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Foot duration and polysyllabic shortening among Arab speakers of English

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ABSTRACT: This study investigates a neglected aspect of second language acquisition. It compares the timing patterns adopted by speakers of English as a foreign language with those of English native speakers. The paper aims to explore the extent to which Arab speakers, whose L1 is not as stress-timed as English is, can acquire the mechanisms of polysyllabic shortening in English. Three groups (English native speakers and two groups of Jordanian speakers of English) were requested to read three sets of monosyllabic, disyllabic and trisyllabic words in a carrier sentence. The total length of the word and the vowel duration in all the words were measured. Clear differences between the native speaker group and the non-native speaker groups were attested. Results show that isochronous foot duration and polysyllabic shortening are a tendency in English speech timing, rather than a fundamental process. Furthermore, acquiring the timing patterns of the stress-timed English rhythm is challenging to Arab speakers.

Key words: Polysyllabic shortening, timing patterns, rhythm, Arabic, English as a second language.

RESUMEN: *Duración del pie y acortamiento polisilábico entre los hablantes árabes de inglés*.– Este estudio investiga un aspecto poco abordado de la adquisición de una segunda lengua. Compara los patrones temporales adoptados por los hablantes de inglés como lengua extranjera con aquellos propios de los anglohablantes nativos. El objetivo del artículo es averiguar la medida en la que los locutores árabes –cuya L1 no es acentualmente acompasada como lo es el inglés– pueden adquirir los mecanismos del acortamiento polisilábico de esta lengua. Se pidió a tres grupos de hablantes (uno de anglohablantes nativos y dos de hablantes jordanos de inglés) que leyeran tres conjuntos de palabras monosílabas, disílabas y trisílabas en una frase portadora. Se midió la longitud total de la palabra y la duración de la vocal en todas esas palabras, y se hallaron claras diferencias entre el grupo de hablantes nativos y los dos de no nativos. Los resultados ponen de manifiesto que en la temporización del habla en inglés la duración isócrona del pie y el acortamiento polisilábico constituyen más una tendencia que un proceso fundamental. Además, se comprueba que la adquisición de los patrones temporales del ritmo acentualmente acompasado del inglés es un desafío para los hablantes árabes.

Palabras clave: Acortamiento polisilábico, patrones temporales, ritmo, árabe, inglés como segunda lengua.

1. INTRODUCTION

The acquisition of second language (L2) prosody is of crucial importance for intelligibility and perceptions of foreign accentedness (Flege, Munro, & MacKay, 1995; Tajima, Port, & Dalby, 1997; White & Mattys, 2007). One neglected aspect of L2 prosody is polysyllabic shortening (PS). PS refers to the phenomenon where vowels, especially stressed vowels, become shorter the more syllables are added to the stem, e.g., the vowel in 'stick' is longer than the vowel in 'sticky' (Lehiste, 1972). This contributes to the perception of a stress-timed rhythm where interstress intervals tend to be regular (Lehiste, 1977; Kim & Cole, 2005; see Turk, 2012, for more details).

Unlike the well-established PS in English, little is known about it in Arabic, which does not seem to use it as much as English does. Most earlier research on the development of the interlanguage (IL) of Arab learners of English focused on segmental aspects and to a lesser degree on suprasegmental aspects including syllable structure, stress, and intonation; however, to the best of our knowledge, no study has tackled PS in the IL of Arab learners. How PS is used by speakers whose first language (L1) is syllable-timed (like Arabic) where PS does not seem to be as evident as in stress-timed languages such as English (see Abu Guba, Mashaqba & Huneety, 2023b) is not clear. We therefore predict that Arab speakers of English will not apply the same degree of PS adopted by English speakers.

The importance of investigating phenomena such as PS is threefold. First, speech timing contributes to making speech more understandable (Ordin & Polyanskaya, 2014; Turk & Shattuck-Hufnagel, 2013). Second, it plays a crucial role in the perception of a foreign accent as lack of durational variation results in a perception of foreign-accentedness (Polyanskaya, Ordin, & Ulbrich, 2013). It has been reported that Jordanian Arab teachers of English were perceived to speak with a fairly strong foreign accent, despite their long experience and use of English (e.g., Abu Guba, Mashaqba, Hneety, & Hajeid, 2021; Abu Guba, Daoud & Jarbou, 2023). One reason behind this could be the lack of durational variation and PS in their speech. Third, acquiring English rhythmic patterns constitutes a major challenge to English learners including those whose L1 is stress-timed with high durational variability (Ordin, Polyanskaya, & Ulbrich, 2011). This study therefore aims to explore the extent to which non-native speakers (NNSs) of English whose L1 is not as stress-timed as English will acquire the mechanisms of PS. The study is thus intended to be a contribution to the study of IL rhythm. It will shed light on the development of PS and the extent to which it is transferable (cf. Ordin & Polyanskaya, 2014). This will enhance our understanding of speech rhythm in general and its interactions in L1 and L2.

