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The Role of Age and Exposure in English Vowel Perception and Production among Native Swahili Speakers

Rose A. Upor[1], Joseph J. Olomy

University of Dar es Salaam, Dar es Salaam, Tanzania

A B S T R A C T

Vowel perceptual studies in Foreign Language Acquisition (FLA) settings where L1 is dominant are generally scarce. The aim of this study, therefore, is to explore the role of the age and exposure factors in the perception and production of English vowels [ɑ-ɜ; æ-ɑ; i-ɪ] by the native Swahili speakers whose exposure to the English language is through formal instruction in a predominantly FLA situation. The participants (n=40) were classified into two groups: young learners and adult learners. Using Flege's Speech Learning Model (SLM), we administered a vowel perception test, and a vowel production exercise. The results confirm that adult learners have an edge over younger learners whereby the former exhibited greater accuracy in determining vowel contrasts and production than the latter. Although both groups shared common difficulties in discriminating the vowel sounds, adult learners had recourse to their prolonged exposure and ingeniously used previously acquired knowledge and skills in sentence structure and meaning to aid discrimination in comparison to the younger learners. Finally, the study supports the SLM contention that adults retain capacities to acquire L1 to perceive the properties of L2 speech sounds and establish new phonetic categories.

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1. Introduction

Second Language Acquisition (SLA) researchers generally agree that younger learners are more successful in Second Language (L2) acquisition than adults, and that the age difference manifests more clearly in the acquisition of L2 phonology (Baker, Trofimovich, Flege, Mack & Halter, 2008; Baker & Trofimovich, 2006; Flege, McKay & Meador, 1999; Guion, Flege, Liu & Yeni-Komshian, 2000; Munro, Flege & McKay, 1996; Jia, Strange, Wu, Collado & Guan, 2006; Oyama, 1976; Tsukada, Birdsong, Bialystok, Mack, Sung & Flege, 2005). Such studies on age and exposure effects (and L2 acquisition in general) have been conducted in both *the naturalistic settings* – where the target language (TL) is spoken in its native context, and *the foreign language learning settings* – where language learning depends on classroom instruction. In fact, most of the research findings based on the naturalistic settings have generally suffered from hasty generalisation and the interpretation of those based on formal language learning settings have been in light of the assumptions and priorities of naturalistic research findings (Muñoz, 2008).

Researchers who base their studies on naturalistic settings use the Length of Residence (LOR) in the TL community to determine exposure, which found that the quality of the input received in naturalistic settings is incomparable to the quality of the input available in formal language learning settings. Although the predictive power of the age effect ceases after the initial stage in naturalistic

[1] Email addresses: upor@udsm.ac.tz, roseupor@gmail.com (R.A. Upor) jjolomy@gmail.com (J.J. Olomy)

settings, it does not do so in formal language learning settings, where the input—an equivalence of the amount available at the beginning in naturalistic settings—may never be provided (Dekeyser, 2000; Johnson & Newport, 1989; Muñoz, 2008). Implicitly, age and exposure in formal language learning settings refer to the time one spends receiving formal instruction; in fact, the more time one spends receiving formal instruction, the more input one is likely to get. Still, the question on the difference in the amount of exposure and TL language input available to L2 learners in these two settings remains unanswered. Many of the findings from studies conducted in naturalistic settings favour younger learners over adult learners (Tohidian, E. & Tohidian, I., 2009). However, some researchers have suggested that the younger learners' superiority might be blocked in the formal language learning setting due to the scarcity of TL inputs they can access (Muñoz, 2008; Singleton & Ryan, 2004; Tohidian, E. & Tohidian, I., 2009) and high cognitive maturity suitable for explicit instruction in formal language setting (Muñoz, 2006).

Formal language learning settings and Foreign Language Acquisition (FLA) are linked because both conditions emphasise on the TL being non-native to the context of learning and/or being non-native to the learners. Many mainstream perception studies involve non-native sounds of immigrants living in the TL community (Balas, 2018). However, few perception studies on foreign language acquisition have been conducted on classroom settings (Balas, 2018; Best & Tyler, 2007). Balas (2018) further proffers that shared characteristics of FLA perception studies include: 1) the TL not widely used; 2) the TL does not extend significantly outside the classroom; 3) emphasis is on grammar and vocabulary; and 4) the source of L2 input is L1 accented and speech by L2 speakers is manifested by diverse varieties and, as a result, learners could contend with incorrect or variable model of the L2 input. In other words, there are limited opportunities for successful L2 learning for such learners exposed to formal instruction.

