2015).

The existence of covert contrast supports the notion that L2 phoneme acquisition is a gradated process—that is, IL (interlanguage) may have an intermediate stage in which speakers of the L2 create systemic but not native-like contrasts before moving to the native-like stage. In addition, it supports the idea that the speech of L2 speakers should be examined by considering their production of phonological contrasts rather than just by whether the contrast is perceived as native-like by native speakers. It is important to note that the absence of evidence of covert contrast in the study sample does not indicate that this stage does not exist; instead, it is possible that the parameters used in the study could not detect covert contrast (Byune et al., 2016). In essence, covert contrast is different from overt contrast or no contrast. The idea behind the overt contrast is that an adult recognizes the contrasts that children/speakers produce, whereas in no contrast phase, an adult cannot detect any contrast editorially, nor is the contrast detected acoustically.

It has been claimed that L1/L2 speakers acquire phonemic contrast as an intermediate step, i.e., covert contrast (Eckman et al., 2014; Macken & Barton, 1980). Most prior studies have used sound identification by native listeners to determine whether an L2 speaker has acquired the production of an L2 phonemic contrast. However, listeners cannot detect the subtle covert contrasts that might fall within a single category in the speaker's L1. Therefore, in most cases, native listeners might misjudge the production of L2 speakers. The results may indicate a failure to understand and interpret the actual nature of L2 acquisition because L2 speakers might make distinctions that native listeners are not naturally able to detect on their own. Categorizing the contrast auditorily without resorting to the acoustic measurements will not accurately judge the contrast (Macken & Barton, 1980). Therefore, the current paper employs an acoustic analysis to investigate the contrast of the given phonological system.

The current paper aims to investigate the acquisition of two pairs of high Arabic vowel contrasts (/u/ and /u:/) as acquired by L2 speakers of Modern Standard Arabic (MSA) (native speakers of Filipino and Indonesian). The researchers selected these two L1 backgrounds due to their genetic similarity (Blust, 2013). Moreover, MSA is known to have approximately six monophthongal vowel phonemes, including the high back long /u:/ and short /u/ (Alotaibi & Hussain, 2010). Compared to MSA, the two L1 languages that will be considered herein have relatively small vowel inventories, and none contain short-long vowel contrast (Cruz, 2015; Soderberg & Olson, 2008). Thus, this paper aims to investigate whether L2 speakers of MSA, who are native speakers of Filipino and Indonesian, produce a covert contrast for the high vowels /u/ vs /u:/. Furthermore, it will be of interest to observe which level of proficiency (beginner or advanced) shows covert contrast. The main research questions that this paper seeks to answer are listed below.

(i) Do Arabic L2 speakers show contrast when producing Arabic high back vowels? If so, what type of contrast?

(ii) Which group of speakers (beginner or advanced) will show the covert contrast in producing the target Arabic high back vowels?

Based on the previous studies, the primary hypotheses of this study are:

H_1: Some Arabic L2 speakers may implement statistically significantly reliable acoustic distinctions between the pairs /u/ and /u:/ native speakers of Arabic do not perceive.

H_2: Beginner Arabic L2 speakers will mostly implement covert or no contrast, while advanced Arabic L2 speakers will do so overtly.

The rest of the paper proceeds as follows. Section (2) reviews the most relevant studies that have examined the phonological contrasts in several languages. Section (3) describes the method employed in the current study and the data collection procedures. Section (4) reports the results of the present study. Section (5) discusses the results of the current study and links them with the past studies. Section (6) summarizes the main results and suggests avenues for future studies.

1.2 Language Background

1.2.1 Modern Standard Arabic (MSA)

MSA is the standardized Arabic form used in formal settings across the Arab world. It is used in academic institutions, the media, education, government, literature, and the law (Ryding, 2005; Versteegh, 2014). MSA is based on CA but has evolved to incorporate new vocabulary and grammatical structures (Putten, 2020). MSA has 36 phonemes: 28 consonants, six vowels, and two diphthongs. According to some researchers, the two diphthongs are classed along with the vowels to total eight vowels (Alotaibi & Hussain, 2010). The vowel inventory of MSA consists of three short vowels (i, u, a) and three long vowels (i:, u:, a:) (see Table 1). The sounds under investigation in this study are listed in bold.

Table 1. Arabic phonemic vowel system

	Front	Central	Back
High	/i/, /i:/		/u/, /u:/
Mid			
Low		/a/, /a:/	

As pointed out in Table 1, vowel contrasts in Arabic are based on vowel quality and quantity (Alghamdi, 1998), in which the vowel length is phonemic and contrastive (Saddah, 2011). There is a clear distinction between short and long vowels, which can change the meaning of words, as in /ʕu:d/ ‘stick’ vs /ʕud/ ‘[imperative form of] come back’.

It is important to note that the Arabic, Filipino, and Indonesian languages demonstrate somewhat different vowel systems. The vowel systems of the target languages will be described in the following subsections.

1.2.2 Filipino (Tagalog)

Filipino (Tagalog), a member of the Austronesian language family, is (along with English) one of the two official languages of the Philippines. Usually spoken in metro Manila, the National Capital Region, and other urban centers of the archipelago, this is a standardized variety of Tagalog based on the native dialect (Blust, 2013). several

researchers (e.g., Schachter & Otanes, 1983; Schachter & Reid, 2018) argue that the vowel length is phonemic and contrastive. Other researchers (e.g., Cruz, 2015; Himmelmann et al., 2000; Ramos & Cena,1990), however, argue that vowel length in Filipino is not contrastive and only occurs in stressed syllables, meaning the contrastive is based on the stress, not the vowel length. Assuming that vowel length is not phonemic in Filipino, the current study investigates Filipino speakers' production of MSA as L2. There are five vowel phonemes in the present system: /a/, /e/, /i/, /o/, and /u/. These originate from a vowel system containing three vowels: /a/, a closed high vowel /i/, and a closed back vowel /u/ (Cruz, 2015), as illustrated in Table 2.

Table 2. Filipino vowel system

	Front	Central	Back
High	/i/		/u/
Mid	/e/		/o/
Low		/a/	

1.2.3 Indonesian

The Indonesian language is spoken throughout Indonesia and is the country's official language. Linguistically, the language belongs to the Austronesian language family and is classified as a standardized version of Riau Malay. There are only six short monophthongal phonemes in Indonesian, including: /i/, /u/, /e/, /ə /, /o/ and /a/. Unlike other languages (e.g., Arabic), Indonesian has no long monophthong phonemes (Soderberg & Olson, 2008), so it does not recognize vowel length distinctions as phonetic features (see Table 3).