The present study will attempt to answer the following questions:

1. How similar is foot duration as produced by English native speakers (NSs) and Arab NNSs? To what extent is foot duration commensurate with the number of segments and syllables among English NSs and NNSs?
2. To what extent do English NSs and NNSs employ PS?

It is expected that foot duration produced by NNSs will be different from that of NSs; the higher the level of the NNSs, the more native-like their performance will be. Also, it is more likely that foot duration among the NNSs will depend on the number of segments and syllables within a foot.

2. BACKGROUND

Earlier studies on PS in English found that stressed syllables tend to become shorter the more syllables are added to the stem (e.g., Lehiste, 1972; Port, 1981; White & Turk, 2010). It was also found that PS was more evident in pitch-accented vowels than unaccented ones (e.g., Kim & Cole, 2005; White & Turk, 2010). This type of shortening was generally believed to be a component of the stress-timed rhythm of English in that it results in more similar foot duration with regular timing between interstress intervals (Lehiste, 1972; Port, 1981).

However, other researchers argued that vowel shortening could also be related to several factors including word-initial/final lengthening, accentual lengthening, and demarcating prosodic boundaries (Beckman & Edwards, 1990; Turk & White, 1999; Turk & Shattuck-Hufnagel, 2000; White & Turk, 2010). Syllables in word-initial position tend to be longer than their counterparts in non-initial position. For example, the diphthong in the monosyllabic word 'choir' will be longer than that in 'acquire', all other things being equal, due to the effects of initial lengthening. Similarly, final lengthening could increase the duration of the vowel in the monosyllabic word 'tune', when it is word-final, but not in the disyllable 'tuna', as the long vowel will not be in word-final position and therefore less affected by final lengthening (Turk & Shattuck-Hufnagel, 2000).

Accentual lengthening, where segments receiving a pitch-accent/phrasal stress undergo lengthening (White & Turk, 2010), is greater in a monosyllable than in a disyllable, as in 'knee' and 'kneecap' (Turk & White, 1999). Furthermore, Turk and Shattuck-Hufnagel (2000) reported that PS was greater in pitch-accented words, an indication that accentual lengthening and PS are interrelated. White and Turk (2010) suggested that PS observed in polysyllabic words might result from different degrees of accentual lengthening where it is highest in monosyllables but attenuates in polysyllabic words. A third possible reason behind PS is related to signaling word boundaries. Evidence for using PS as a cue to prosodic boundaries comes from languages with fixed word-initial stress such as Estonian and Finnish. In these languages PS tends to be inexistent because prosodic boundaries are already signaled by primary stress, and therefore there is no need to use vowel length to demarcate word edges (Suomi, 2007).

Although these factors suggest that PS can be related to aspects other than stress-timing, they do not refute the contention that PS can also be related to stress-timing tendencies. The purpose of this study is not to explain why this shortening happens; rather it aims to find the extent to which Jordanian Arab NNSs of English apply vowel shortening in their ILs.

Very few studies investigated PS in the IL of English NNSs. Krivokapic (2013) comparing four American NSs with four Indian speakers of English as an L2, found that the Indian speakers, who used English all their lives, employed PS in an English nativelike manner. No sufficient information about the participants was available to know the degree of their bilingual status, which casts doubt on the validity of the results. Dealing with bilinguals rather than foreign language speakers, Gibson and Summers (2018) compared the use of PS in English and Spanish by a group of English monolinguals and a group of balanced bilinguals in English and Spanish repeating nonwords in the two languages. They found that the English monolinguals did not implement English PS when repeating the Spanish nonwords, while the bilingual group used a degree of PS that was appropriate with the language in question. Both groups produced more PS in English than in Spanish, which is a syllable-timed language. To account for the lack of transfer of English timing patterns into Spanish (which was expected as the English monolinguals' level in Spanish was limited, as adults), the researchers argued that this unanticipated finding could relate to the group's early exposure to Spanish (around age 4), an exposure that could have given them the ability to acquire motor plans that might have prevented transfer of PS from L1 to L2. This does not seem to be the case. It seems that PS, which is a characteristic of stress-timed rhythms, does not transfer to L1s with syllable-timed rhythms at beginning levels as it is a marked feature and L2 learners start with a syllable-timed rhythm regardless of their L1 rhythm class, most probably due to lack of adequate articulatory control, which improves as L2 proficiency increases (Ordin & Polyanskaya, 2014).