These claims suggest a relationship between the language learning setting, the duration of exposure and age of learners in a formal language learning setting. Using Flege's Speech Learning Model, this study attempts to address the limitations of previous perceptual studies on the vowel contrast by investigating the English vowel perception among Tanzanian native Swahili speakers learning English as a Foreign Language (EFL). The study uses early EFL learners and advanced adult learners comparatively to examine their perception of vowels in EFL as their native Swahili language has fewer vowels than English. The Speech Learning Model (SLM) is an approach to L2 acquisition aimed to explain how age-related factors affect one's ability to produce L2 vowels and consonants with native fluency. The model is primarily concerned about the ultimate attainment of L2 pronunciation among L2 learners who have spoken the L2 for many years. It emerged as a reaction to the *critical period hypothesis* (CPH), which states that there is a limit to the time (before puberty) when an L2 learner can learn to pronounce L2 vowels in a native-like manner. In this regard, the SLM proposes that the pronunciation of a given L2 sound accurately depends on the accuracy of L2 learners perceiving the same sound, and that all the production errors are perceptually motivated. According to the SLM, during L1 acquisition, speech perception is attuned to contrastive phonic elements of the L1. Thus, L2 learners with fully developed L1 sound categories may fail to understand the differences between the pairs of sounds found in L2, or between L2 and L1 sounds. This failure could be attributable to either their unwitting treatment of distinct L2 sounds as a single category or L1 phonology filtering L2 sound features out, or both. Therefore, the SLM claims that learners of all ages can learn a new language as they can learn to perceive the differences between sound categories in their language with those of the TL, or the differences between the sound categories in TL (Flege, 1995).

1.1 Vowel perceptual studies: Native language dependence or length of Instruction?

Generally, perceptual studies indicate that the size of the vowel inventory helps to contrast meaning, hence signalling how speakers/listeners perceive these sounds (Boomershine, 2013; Bradlow 1993, Fox A., Flege, J. E., & Munro, M. J., 1995, Levy & Strange 2008, Polka 1995). Perceptual studies have used three key models to explain sound perceptual contrast over the years: 1) the SLM (Flege, 1995); 2) the Perceptual Assimilation Model (PAM) (Best 1994; Best, 1995; Best & Tyler, 2007); and 3) the Second Language Linguistic Perception (L2LP) (Escudero, 2009). Yet, Balas (2018) argues that perceptual studies have not been equally concerned about all aspects of perception. Whereas PAM-based studies have focused on non-native listeners, SLM and L2LP have focused on L2 learners while

factoring in the LOR in the naturalistic setting of the TL. Notably, studies in FLA settings where the L1 is dominant are generally scarce (Balas, 2018; Lin, 2014; Perwitasari, 2018). Moreover, general findings indicate that vowel sound contrasts are attuned to the size of the vowel inventory between the learner's L1 and the L2, which has a more robust inventory than the former. In this regard, Maddieson (1984) has argued that sound perception may be difficult for learners whose L1 has an average of 5 – 7 vowel systems compared to the L2 with more than a dozen in its system. Best's PAM proffers that similarities between L1 and L2 can predict difficulties in discriminating non-native contrasts, listeners not familiar with a phonological contrast in L2 may resort to associating the sound with a single native sound (Best, 1994; Best ,1995; Best & Tyler, 2007).

On the other hand, evidence indicates that proficiency plays a key role in one's ability to discriminate sounds. Similar results also emerged in Fox et al.'s (1995) study, hence suggesting that vowel perception dimensions are gradually modified as the learners' L2 proficiency improves. Based on these findings and since this study is situated within FLA, we can hypothesise that advanced L2 learners in EFL settings are more proficient in L2 than early learners.

1.2 The Present Study

In Tanzania, English is largely a foreign language despite its being one of the two official languages in the country alongside Swahili. After all, the English language learning environment in Tanzania falls under a foreign language learning (FLL) setting since the learners of the language normally get most (if not all) of the TL input from the classroom through formal instruction and, largely, from English non-native speaker models. Limited input is often available outside the classroom, particularly outside the school environment. In fact, the school pushing for "*Speak English Only*" in the premises, though largely ineffective in many secondary education institutions, might create a semblance of non-classroom input. Besides, English is taught only as a subject at the primary school level with few instructional hours per week except for a handful few English-medium primary schools that privileged children often attend and serves as a medium of instruction (MoI) in higher levels of education from secondary education upwards. These contextual factors may not adequately represent the research problem without a description of the vowel systems of both languages.

The English vowel system differs significantly from the Swahili vowel system. Whereas English (RP/GA) has 12 monophthongs, Swahili has only five basic vowels (which are all monophthongs). One of the earliest studies into the vowel inventory of Swahili was done by Polomé (1967) who confirms further that the structural differences between Swahili and English cause a considerable amount of difficulty for a native Swahili speaker who studies English. Phonic differences between the languages indicate that there are up to 11 vowel allophones that can occur in Swahili. For example, [i], [ɪ], [u], [ʊ], [e], [ɛ], [o], and [ɔ] are in complementary distribution – sometimes in free variation, depending on the speaker- in Swahili whereas in English such distinctive features are phonemically contrastive. Besides, the distribution of vowel length is different for both languages. In Swahili, stress and nasal clusters are mainly responsible for vowel lengthening unlike in English, where voicing is responsible depending on the environment. For a Swahili native speaker to encode English vowel contrasts, not only would they have to redistribute the allophones of their five vowel phonemes but they would also redistribute vowel length according to the English patterns. This phenomenon magnifies the importance of minimal pairs as a means of teaching vowel contrast to EFL learners, especially in FLA contexts. The English language syllabus in Tanzania dedicates a considerable section to developing competencies to listen and comprehend phonemic contrasts in early learners (TIE, 2015). Minimal pairs is one of the techniques that is widely used by teachers to teach vowel contrast in Tanzania. Nevertheless, Brown (1995) adds a word of caution to the use of minimal pairs. He argues that without a functional load being determined for minimal pair instruction, the likelihood for successful instruction and acquisition would be minimal at its best. Studies are yet to determine the functional load of minimal pairs in Tanzania, however, experience from other countries suggests that the minimal pair technique is effective in teaching pronunciation (Nur & Rahman, 2018).