Table 3. Indonesian vowel system

	Front	Central	Back
High	/i/		
Mid	/e/	/ə/	/o/
Low		/a/	

Based on Tables 2&3, it is expected that native speakers of Indonesian and Filipino who learn Arabic as an L2 will encounter difficulty in categorizing the contrast of Arabic vowel length that doesn't exist in their L1 in a native-like fashion (Munro & Derwing 1995). Adult speakers tend to substitute certain L2 phonological features with other features in their native systems.

2. Literature Review

This section is organized as follows. Subsection 2.1 introduces theoretical frameworks that have been proposed to explain the difficulties that L2 speakers face in acquiring L2 phonemics, such as the Speech Learning Model (SLM) and the Perception Assimilation Model (PAM). Subsection 2.2 focuses on studies that have explored covert contrast in both L1 and L2 speakers. Finally, subsection 2.3 discusses the primary acoustic cues of vowel sounds.

The production and perception of phonemic contrasts have been studied across languages, such as Arabic and Japanese (Tsukada, 2011), Japanese (Hisagi et al., 2015), Greek (Georgiou, 2018), English (Alharbi & Aljutaily, 2020), and Swahili (Alsamaani, 2021). Several previous studies have investigated the consonant contrast as it relates to adults acquiring their L2 (e.g., Caramazza et al., 1973; Eckman et al., 2014; Eckman et al., 2015) and children receiving their L1 (Altoriqi, 2021.; Li et al., 2009). Despite this, few

studies have examined vowel contrasts in L2 acquisition (Kartushina & Frauenfelder, 2014; Lengeris & Hazan, 2010; Zaltz & Segal, 2022).

Several early studies (e.g., Kartushina & Frauenfelder, 2014; Flege, 1987; Leather & James, 1991; Bohn & Flege, 1991) have made significant contributions to our understanding of L2 phonological acquisition by comparing how L2 speakers implement L2 contrasts with the production of native speakers of the L2. Kartushina and Frauenfelder (2014) examined the role of an individual's L1 in the production of L2 vowel contrasts, focusing on the acquisition of two French vowel contrasts (/ø-œ/ and /e-ɛ/) by Spanish speakers. They found that participants with better L2 perception abilities demonstrated more accurate L2 production, suggesting that L2 perception plays a crucial role in developing L2 production abilities. The study also revealed that individual differences in L1 inventory influenced L2 sound production. Notably, participants with a more variable L1 vowel inventory produced more accurate L2 vowel sounds. These works highlight the significance of the speaker's L1 and L2 perception in developing L2 phonetic production. Moreover, the speakers' realizations were neither entirely characteristic of their L1 nor L2, but rather, a 'compromise' between the two. Flege (1991) stated that the intermediate stage is that L2 speakers rely on their existing L1 phonetic categories when learning new L2 phonetic contrasts. This reliance can make it challenging for speakers to accurately perceive and produce L2 sounds that are similar but not identical to the sounds of their L1. As speakers gain more exposure and practice in the L2, their production of sounds may gradually shift toward the L2 norms. Accordingly, this has led to the formulation of at least two influential frameworks, the Speech Learning Model (SLM) (Flege, 1995) and the Perception Assimilation Model (PAM) (Best, 1995), both of which have contributed significantly to understanding why speakers struggle with the production and perception of certain L2 sounds.

2.1 Speech Learning Model (SLM)& Perception Assimilation Model (PAM)

Flege's SLM suggests that L1 and L2 sounds are perceptually interconnected, and the establishment of L2 sound categories is based on their similarity or dissimilarity to L1 sounds. In some cases, the formation of new phonetic categories for L2 sounds can be obstructed by the mechanism of equivalence classification, in which a single phonetic category of L1 encompasses two L2 sounds. This makes difficult for speakers to differentiate these sounds in both production and perception. L2 speakers have a higher likelihood of accurately producing L2 sounds that are distinct from any L1 sounds, as opposed to L2 sounds that closely resemble L1 sounds and can, therefore, be grouped into an L1 sound category. Flege (1995) also emphasized the importance of age in L2 speech learning. The model suggests that the ability to learn new phonetic contrasts declines with age as the neural plasticity necessary for learning new speech sounds decreases. However, Flege argues that this decline is not absolute, and adults can still acquire new phonetic contrasts with sufficient exposure and practice. Moreover, Flege's work highlights the role of various factors that can influence L2 speech learning, such as language use, social context, and motivation.

Several empirical studies (Flege & Eefting, 1987; Flege et al., 1995; Munro & Derwing, 1995b) support the SLM's predictions. Flege et al. (1995) explored French speakers' acquisition of English vowels. They found that French speakers who had less experience with English produced English vowels more similarly to French vowels, in comparision, French speakers who had more experience with English produced English vowels more accurately, indicating that L1 interference decreases with increased L2 exposure. In addition, Munro and Derwing (1995b) conducted a study on Chinese speakers' perception and production of English vowels. They found that the speakers' perception of English vowels was influenced by their L1, as the speakers' perception was better for vowels with no corresponding vowel in Mandarin Chinese. This result is consistent with the SLM's prediction that L2 sounds distinct from L1 sounds are more accessible for L2 speakers to perceive and produce accurately.

The Perceptual Assimilation Model (PAM), as proposed by Best (1995), posits that L2 sounds are typically perceived based on their similarities and differences from the L1 inventory, and their relative proximity to L1 sounds in the phonological space. Consequently, L2 speech sounds become perceptually assimilated to L1 segments. This model predicts that L2 speakers' ability to discriminate two L2 sounds is better when they belong to different L1 phonemic categories than when they belong to the same L1 phonemic category. Furthermore, if L2 sounds cannot be classified into any L1 phonemic category, L2 speakers' perceptual accuracy is predicted to be fair to good (Best & Tyler, 2007). One potential assimilation pattern that is predicted by PAM and relevant to the current study is single-category assimilation. This occurs when two L2 sounds are assimilated into the same L1 category, leading to poor discrimination of the L2 sounds by the speaker. Several studies (Zaltz & Segal, 2022; Hisagi et al., 2015) have demonstrated that the PAM's predictions of Single Category Assimilation patterns are accurate. These studies indicate that the L1 plays a role in vowel length perception. Particularly, if a language has a phonological distinction based on vowel length, individuals who are native speakers of that language would be more sensitive to this distinction due to their L1 experience. On the other hand, if the L1 lacks such a distinction and assimilates vowels of different lengths into a single category, discrimination between short and long vowels may be diminished. The PAM posits that discrimination is diminished when two members of a phonetic-phonemic contrast are assimilated into the same phonetic-phonological category in the speaker's L1 (Best, 1995).

The L2 participants of the current study speak Filipino and Indonesian language natively, which do not include the vowel contrasts /u:/-/u/, although they do have short vowels /u/ (Except for Indonesian which lacks /u/ altogether). Based on the SLM and the PAM, it is predicted that the current study participants will likely face challenges in distinguishing the vowel contrasts under investigation.