In another study tackling PS among bilingual children, Gibson & Bernales (2019) compared PS in Spanish and English bilingual children with that in monolingual Spanish and English ones. They found that both groups implemented PS similarly although Spanish is syllable-timed, while English is stress-timed. They argued that lack of differences between the groups could be attributed to a universal phonetic constraint whereby speakers use one puff of air to produce a string of segments and these segments tend to be shorter the more segments or syllables there are (Quené, 2008, p. 1109).

Studies dealing with the acquisition of polysyllabic shortening by Arabic speakers of English are lacking. Moreover, previous studies dealing with timing patterns in Arabic and the ILs of Arabic speakers of English are rather limited. Abu Guba, Mashaqba, Jarbou & Al-Haj Eid (2023c) compared the degree of vowel reduction as produced by Jordanian Arab speakers of English and English NSs. They found that the Jordanian NNSs of English, even the advanced ones, failed to produce English reduced vowels in a native-like manner. Although the Jordanian NNSs were aware that the reduced vowels were unstressed, they did not reduce the duration of the reduced vowels, which were significantly much longer than those produced by the English NSs. These findings seem to suggest that Jordanian Arabic speakers do not use durational variation in their speech as much as English NSs do. This seems to be related to the mechanisms of Arabic speech rhythm, which is clearly different from that of English (Abu Guba, Fareh & Yagi, 2023a). Put differently, it could be the case that the syllable-timed Jordanian Arabic speech rhythm results in less variation in timing patterns where vowel duration tends to be similar in feet regardless of their segmental make-up.

This study will further investigate timing patterns by examining the extent to which Jordanian Arabic speakers use PS in their ILs. This will shed more light on Arabic speech rhythm and its mechanisms and on the nature of PS in general. Is PS a phonetic universal and to what extent is it related to the speech rhythm of a language?

3. METHODS

3.1. Participants

Three groups of participants, with no known speech or hearing disorders, took part in this study. Group 1 (n =10) comprised American English native speakers living in the United Arab Emirates at the time of recoding; all of them used General American English to record the sentences. Group 2 (n = 10) represented advanced Jordanian speakers of English; all of them received a degree in English language and literature (8 BA and 2 MA) from a university in Jordan. All of them studied in Arabic medium schools, and none had lived outside Jordan for more than a month. Group 3 (n = 10) consisted of intermediate Jordanian speakers of English. They were sophomore students studying English language at a Jordanian university at the time of recording. Again, all of them studied in Arabic medium schools and none lived outside Jordan for more than a month. For both groups of NNSs, they learned English in public Jordanian schools through formal instruction by Jordanian non-native speakers of English. None had travelled to an English-speaking country, and none had been taught by native speakers of English. Note that none of the NNS groups had received any phonological training; they only did a three-hour course in phonetics that focused on learning the IPA phonetic symbols. More details are provided in Table 1. Note further that none of the participants was aware of the purposes of the study.

3.2. Tools

Participants were requested to read three sets of words, given in (1), in the carrier sentence "I say ___ twice" three times (the middle one was analyzed). This is to minimize the effects of accentual lengthening, and preclude the effects of initial lengthening, or final lengthening (see White & Turk, 2010; Turk, 2012). In this context, the target word is expected to bear a nuclear pitch accent as it has the only

Table 1: Details on participants

	Mean age and range	Mean exposure to English	Gender
NS Group	30 (23-36)	NA	8 females and 2 males
Advanced Group	32 (26-38)	22 years	8 females and 2 males
Intermediate Group	20 (19-23)	14 years	8 females and 2 males

new information (Port, 1981). In a couple of instances, the nuclear pitch accent did not fall on the target word and the participants were instructed to repeat that, without bringing this to their attention.

(1): Words used in the task

a. Need, needing, neediness
b. Seed, seeding, seediness
c. Speed, speedy, speedily

Trisyllabic words were chosen carefully. Words with a potential stress shift as per Arabic stress rules (see Abu Guba, 2018, for details on stress rules in Arabic) were excluded. It has been observed that Jordanian learners of English tend to shift stress rightward to closed peninitial syllables, as in 'meaningful', with stress incorrectly assigned to the second syllable. Moreover, no four-syllabic words with stress on the initial syllable are attested in Jordanian Arabic; therefore, such four-syllable English words were excluded because it would be impossible to control for possible stress shift by Jordanian speakers. For example, in a word like 'meaningfully', stress would shift to the second syllable according to Arabic stress rules and so many Arab learners would stress the second syllable in their ILs.

All the recordings were made in a quiet place using an LG professional recorder at a 44k sampling rate. Upon completing all the recordings, the researcher measured the duration of the long vowel /i:/ in all the words using Praat 1.4.9 (Boersma & Weenink, 2015). This was done auditorily by listening to the sounds and visually by inspecting the spectrograms and waveforms. The beginning of the vowel was taken to be the beginning of formant structure and the periodic waveform (Kent & Read, 2002). Furthermore, the whole duration of each word was measured to find out the duration of each foot and to calculate the percentage of the long vowel in the whole word. In words ending in /d/, the burst phase of the /d/ was taken as the right boundary of the word, i.e., to the beginning of the hold phase of the stop /t/ in the word twice. For the words ending in a vowel, the end of striations was taken as the end of the word, and for words ending in /s/, the end of the noise of the sibilant was taken as the end of the word (Kent & Read, 2002). A random subset of the recordings was measured by a Jordanian Arab phonetician and no discrepancy was found between the two transcribers.

4. RESULTS AND DISCUSSION

Results show that there were clear differences between the NSs and the NNSs, but negligible differences between the two NNSs' groups. In this section, we first compare the duration of feet across the three groups, and then we compare the vowel duration in the three types of words as produced by the three groups.

4.1. Foot duration

The NSs exhibited less variation in foot length than did the NNSs, with feet becoming longer the more segments were added to the foot (Figures 1 and 2). NSs' feet in monosyllabic words were 367.3 ms; in disyllabic words, 402; and in trisyllabic words, 553 ms. That is, disyllabic feet were 35 ms longer than monosyllabic feet and trisyllabic feet were 186 ms longer than monosyllabic ones. This runs against the isochrony view of feet in English (e.g., Abercrombie, 1967). Rather, these results lend support to the view that similar foot duration in English, which is a stress-timed language, is a tendency such that syllables do not have the same duration, with stressed syllables being longer than unstressed ones, and compression of syllables applying the more syllables there are in a foot (see Roach, 1982; Dauer, 1983).

Foot duration among the NNSs exhibited more variation as shown in figure 1. Although monosyllabic feet were close to the ones produced by the NSs, disyllabic and trisyllabic feet were considerably longer across the two groups of NNSs. Disyllabic and trisyllabic feet produced by the advanced group were about 75 and 91 ms, respectively, longer than those of NSs. Similarly, the intermediate group produced disyllabic and trisyllabic feet that were 88 and 108 ms, respectively, longer than feet produced by the NSs. Differences between the advanced and the intermediate groups were much smaller: 13 ms between disyllabic feet and 17 ms between trisyllabic feet. A mixed model ANOVA comparing foot duration across the three groups with the number of syllables as a fixed factor and word as a random factor, controlling for speaker and gender revealed a main effect for the interaction of group and number of syllables ($F(4, 4.256) = 27.264$, $p = .003$, $\eta_p^2 = 96$, power = 1). Bonferroni post-hoc tests revealed that the differences between all the groups were significant; p was < .001 for all the differences between the NS and NNS groups while it stood at .033 for the difference between the advanced and the intermediate groups.

This shows that the NNSs produced much longer feet the more segments were added, which suggests that their IL is more syllable-timed than stress-timed, and they do not seem to use PS as much as the English NSs do (discussed in the following subsection).

Figure 1. Foot duration across the three groups.