Recent discussions on the acquisition of L2 and L1 have focused on covert contrast to answer the larger question of whether language acquisition is a gradated or categorical process. A crucial aspect of the covert contrast stage is that it indicates that speakers recognize the presence of the L2 contrast but cannot produce it in a manner that is recognizable by native speakers of L2. Therefore, this study sought to examine if the individuals experiencing difficulties in producing the vowel contrasts in question as native-like are genuinely unable to differentiate these contrasts, or if they can distinguish them but still native listeners fail to identify them (covert contrast).

2.2 Covert Contrast

Essentially, the concept of covert contrast refers to the phenomenon in which speakers produce a statistically significant acoustic or articulatory difference, but native/adult listeners do not perceive it. Yet, the first article to discuss covert contrast as a stage of the acquisition was that by Macken and Barton (1980), who identified the stages of Voice Onset Time (VOT) acquisition to explain the types of VOT contrast. The longitudinal study by Macken and Barton (1980) examined the acquisition of American English voicing contrast by four monolingual children. According to Macken and Barton (1980) analysis of the production of their participants they stated that there are three stages of VOT acquisition for English word-initial stops: (1) No contrast: children make no distinction in VOT; (2) Covert contrast: Children are statistically significant capable of distinguishing voiced stops from their equivalent voiceless ones, yet adult speakers are not able to notice this distinction; (3) Overt contrast: Children make VOT distinctions just as adults do. Thus, these stages can be generalized to all types of sounds, including vowels.

In the years following Macken and Barton's article (1980), numerous studies have discussed the phenomenon of covert contrast in L1 and disordered speech from the consonantal level (e.g., Li et al., 2009; Altoriqi, 2021; Eckman et al. 2014; Eckman et al.

2015). Nevertheless, one of the main studies of covert contrast in L2 that has considered vowels is Song and Eckman's (2019). Song and Eckman examined the occurrence of covert contrast in the speech of Korean, Portuguese, and Spanish speakers. Since none of these languages have the tense/lax contrast, the researchers studied the production and perceptions of the high-front English vowels /i/ and /ɪ/ by the native speakers of these languages. Based on the acoustic analysis of vowel duration, F1 and F2, the results showed that all native English speakers produced an overt contrast between /i/ and /ɪ/. Among L2 speakers, more than half were found to produce covert contrasts, indicating that they attempted to differentiate the sounds, even if the differences were subtle and not easily discernible. Interestingly, a small group of participants from each language background showed progress in their ability to produce and perceive the target vowels throughout the course of the three sessions, suggesting that targeted training can effectively enhance speakers' phonological competence.

Another study was conducted by Song and Eckman (2021), who used ultrasound tongue imaging to examine whether L2 American English speakers created articulatory and acoustic distinctions when producing vowel contrasts in English (/i/-/ɪ/ and /ɛ/-/æ/). They aimed to identify the presence of such covert contrasts in the L2 English speakers with Korean and Spanish backgrounds. Their study involved 21 participants, including seven native Korean speakers, seven native Spanish speakers, and seven native English speakers as controls. The participants were recorded while producing English words that exemplify the vowel contrasts of /i/-/ɪ/ and /ɛ/-/æ/. The results revealed that in the case of the /i/–/ɪ/ contrast, seven different L2 participants presented seven potential instances of covert contrasts. Similarly, for the /ɛ/–/æ/ contrast, there were seven possible cases from seven L2 participants, all of whom were Korean speakers. Out of these 14 potential cases of covert contrasts, eight were confirmed to be instances of covert contrasts. Among the 14 L2 participants, five demonstrated covert contrasts. Of these five participants, three produced only an acoustic distinction; one participant produced solely an articulatory distinction; and another participant produced both acoustic and articulatory distinctions between the L2 vowels, which English native speakers did not perceive.

2.3 Acoustic Cues for Vowels

The investigation of covert contrast in phonetics generally involves the analysis of multiple acoustic measures. These measures aim to explore subtle differences in sound production, which cannot be perceived by listeners, but are detectable acoustically and statistically. For an in-depth examination of covert contrasts in Arabic vowels, F1, F2, and duration cues will be utilized in this study, as they are crucial to identifying and analyzing the vowel characteristics. Generally, the quality of vowels is determined by three parameters: vowel height, vowel frontness/backness, and lip roundness. A vowel can have three positions in terms of frontness/backness, so when it is produced, one of three parts of the tongue is raised: the front, the center, or the back. Furthermore, the lips can be either rounded or unrounded while producing a vowel (Georgiou, 2018).

Acoustically, the primary cue for vowel investigation is formant frequency, which is supported by various studies (e.g., Alghamdi, 1998; Peterson & Barney, 1951; Titze, 1994). According to Titze (1994), formants (i.e., F1, F2, F3) represent the acoustic reflection of the voice tract, which allows us to compare vowels with different qualities according to their frequencies. For instance, the first formant frequency (F1) fluctuates between 300–1000 Hz and is correlated with vowel height quality. As the frequency decreases, the tongue rises toward the roof of the mouth. The second formant frequency (F2) is associated with the frontness/backness of a vowel and fluctuates between 850–2500 Hz; the higher the frequency, the more front the vowel is, and vice versa. Additionally, round lips can cause lower F2 values. Vowel roundness is associated with the third formant frequency (F3). According to Gokulan et al. (2013), it is commonly observed that the first two formants, F1 and F2, are typically adequate to differentiate between vowel sounds. As supported by Kepuska and Alshaari's (2020) and Alghamdi

(1998) study, who conducted a study on vowels of Modern Standard Arabic (MSA), specifically focusing on the distinctions between short and long vowels. In their research, they utilized formants (F1 and F2) as representative measures to examine and analyze these vowel differences. Comparing formant values between short and long vowels revealed close proximity, indicating that Arabic long vowels primarily represent elongated versions of their corresponding short vowels. Similarly, Farchi et al., 2019 investigated Arabic vowels, specifically long vowels (/a:/, /i:/ and /u:/) and compared them with the short vowels (/a/, /i/, and /u/). Findings showed that long vowels are approximately twice as long as short vowels. Further, the long vowels maintained their voiced quality even with increased duration. Notably, the F2 band energy remained constant across all vowels, while the F1 band energy increased. These results enhance our understanding of Arabic vowels' acoustic characteristics regarding duration and energy distribution. Thus, the current paper analyzed Arabic vowels using duration, along with F1 and F2 formant frequencies.

Overall, the literature review reveals significant gaps in our understanding of L2 phonological acquisition, particularly during the intermediate phases of language acquisition. The connection between the acoustic features of L2 production and their phonetic transcriptions based on listener identification remains unclear. It requires further investigation, particularly in the context of covert contrasts in L2 acquisition. This paper examines covert contrasts in L2 phonology, aligning with findings in L1 acquisition and disordered speech that have received more attention thus far. Notably, most research on covert contrasts has focused on consonant acquisition, with limited exploration of vowel distinctions. Therefore, there is a need for more research on the L2 acquisition of vowels to determine if the acquisition mechanisms for vowel contrasts are similar to those for consonant contrasts.

3. Methodology

3.1 Participants

The participants voluntarily participated and signed the consent form before initiating the study. Three groups were recruited to participate. Two groups of speakers whose L1s are similar genetically (Cruz, 2015) and have no vowel length contrast, including Filipino (45 speakers) or Indonesian (39 speakers) and Arabic as their L2. They enrolled in the Institution of Teaching the Arabic Language for Non-native speakers at Qassim University, King Saud University and Princess Norah University. Additionally, three speakers of Arabic were included in the sample as a control group. The selected participants are undergraduate students and their level of education particularly that of Non-native speakers, is either at level one/two or five/six. All participants are ranging in age from 21 to 31 years old. The participants of each group of Non-native speakers (i.e., the Filipino and Indonesian speakers) were divided into two groups depending on their level of education (beginner or advanced): beginner group comprises those who are at either level one or two, whereas advanced group includes those who are at either level five or six.

3.2 Procedures and Stimuli

The data were gathered by a production task and they were collected by creating 10 actual common monosyllabic Arabic minimal pairs CVC(C) having the target vowels /u/ , /u:/ as in /ʕud/ 'imperative form of 'come back' that contrasts with /ʕu:d/ 'stick'. The reason for assigning this syllable structure is to facilitates accurate segment comparison (see Appendix A for the list of words). The list of words with the target vowels were ordered randomly and presented on the computer screen in Arabic orthography. Each participant met individually in a quiet room and seated in front of the computer screen and asked to wear a headset with built-in microphone. The participants were instructed to read each

word aloud at a normal speech rate twice. Then, their productions were recorded at a sampling rate of 44.1 kHz and segmented by Praat (Boersma & Weenink, 2005), making them ready for scrutinizing acoustic correlates.

3.3 Segmentation of Vowels and Acoustic Analysis

The study used an acoustic analysis to analyze the vowel contrasts, using the relevant acoustic cues (i.e., F1, F2, vowel duration). We first recorded all the words with the target vowels produced by the participants by using Praat. Then, we divided the recording files for each participant into smaller files, consisting of a word with the target vowel extracted from the word, to create a TextGrid and start the acoustic analysis. The values of the acoustic measurements were taken automatically by a Praat script. Lastly, the measurements were exported to an Excel spreadsheet for later statistical analysis. Thus, approximately 1680 tokens were targeted in this paper (i.e., 10 words × 84 participants × 2 repetitions for each).

Segmentation was conducted manually based on the visual display of the spectrogram and oscillogram. In segmentation, the vowel onset was defined as the time when on the spectrogram pitch and F2 appear clearly. Vowel offset was defined as when F2 ceases to exist or is greatly reduced in strength. Vowel boundaries were placed when the oscillogram showed a nearly regular frequency to avoid the influence of consonants surrounding the vowel. An example of vowel segmentation is shown in **Error! Reference source not found.**.

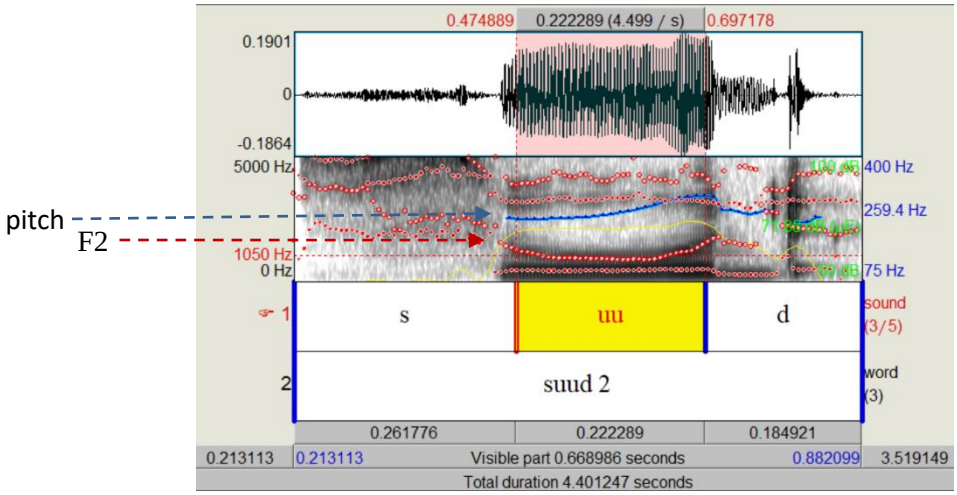

Figure 1. Segmentation of the /u:/ in the word /su:d/ ‘plural of black’

After segmenting all audio files (1680 files), the duration of the vowel (in milliseconds) and the frequency of the first and second formants (F1 and F2) were measured. Measurements of vowel formants were taken at the midpoint of each vowel’s production, where consonants surrounding the vowel were considered minimally influential.

3.4 Scoring of Sound Identification Data

Three native-speaker who are specialists in the Arabic language were recruited to produce reliable sound identification. The recorded words that included the target vowels from every participant were played to the native identifiers for sound identification. Prior to the sound identification, the native identifiers were given answer sheets numbered with the items and instructed to write down exactly what sound they heard, without attempting to guess what the speaker intended to produce. The vowels in each word were identified by each native identifier, giving three identified sounds for each token. The identified sound for each token must be agreed upon by at least two of the three native identifiers.

An 80% threshold was employed to determine whether an L2 speaker consistently produced the vowel contrast according to sound identification by native identifiers. That is, an L2 speaker was considered to have vowel contrast only if at least 80% of the target vowel were perceived correctly by native identifiers. If the native-like production fails to meet the 80% threshold for one or both vowels, the participant's IL (interlanguage) was defined as lacking contrast. Based on the analysis of the 80% threshold, participants were categorized as either "having contrast" (achieving 80% or higher on both contrasting vowels) or "having no contrast" (scoring below 80% on one of the contrasting vowels). **Error! Reference source not found.** illustrates this point more clearly (Eckman et al., 2014; Mar, 2016; Olson, 2022). By adhering to this established criterion, we ensure the reliability and validity of this methodology, enabling meaningful comparisons with existing literature.

Table 4. Classifying the participants as having contrast or No contrast based on the sound identification

/u/ (5 words)	/u:/ (5 words)	Having the vowel contrast
Above 80%	Above 80%	Yes
Below 80%	Above 80%	No
Above 80%	Below 80%	No
Below 80%	Below 80%	No

The calculation for the percentage of native listeners identification was conducted by taking the number of correctly identified words, multiplying that number by 100, and then dividing the result by 10, which corresponds to the total number of words that represent the target vowel. A Fleiss' Kappa coefficient of 0.886 indicates high reliability in identifying vowel sounds across all three native identifiers.