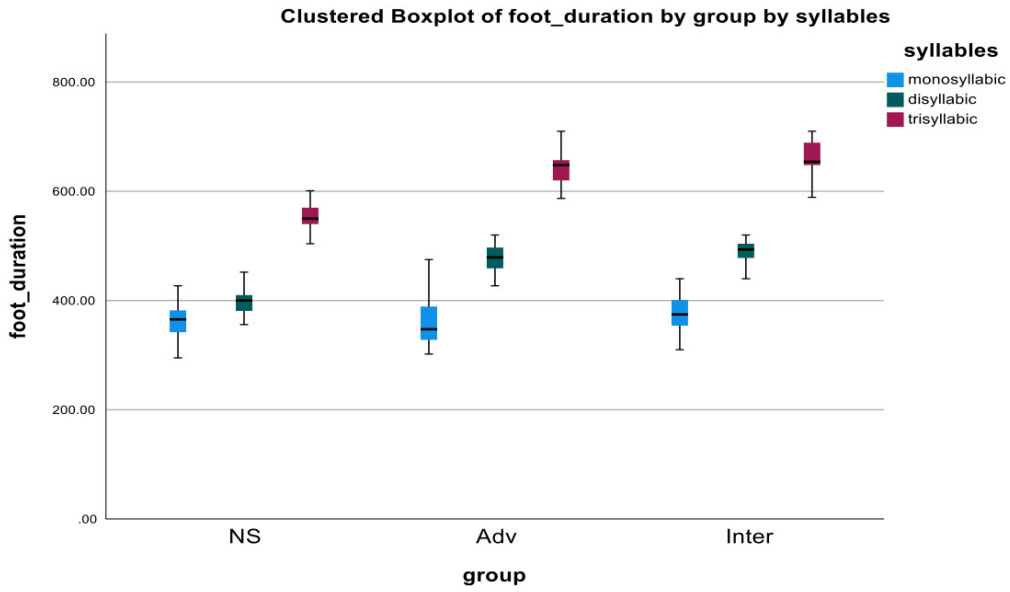
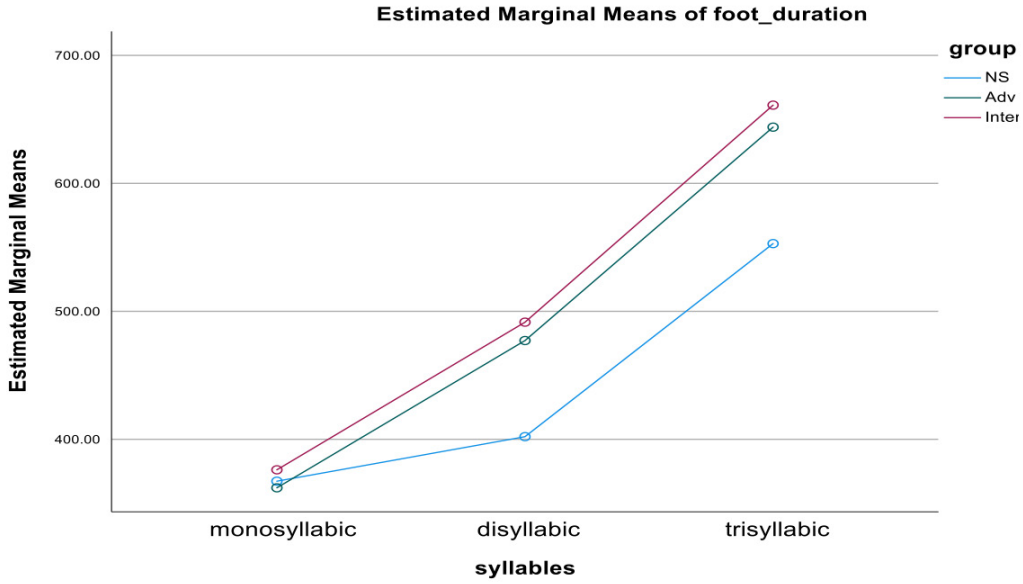


Figure 2. Foot duration according to number of syllables across the three groups.



4.2. Polysyllabic shortening

In this subsection, we first compare the duration of the long vowel across the three groups and then we compare the percentages of the long vowel in the whole word to give a clearer picture and provide more evidence on PS across the three groups.

4.2.1. Long vowel duration

Figures 3 and 4 give details on the duration of long vowels in monosyllabic, disyllabic and trisyllabic words. Overall, the vowel becomes shorter the longer the word is across the three groups; however, clear differences were attested among the NSs and the NNSs in the realization of long vowels in polysyllabic words.

Mean vowel length in monosyllabic words was very close across the three groups (around 150 ms). However, clear differences among the three groups in producing disyllabic and trisyllabic feet were attested. NSs produced shorter vowels in disyllabic feet (100 ms) and even shorter ones in trisyllabic feet (87 ms). The long vowel was 50 ms (33%) shorter in disyllables than in monosyllables and 13 ms (13%) shorter in trisyllables than in disylla-

Figure 3. Long vowel duration across the three groups.

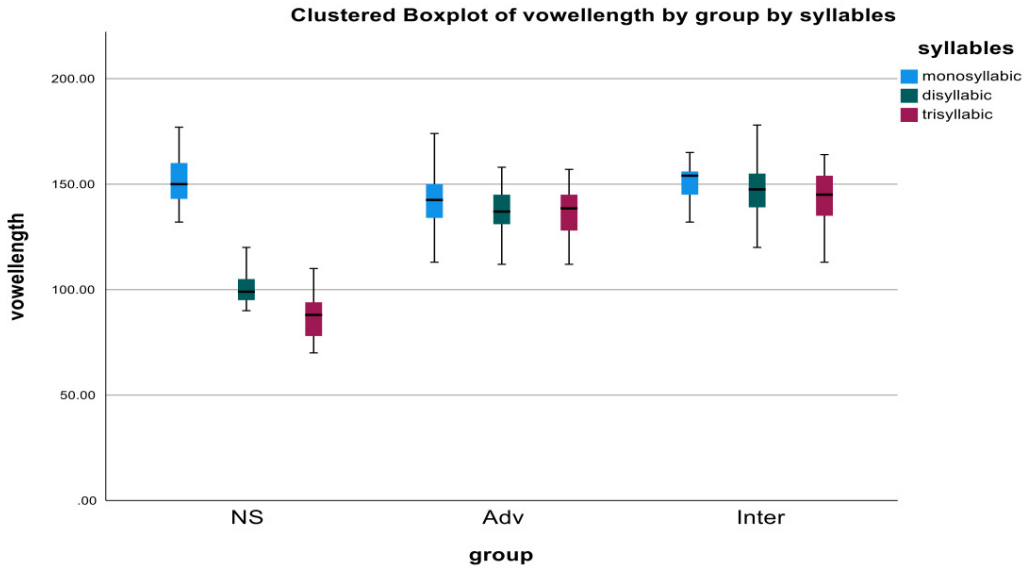
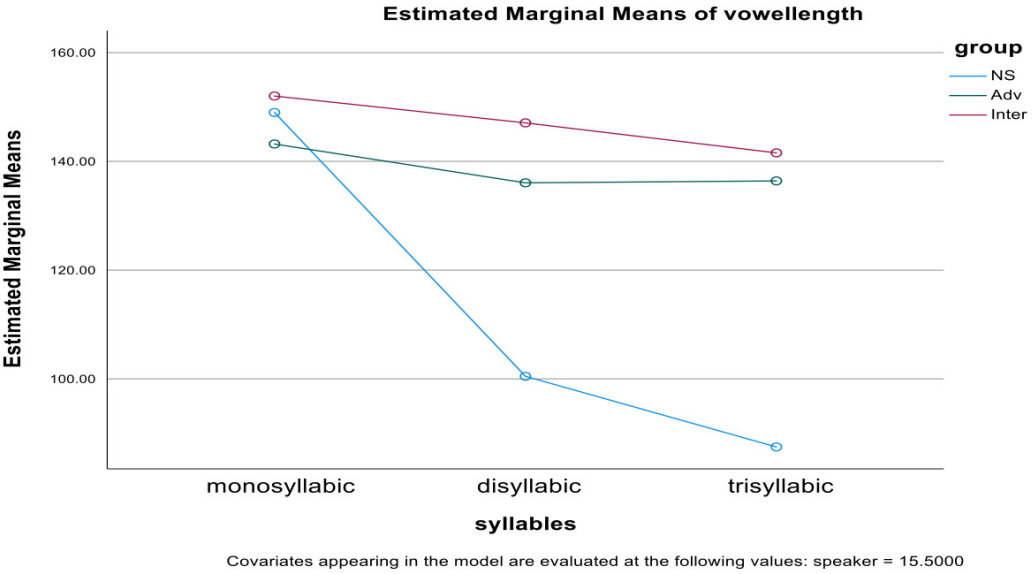


Figure 4. Long vowel duration according to number of syllables across the three groups.



bles. This shows that NSs apply polysyllabic shortening, which is in harmony with the literature on PS in English (cf. Section 1).

By contrast, the NNSs did not shorten their vowels considerably in longer words with less than a 7-ms difference between vowels in monosyllabic feet and polysyllabic feet across both groups. Moreover, the vowels in polysyllabic words across the two NNS' groups were much longer than those produced by the NSs (about 42 ms longer in disyllabic words and 52 ms longer in trisyllabic words), although the differences between the three groups in producing the long vowels in monosyllabic words were too small. The differences between the advanced and the intermediate groups were rather small: the long vowel in disyllables produced by the intermediate group was 12 ms longer than that produced by the advanced group, and the long vowel in trisyllabic feet produced by the intermediate group was 6 ms longer than that realized by the advanced group.