3.5 Statistical Procedures

In addressing the research questions, two statistical tests were employed. We employed a paired-sample t-test to answer Q1 by using IBM SPSS statistics for Mac with a significant level set as $p < .05$ to determine if a participant produced a statistically significant, reliable distinction in acoustic variables between /u/ and /u:/. First, we calculated the mean of each acoustic measure (i.e., F1, F2, vowel duration) of each vowel, /u/ and /u:/, for each individual. Then, a paired-sample t-test was used to compare the mean of acoustic measures for /u/ with the mean of /u:/ measurements.

Participants are considered to have produced an acoustic distinction if the results display any significant acoustic results in any of the target cues (i.e., F1, F2 and vowel duration). Native listeners' identification of sounds and statistically significant results from the acoustic data were combined to determine the type of contrast (i.e., overt, covert, No contrast). Three possible outcomes are suggested by statistical acoustic data and native listeners' identification: 1. Overt Contrast: When both native listeners' identification and statistical acoustic data indicate contrast. 2. Covert Contrast: If native listeners perceive no contrast, but statistical acoustic data indicates contrast. 3. No Contrast: when both native listeners' identification and statistical acoustic data confirm no contrast. Table 5 illustrates these outcomes.

Table 5. Classifying the participants as having contrast or No contrast based on the sound identification

Identification contrast	Acoustic contrast	Type of contrast
No	No	No contrast
No	Yes	Covert contrast
Yes	Yes	Overt contrast

The second statistical test (Chi-Squared test) was employed to answer the Q2. To accomplish this, the participants were divided into two groups based on their level of education (beginner or advanced). Then, a chi-squared test was conducted to determine if the presence of covert contrast was associated with a specific group for the two vowel contrasts (/u/ vs /u:/). The analyses were conducted using the software package R for statistical computing. If the Chi-squared test indicates a significant relationship between these groups, a bar chart would be used to illustrate the results. An analysis of this chart aims to visualize the distribution of data and enable an intuitive understanding of which group is associated with covert contrast. The beginner group consisted of 42 participants enrolled in levels one or two, and the advanced group consisted of 42 participants enrolled in levels five or six.

4. Results

As explicitly mentioned earlier, the goal of the current study is to investigate the acquisition of two pairs of high back Arabic vowel contrasts (/u/ and /u:/) as acquired by L2 speakers of Modern Standard Arabic (MSA) (native speakers of Filipino and Indonesian). This section is divided into two main subsections. Subsection (4.1) lays out the overall results of the existence of covert contrast in the vowel production of L2 speakers. Subsection (4.2) presents the association between the educational level and realization of the pair contrasts.

4.1 The Existence of Covert Contrast in the pairs of /u, u:/

This section postulates the existence of covert contrast among, control group, Filipino and Indonesian L2 MSA speakers. The two contrasting vowel pairs (/u/ vs /u:/) are analyzed individually, with each section commencing with an examination of the identification results, followed by the acoustic results specific to each respective native language (NL) background. To begin with the results of the control speakers, as we expected that the speakers exhibited clear distinctions between /u/ and /u:/. Table 5 displays the mean values of acoustic measurements as produced by the native Arabic speakers (control group). Both identifications task and acoustic measurements confirmed the overt contrast in their production, as presented in Table 6.

Table 5. Mean values and SD of acoustic measurements of the target vowel pairs by control group

F1		F2		Vowel Duration	
/u/	/u:/	/u/	/u:/	/u/	/u:/
456.8 (110.8)	432.30 (70.2)	1746.9 (293.3)	964.9 (206.7)	.0739 (0.19)	.1878 (.039)

Based on Table 5, each control participant consistently produced target-like renditions of /u/ vs. /u:/ accurately and the control speakers identified and produced each pair with a 100 % accuracy rate. This is clearly appeared from their values in which their acoustic means values unveiled substantial and statistically significant discrepancies in F1, F2, and

vowel duration between vowel pairs contrasts ($p < .001$). Thus, as anticipated, each of the native-speaking controls demonstrated an overt contrast between /u/ and /u:/.

4.1.1 The Existence of Covert Contrast among Indonesian speakers of /u/ vs. /u:/

The outcomes of t-test analyses were conducted to compare the means of the acoustic attributes of /u/ and /u:/ among Indonesian speakers. These findings were combined with the results of native identification. Table 6 demonstrates these findings. The shaded part represents beginner group, while latter part represents the advanced group.

Table 6. Results of Indonesian speakers for /u/ and /u:/

Indonesian Speakers	Native Identification Results	Acoustic Measures with Statistical Results			Type of Contrast
	Contrast /u/, /u:/	F1	F2	Vowel Duration	
S29MIB	No	P= .752	P= .092	P= .160	No Contrast
S33MIB	No	P= .655	P= .453	P= .287	No Contrast
S24MIB	No	P= .903	P= .025*	P= .015*	Covert
S16MIB	No	P= .121	P= .000*	P= .000*	Covert
S27MIB	No	P= .921	P= .003*	P= .003*	Covert
S28MIB	No	P= .454	P= .010*	P= .148	Covert
S31MIB	No	P= .025*	P= .030*	P= .122	Covert
S34MIB	No	P= .004*	P= .014*	P= .000*	Covert
S6MIB	Yes	P= .001*	P= .012*	P= .000*	Overt
S19MIB	Yes	P= .546	P= .315	P= .000*	Overt
S20MIB	Yes	P= .047*	P= .009*	P= .000*	Overt
S25MIB	Yes	P= .001*	P= .001*	P= .000*	Overt
S30MIB	Yes	P= .004*	P= .001*	P= .000*	Overt
S32MIB	Yes	P= .016*	P= .028*	P= .000*	Overt
S17MIA	No	P= .242	P= .348	P= .009*	Covert
S18MIA	No	P= .069	P= .002*	P= .000*	Covert
S21MIA	No	P= .256	P= .088	P= .025*	Covert
S50FIA	No	P= .039*	P= .003*	P= .022*	Covert
S55FIA	No	P= .511	P= .554	P= .001*	Covert
S4MIA	Yes	P= .727	P= .841	P= .000*	Overt
S5MIA	Yes	P= .070	P= .835	P= .000*	Overt
S7MIA	Yes	P= .481	P= .011*	P= .000*	Overt
S8MIA	Yes	P= .021*	P= .000*	P= .000*	Overt
S9MIA	Yes	P= .310	P= .575	P= .000*	Overt
S10MIA	Yes	P= .487	P= .000*	P= .000*	Overt
S11MIA	Yes	P= .183	P= .002*	P= .000*	Overt
S12MIA	Yes	P= .854	P= .016*	P= .000*	Overt

S13MIA	Yes	P= .003*	P= .002*	P= .000*	Overt
S14MIA	Yes	P= .028*	P= .000*	P= .000*	Overt
S15MIA	Yes	P= .414	P= .060	P= .000*	Overt
S22MIA	Yes	P= .133	P= .142	P= .000*	Overt
S23MIA	Yes	P= .052*	P= .003*	P= .000*	Overt
S48FIA	Yes	P= .048*	P= .668	P= .000*	Overt
S49FIA	Yes	P= .007*	P= .018*	P= .000*	Overt
S51FIA	Yes	P= .272	P= .002*	P= .002*	Overt
S52FIA	Yes	P= .015*	P= .000*	P= .000*	Overt
S53FIA	Yes	P= .058	P= .137	P= .000*	Overt
S54FIA	Yes	P= .002*	P= .304	P= .000*	Overt

In case of the contrast between short and long vowel /u, u:/ as found in the identification task, it is evident that 34% of Indonesian speakers showed no contrast and 64 % showed the contrast between the pairs /u/ and /u:/. However, the statistical results of the means of acoustic cues of Indonesian speakers showed different contrast in their vowel production of /u/ -/u:/. Only 3 speakers from the beginner group showed no contrast, and 11 speakers displayed covert contrast (6 from beginners and 5 from advanced speakers). Interestingly, the majority of Indonesian speakers overtly contrast the vowel pairs in which 19 belongs to the advanced group, while 6 speakers from beginners. Although both vowel pairs /u, u:/ do not appear in their phonological system, they succeed in achieving them in a native-like manner. In sum, Indonesian speakers who exhibited overt contrast consistently demonstrated a statistically reliable distinction between /u/ and /u:/ in vowel duration. In contrast, participants with covert contrast displayed variability in their acoustic distinctions, with some showing a statistically reliable distinction in F2, while others exhibited a statistically reliable distinction in F1 and F2.

4.1.2 The Existence of Covert Contrast among Filipino speakers of /u/ vs. /u:/

Table 7. Results of Filipino speakers for /u/ and /u:/

Filipino Speakers	Native Identification Results	Acoustic Measures with Statistical Results			Type of Contrast
	Contrast /u/, /u:/	F1	F2	Vowel Duration	
S79FFB	No	P= .883	P= .902	P= .091	No Contrast
S81FFB	No	P= .560	P= .882	P= .309	No Contrast
S82FFB	No	P= .771	P= .382	P= .174	No Contrast
S57FFB	No	P= .134	P= .051*	P= .028*	Covert
S68FFB	No	P= .000*	P= .004*	P= .000*	Covert
S70FFB	No	P= .003*	P= .022*	P= .001*	Covert
S71FFB	No	P= .401	P= .029*	P= .000*	Covert
S72FFB	No	P= .714	P= .000*	P= .000*	Covert
S73FFB	No	P= .130	P= .081*	P= .000*	Covert
S74FFB	No	P= .103	P= .106	P= .000*	Covert
S75FFB	No	P= .049*	P= .011*	P= .021*	Covert

S76FFB	No	P= .351	P= .045*	P= .001*	Covert
S77FFB	No	P= .483	P= .088	P= .002*	Covert
S78FFB	No	P= .174	P= .004*	P= .000*	Covert
S80FFB	No	P= .007*	P= .028*	P= .000*	Covert
S84FFB	No	P= .479	P= .011*	P= .000*	Covert
S86FFB	No	P= .048*	P= .251	P= .553	Covert
S87FFB	No	P= .931	P= .524	P= .005*	Covert
S35MFB	Yes	P=.003*	P= .001*	P= .000*	Overt
S36MFB	Yes	P= .015*	P= .122	P= .000 *	Overt
S65FFB	Yes	P= .362	P= .029*	P= .000*	Overt
S66FFB	Yes	P= .000*	P= .000*	P= .000*	Overt
S80FFB	Yes	P= .042*	P= .009*	P= .003*	Overt
S83FFB	Yes	P= .066	P= .018*	P= .000*	Overt
S85FFB	Yes	P= .125	P= .002*	P= .000*	Overt
S62FFA	No	P= .772	P= .133	P= .179	No Contrast
S42MFA	No	P= .620	P= .032*	P= .001*	Covert
S63FFA	No	P= .026*	P= .990	P= .464	Covert
S37MFA	Yes	P= .000*	P= .000*	P= .000*	Overt
S38MFA	Yes	P= .001*	P= .001*	P= .000*	Overt
S39MFA	Yes	P= .001*	P= .000*	P= .000*	Overt
S40MFA	Yes	P= .003*	P= .006*	P= .000*	Overt
S41MFA	Yes	P= .074	P= .000*	P= .000*	Overt
S43MFA	Yes	P= .051*	P= .000*	P= .000*	Overt
S44MFA	Yes	P= .054*	P= .003*	P= .000*	Overt
S45MFA	Yes	P= .014*	P= .558	P= .000*	Overt
S46MFA	Yes	P= .010*	P= .012*	P= .000*	Overt
S47MFA	Yes	P= .061	P= .002*	P= .000*	Overt
S46MFA	Yes	P= .004*	P= .000*	P= .000*	Overt
S47MFA	Yes	P= .002*	P= .001*	P= .000*	Overt
S56FFA	Yes	P= .006*	P= .156	P= .000*	Overt
S58FFA	Yes	P= .000*	P= .081	P= .000*	Overt
S59FFA	Yes	P= .000*	P= .000*	P= .000*	Overt
S60FFA	Yes	P= .000*	P= .001*	P= .000*	Overt
S61FFA	Yes	P= .047*	P= .146	P= .001*	Overt

The identification results showed that the contrast between short and long vowel /u, u:/ are that 45% of Filipino speakers showed no contrast and 55 % showed the contrast between the pairs /u/ and /u:/. The Filipino speakers showed a higher percentage in

producing the contrast compared to the Indonesian speakers and this is because they are familiar with this vowel quality as they have /u/ in their L1 vowel inventory. In terms of the statistical results of the means of acoustic cues, 3 beginners and 1 advanced Filipino speaker showed no contrast, and 17 speakers displayed covert contrast (15 from beginners and 2 from advanced speakers). The majority of advanced Filipino speakers showed the contrast overtly, while the majority of the beginners showed covert in producing the vowel pairs. This result aligns with the Hypothesis 2 that states that the beginners group will mostly implement covert contrast or no contrast, while advanced speakers will overtly show the contrast. The Filipino speakers displayed a statistically reliable distinction in all three acoustic variables with overt contrast, whereas they mostly exhibited a statistically reliable distinction in F2 and vowel duration with covert contrast. Thus, the shared characteristic among participants who demonstrated overt or covert contrast was the presence of a statistically reliable distinction between /u/ and /u:/ in terms of vowel duration.