A mixed model ANOVA comparing vowel length across the three groups with the number of syllables as a fixed factor and word as a random factor, controlling for speaker and gender, revealed a main effect only for the interaction of group and number of syllables ($F(4, 3.583) = 24.245$, $P = .007$, $\eta_p^2 = 96$, power = .98). Bonferroni post-hoc tests revealed that the differences between the NS group on the one hand, and the advanced and the intermediate groups on the other hand, were significant ($p <$

.001). However, the differences between the advanced and the intermediate groups were not significant (p = .151).

4.2.2. Percentages of the long vowel in the whole word

To control for tempo effects, we compare the percentages of the long vowel in the different words in this section. This is necessary as the differences in the previous section might be affected negatively by speaking rates that can be different across and within speakers. Figures 5 and 6 below show that the mean percentages of the long vowel in the whole word in monosyllabic words across the three groups were very close (around 40%). However, clear differences between the NS group and the other NNS groups with respect to the percentages in disyllabic and trisyllabic feet were attested, but very small differences between the NNS groups were attested. Although the advanced and the intermediate groups reduced the percentages of their vowels in disyllabic and trisyllabic words, their percentages were still higher than those of the NS group. They were 5% and 7% higher in disyllabic words, respectively, and about 7% higher in trisyllabic

Figure 5. Percentages of long vowels in the whole word across the three groups.

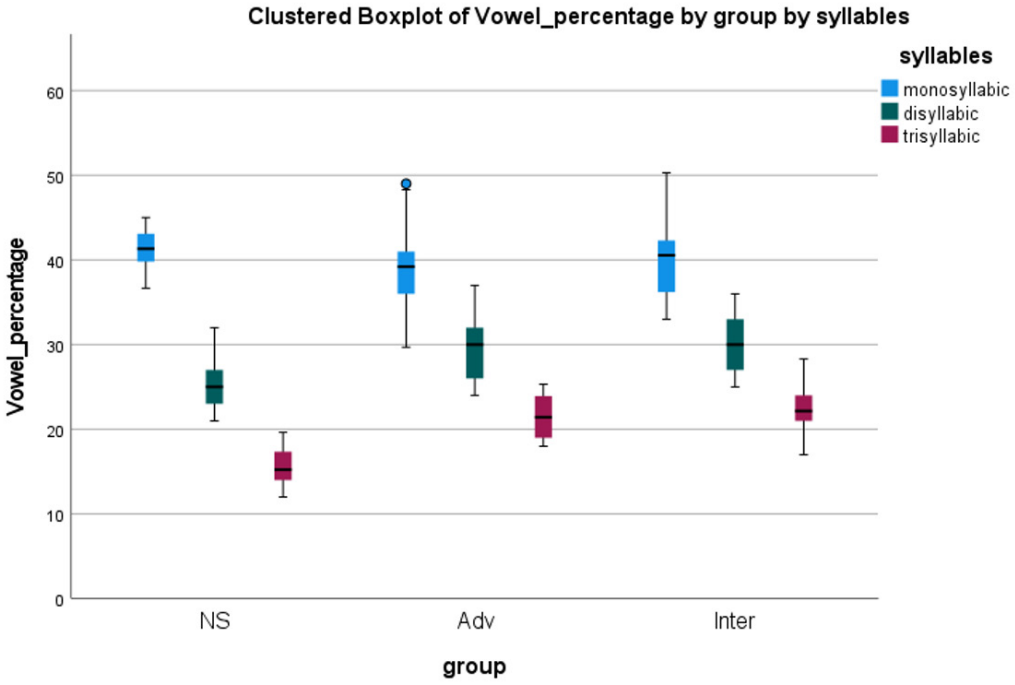
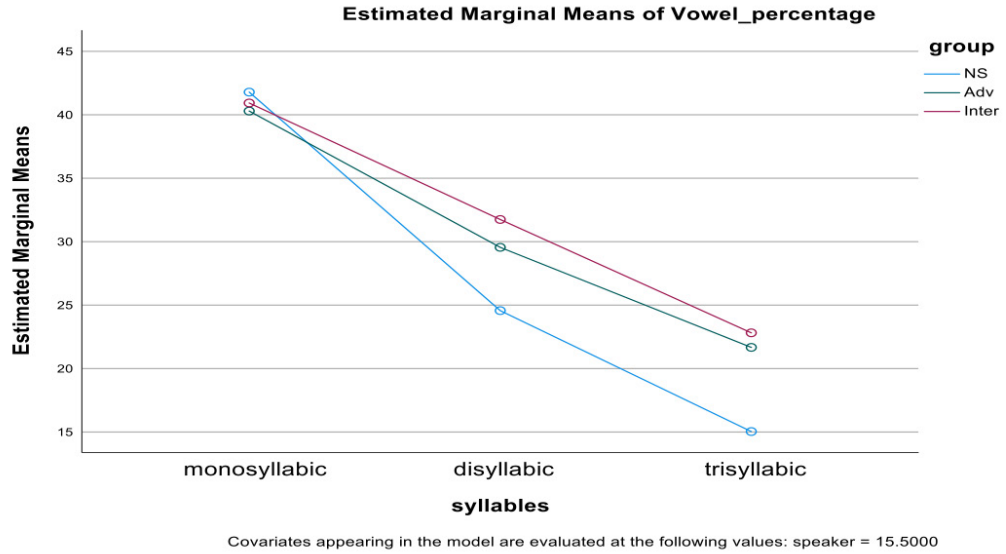