To summarize 4.1, The most relied-upon acoustic feature to distinguish /u/ and /u:/ contrasts was vowel duration, with nearly all speakers showing statistically significant results for this measure, irrespective of whether they demonstrated covert or overt contrast. As for the secondary acoustic measurements, it was observed that for the /u/-/u:/ contrast, F2 was the primary distinguishing factor employed by the speakers. These findings highlight the significance of vowel duration as a consistent acoustic cue in both contrast types, alongside the varying importance of F1 and F2 based on the specific vowel contrast.

4.2 The Effect of Education Level on the realization of /u/ vs. /u:/

This section presents the results of chi-square analyses conducted on a combined sample of Filipinos and Indonesians (a total of 84 participants; 42 beginner level, 42 advanced level) to investigate the relationship between education level (independent variable) and the presence of covert contrast (dependent variable) of the vowel pairs contrasts (u vs. u:), addressing the second research question. The initial chi-squared analysis explored the correlation between education levels (beginner and advanced) and covert contrast. This test will provide a more detailed analysis of the distribution of covert contrast presence across education levels and gain deeper insights into which level (beginner or advanced) is associated with covert contrast. Based on the chi-squared analysis, we hypothesized that the educational levels of L2 speakers may associate with the presence of covert contrast (i.e., a stage in the development of speech production) in target vowel production (i.e., u vs. u:). That is, the lack of contrast or the presence of the covert contrast appeared more frequently with speakers at first or second level (beginner group), while advanced speakers (at five or six level) show frequently the overt contrast. Chi-squared analysis with Yates' continuity correction[3] confirmed the hypothesis by identifying a statistically significant relationship between education levels and the presence of covert contrast as shown in table 8.

Table 8. Frequencies and Chi-square test of presence of covert contrast in /u/ & /u:/ across beginner and advanced participants (N =84)

Group	Percentage of Covert Contrast		χ^2	df
	N	%		
Beginner Speakers	20	47.62%	7.8596	1
Advanced Speakers	7	17.07%		

[3] A Yates' continuity correction is often applied when dealing with 2x2 contingency tables to account for small sample sizes. However, in this case it did not change the overall conclusion, which still indicates a significant association between the two categorical variables.

Table 8 illustrated that among Beginner speakers, the presence of covert contrast is notably higher compared to Advanced speakers, indicating a significant association between the Beginner group and covert contrast in the /u/ vs. /u:/ contrast. The Beginner group exhibits 47.62% covert contrast, while the Advanced group exhibits 17.07%, suggesting that the presence of covert contrast decreases as proficiency levels increase from Beginner to Advanced. These results affirm a statistically significant association between educational levels (Beginners and Advanced) and the presence or absence of covert contrast. According to Cramer's V, the effect size was approximately 0.342, indicating a moderate and statistically significant association. This effect size indicates a significant and discernible correlation, even though it is not exceptionally strong.

5. Discussion

The concept of covert contrast as a stage of the acquisition was first discussed by Macken and Barton (1980). It refers to the phenomenon in which a speaker produces a statistically significant acoustic difference, but native/adult listeners do not perceive it. Macken and Barton identified the stages of acquisition including three types of contrast: 1. No contrast: speakers make no contrast; 2. Covert contrast: speakers are statistically significant capable of distinguishing the contrast, but adult L2 native speakers are not able to notice this distinction; 3. Overt contrast: speakers make distinctions in a native-like manner. The current study examined the acquisition of contrast of the Arabic high back vowel (/u/ and /u:/) as acquired by L2 speakers of Arabic (native speakers of Filipino and Indonesian). The L1 of the participants lack the vowel length contrast in their phonological systems. The SLM model (Flege, 1987) and PAM model (Best, 1995) suggest that L1 and L2 sounds are perceptually interconnected, and the establishment of L2 sound categories is based on their similarity or dissimilarity to L1 sounds. This makes it difficult for speakers to differentiate these sounds in both production and perception. L2 speakers have a higher likelihood of accurately producing L2 sounds that are distinct from any L1 sounds, as opposed to L2 sounds that closely resemble L1 sounds and can, therefore, be grouped into an L1 sound category. Acoustically, the short and long vowels in Arabic are almost similar in their spectral characteristics, but different in duration, in which the long one is more than twice the length of the short vowel (Farchi et al., 2019). Accordingly, it is predicted that the L2 speakers of the current study are likely to face challenges in distinguishing the vowel contrast of /u/ and /u:/ that don’t exist in their L1s (Zaltz & Segal, 2022).

The results reported that the participants displayed varying degrees of contrast in their vowel realization of /u/ and /u:/, including No contrast, covert, and overt contrast. The participants displayed only six cases of (No contrast) that occurred mostly among the Indonesian speakers, and this is expected since Indonesian participants lack this kind of vowel quality /u, u:/ in their phonological systems. As for the covert contrast, when comparing the two groups (Indonesian and Filipino) in the presence of the covert contrast, the highest frequency to the covert contrast would be observed to occur amongst the Filipino group, at 37 %, compared to 28 % for the Indonesian group. The high rate of covert contrast appeared among Filipino participants is expected since they are familiar with the vowel quality /u/, and thus indicating that they were attempting to differentiate the vowels, even if the differences were subtle and not easily discernible auditorily. Another possible explanation towards this result is that most Filipino speakers had an early childhood exposure to Arabic, particularly through Quran recitation. Given the Quran’s intricate rules, many of which hinge on the duration of vowels, participants may have internalized a heightened focus on vowel duration. Accordingly, these results aligned with the assumption of Interlanguage theory (IL) as developed by Selinker (1972). This theory highlighted the role of speakers’ L1 in shaping their L1, suggesting that the participants of the current study were trying to develop a unique and dynamic linguistic system as they attempt to acquire the L2. Thus, in this case, the IL system is

seen as transitional (Tarone, 2018), meaning that speakers' linguistic knowledge and abilities are in a state of constant flux and development as they progress toward the acquisition of Arabic vowel distinction. The result also resonates with the principles of SLM (Flege, 1995), emphasizing the significance and influence of exposure to an L2 and aligns with the idea that the positive impact of early language exposure. Regarding the overt contrast (making vowel distinctions just as native-like fashion), the current results are consistent with the study of Song and Eckman's (2019) in which more than half of the current participants from each language background were found to produce an overt contrast between /u/ and /u:/. Contrary to the results of the presence of the covert contrast, the highest percentages of realizing these vowels overtly occurred among the Indonesian speakers (64%) compared to the Filipino group (53%). Although the vowels /u, u:/ are absent in the vowel system of Indonesian, they outperformed the Filipino speakers in realizing the vowel distinctions overtly. One presumed justification to their performance comes from the fact that the perception of the L2 speakers is better for vowels that had no corresponding vowel in L1 (Munro and Derwing, 1995b). This made the Indonesian speakers, with no corresponding vowel, performed with a higher percentage than Filipino speakers. This result may be consistent with the prediction of SLM in which a new sound of L2 that is different from L1 would be easier for L2 speakers to perceive and produce accurately (Flege, 1995).