Figure 6. Percentages of long vowels according to the number of syllables across the three groups



words for both groups. The differences between the advanced and the intermediate groups were less than 2%.

A mixed model ANOVA comparing the vowel percentages across the three groups with the number of syllables as a fixed factor and word as a random factor, controlling for speaker and gender, revealed a main effect for group (F(2, 8.329) = 5.228, P = .034, ηp2= 56, power = .67), and for the number of syllables (F(2, .823) = 655.821, P = .048, ηp2= 99, power = .72), but not for the interaction between groups and syllables (p= .615). This is because the differences between the three groups with respect to monosyllabic words were marginal, and the differences between the advanced and the intermediate groups were also very small. Bonferroni post hoc tests revealed that only the differences between the NS group on the one hand, and the other two NNS groups, on the other hand, were significant, while the differences between the two NNS groups were not significant (p= .494).

Taking all the results together, we can clearly see that the NNS groups do not use PS as much as the NS group do, an indication that the NNSs' IL tends to be less stress-timed, and the NNSs have not acquired the stress-timed rhythm of the English language. This is in line with Abu Guba et al.'s (2023b) finding that the degree of PS in Modern Standard Arabic (the formal variety in Arabic) as produced by Jordanian speakers is not comparable to that in English; Jordanian speakers produced vowels in disyllabic words and trisyllabic words with similar durations, but the vowels were shorter than in monosyllabic words.

Moreover, the present study's findings do not agree with Gibson and Bernales (2019), who argued that PS could arise from a universal phonetic constraint that requires a faster articulation rate the more syllables are added and that it is not strongly related to language proficiency. The slightly better performance of the advanced group (although statistically not significant except for foot duration) seems to suggest that more experience with the language may have a positive effect on the acquisition of timing properties of the English rhythm. This is in line with the observation that L2 learners seem to adjust their L1 motor plans in acquiring L2 phonology (Flege, Takagi & Mann, 1995). However, it seems the advanced group in this study did not acquire English timing patterns adequately to block L1 transfer. This suggests that such prosodic aspects are difficult to master, and they need more efforts and time to acquire (cf. Abu Guba, 2021, and Abu Guba et al., 2023c, who reported that Jordanian-Arabic advanced speakers of English performed better than intermediate speakers producing English prosodic aspects but failed to perform in a near-native manner).

5. CONCLUSION

It has been shown that the English NSs tend to employ PS more than do the two groups of NNSs. However, these results show that isochronous foot duration and polysyllabic shortening are a tendency in English speech timing, rather than a fundamental process. The performance of the advanced group was slightly better than that of the intermediate group, but the differences between the two NNS groups were not statistically significant except for the differences in foot duration. It seems that the NNSs still use the mechanisms of their L1 rhythm (which is less stress-timed than that of English (cf. Section 2). A future study that explores PS in native Jordanian colloquial Arabic words is recommended to find out the extent to which L1 transfer plays a role in acquiring this feature.

Findings suggest that acquiring the timing patterns of the stress-timed English rhythm is challenging to Arabic-speaking NNSs. It seems that the NNSs need to be made explicitly aware of these timing properties as a prerequisite to reduce the effect of L1 transfer and ultimately acquire these timing patterns. It is likely that explicit teaching and training on these aspects could be helpful here, which is left for future research. English language learners and teachers should pay more attention to timing patterns, which would help boost intelligibility and reduce foreign accentedness. They should work on mastering English durational variation quite early especially because Arabic is rhythmically different from English.

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