The means of the target acoustic cues (F1, F2, vowel duration) were measured and displayed that the vowel pairs (/u/, /u:/) vary in their means of acoustic parameters. Some participants produced the contrast of the vowel pairs with some overlapping acoustic cues. Since the L1 of the current participants lack this contrast, some speakers tried to accommodate these vowel pairs to the acoustically closer sound of their L1, indicating that the participants showed 'No contrast'. This also indicates that the participants encountered difficulty in recognizing spectral features of the vowel pairs. The t-test confirmed that there was not a significant difference between the means of acoustic value of /u/ and /u:/. However, we observed the covert contrast in realizing the vowel contrasts among both groups of participants, particularly when at least one acoustic parameter shows a significant difference. Therefore, our findings are compatible with the conclusion reported in the study of Georgiou (2022), which reported that the speakers consistently employed durational cues to distinguish Arabic /u/- /u:/. The duration vowel was the predominant cue, compared to F1 and F2. Our participants employed different durations to realize /u/ and /u:/ and they displayed that they are aware of the durational differences between the two Arabic vowels. This finding is in line with some studies that reported similar conclusions in other languages (e.g., Spanish (Escudero & Boersma, 2004), Greek (Georgiou, 2022), which reported that speakers use durational parameter to differentiate between the short vowel and its long counterpart.

With respect to the question of which group of speakers (beginner vs. advanced) shows the covert contrast frequently in the vowel pairs /u/ and /u:/, our findings indicated that the educational level playing a significant role in presence of the covert contrast when producing the vowel distinction. As expected, the beginner Arabic L2 speakers mostly implement covert contrast or no contrast in distinguishing the contrast between /u/ and /u:/, while advanced Arabic L2 speakers mostly do so overtly, indicating a decline in covert contrast occurrence as proficiency levels advance. This relationship implies that as speakers progress from beginner to advanced levels, they exhibit a systematic progression from no contrast to covert contrast to overt contrast in their production. Consequently, the results support the notion that covert contrast represents an intermediate stage in the acquisition process. This is asserted by empiricist theories in which language acquisition is predominantly influenced by environmental factors, including exposure to language and social interactions. Based on the Speech Learning Model (Flege, 1995), both adult and young speakers have the ability to learn the language in a native-like manner, but with disparate degrees of learning ease. Therefore, we assume that the advanced group was exposed to Arabic and had a great amount of input more than the beginner

participants, leading that the advanced participants succeeded in realizing the contrast overtly, at 42%, compared to 15% for beginner group. The evidence substantiating this claim is twofold. First, it is observed that the majority of L2 speakers, in the current paper, exhibiting no or covert contrast stages are beginners, whereas most advanced speakers demonstrate overt contrast. Secondly, participants show a tendency to produce a greater number of acoustic distinctions as they transition from a stage of no contrast to covert contrast, and eventually to overt contrast. Specifically, participants displaying no contrast between the contrasting target vowels fail to make significant distinctions in any of the three acoustic measures. In contrast, those designated as demonstrating covert contrast typically make significant distinctions in one or two acoustic measures. Meanwhile, the majority of participants demonstrating overt contrast show significant distinctions in all three acoustic measures (38 cases), followed by those exhibiting distinctions in two measures (31 cases). In sum, participants demonstrating overt contrast tend to exhibit more acoustic distinctions between the contrasting vowels in question compared to those displaying covert contrast. Based on this body of evidence, this paper strongly suggests that covert contrast is an intermediate stage in the acquisition process. This assertion is in line with the consistent findings of prior studies conducted by Eckman et al. (2014), Eckman et al. (2015), Macken and Barton (1980), Mar (2016), Song and Eckman (2019), and Song and Eckman (2021). In sum, the current results asserted that a covert contrast stage is not merely a potential phase in acquiring L2 phonemic contrast; rather, it appears to be a necessary step in the overall acquisition process of various grammatical constructions and concepts. For instance, the progression from basic verb conjugation to advanced tenses as documented by Gass and Selinker (2008) demonstrated that an English speaker initially master present tense when expressing past actions, but the speaker achieves proficiency over time with practice. Thus, it could be concluded that results of the educational level effect in the current study fully supported our hypothesis, which states that the covert contrast is observed more frequently among the beginner participants than advanced participants.

6. Conclusions

This paper empirically explores covert contrast, specifically focusing on vowel length contrast, in the production of long/short MSA vowel pairs (/u/-/u:/) among native speakers of Indonesian and Filipino. The data were collected by recording sounds while speakers read aloud the target words involving the target vowels. Through a combination of acoustic analysis and native speakers' identification, this paper extensively examined the production of MSA vowels among 84 L2 MSA speakers, revealing intriguing findings. The results shows that the vowel duration is the reliable acoustic cue that speakers rely on, compared to the other acoustics (i.e., F1 and F2). The current results also align with a broader conclusion suggesting that covert contrast may inherently characterize L2 phonological acquisition, akin to the acquisition of contrasts in L1. Thus, supporting the notion that covert contrast is an integral component of the phonological acquisition process. Moreover, the findings support the idea that covert contrast serves as an intermediate stage in L2 phonology. Additionally, they highlight the impact of diverse NL backgrounds and the amount of exposure on L2 phoneme production, particularly influencing error-prone productions.

The present findings align with one of the principles of SLM (Flege, 1995), in which the amount of exposure may facilitate the L2 sound production; thus, the speakers of the advanced level of Arabic classes demonstrated a high percentage of an overt contrast of Arabic vowels than the speakers of beginner level who are mostly displayed no or covert contrast of the target Arabic vowels. In sum, the results expand our comprehension of the mechanisms through which phonological contrasts are acquired in L2 speakers. Additionally, the findings assert that a stage of covert contrast is not merely a possible

phase in the acquisition of L2 phonemic distinctions but is, in fact, a necessary step in the overall acquisition process.

However, the current study subjects to certain limitations. First, the method of collecting sounds through word reading may introduce orthographic influences on observed errors. Future studies are encouraged to employ interview methods to capture authentic L2 MSA speaker production in real conversations, minimizing potential orthographic considerations. Second, it is advisable to adopt a longitudinal design, focusing on individual progress. This approach would provide a more in-depth and nuanced understanding of how contrast stages develop over time for each participant, acknowledging the potential variability and individual differences in the acquisition process.

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