Overall, the few perception studies available in Tanzania have largely focused on the difficulties that learners grapple with when attempting to produce English vowels. The studies have attributed the challenges to either the discrepancy between Swahili and English, or the transfer of the learners' L1 to L2 (Maghway, 1981; Mwambapa, 2012). None of these studies has explored both the perception and

the production of English vowels by Swahili speakers learning English in the FLA context of Tanzania. Neither have the studies considered the influence of the learners' age and exposure to English. The present study, therefore, investigated the role that learners' individual differences – age and exposure to English – play in the perception and production of English vowels by EFL learners who speak Swahili as their first language in addition to testing the relevance of the SLM claim that success in the production of English vowels depends on the learner's ability to overcome the perceptual difficulties. Its main objective of the study was to investigate the role age and exposure to English play in the perception and production of English vowels among native Swahili speakers learning EFL. The study sought answers to the following questions: How do native Swahili speakers perceive and produce English vowels? How does age and the degree of exposure to EFL affect the perception and production of English vowel sounds? The former was a primary and the latter a secondary question.

2. Methods

2.1 Participants

In all, 40 native Swahili learners of English as a foreign language (EFL) took part in the study. These were divided into two groups based on age and one American native speaker of English who provided the stimuli data. The first group of respondents was 20 4th grade pupils aged 8 - 14 years (mean age =9.9 years) classified as early bilingual learners, who were in their primary stages of learning English. These early bilinguals had received EFL instruction for at least more than three years. The second group of respondents consisted of 20 undergraduate students from the University of Dar es Salaam (mean age =24.9 years), or adult bilingual learners of EFL, who were all in their final year of studies. Both clusters were learning English through formal instruction. The adult learners' length of exposure to EFL through formal instruction was 14+ years. None of the participants reported hearing disorders.

2.2 Data Collection Instruments and Procedure

A male adult native speaker of English was recorded in the Language Laboratory at the University of Dar es Salaam. He hailed from New England in the United States. The data was collected using two experiments involving vowels [ɑ-ɜ; æ-ɑ; i-ɪ] perception and production. The rationale for selecting these vowels was first, they form the core of most commonly used minimal pairs in English that are formed with monophthongs. Second, Swahili basic vowels are all monophthongs therefore use of minimal pairs of this nature would limit the study focus. The experiments included one-syllable words and short sentences containing English vowels which form minimal pairs [ɑ-ɜ; æ-ɑ; i-ɪ] produced by the English native speaker (ENS) for the perception and production exercises. The vowel perception test preceded the vowel production test. The ENS produced 30 one-syllable English words. The words were divided into three groups of 10. Each group had words containing a minimal pair different from the minimal pairs found in the words in the other groups. There were also 30 short English sentences which contained the same words produced by the native speaker of English.

During the first experiment, the respondents attempted to identify the word they had heard from the native speaker by choosing one of the two alternatives provided for each word and sentence. The experiment tested them for the extent to which they discriminated against the English vowel sounds. Researchers, who have tested these vowels to investigate the influence of age and/or exposure to English on the acquisition of English phonology, include Baker *et al*. (2008) whose study focused on the native Korean children' and adults' perception and production of /i/, /ɪ/, / /ʊ/, and /u/. Other scholars such as MacKay and Fullana (2007) contend that the vowel /æ/ had yet to be widely tested.

3. Results and Discussion

3.1 Experiment 1: Vowel Perception Test

This experiment sought to establish the extent to which the native Swahili EFL learners contrasted English vowels produced by the English Native Speaker (ENS) at both the word and sentence level by testing their perception of the minimal pairs of these sounds ([ɑ-ɜ; æ-ɑ; i-ɪ]).

3.1.1 Procedures

The respondents were informed about the nature of the experiment and the need for them to relax. The respondents received a list of words in the order in which the ENS had produced them. During this experiment, the respondents listened to the recordings from the native speaker's production of the words and sentences and picked the vowel they had heard. The respondents listened to 30 English one-syllable words and 30 short English sentences containing the target vowels to identify the vowels by indicating the right word (containing the vowel they had heard) from the alternatives provided. For each word or sentence the ENS produced, there were two alternatives from which the respondents selected one they deemed to be correct. Each respondent was tested alone in a quiet room, with the recording made using a voice recorder (Shinco v-25) and a computer.

3.1.2 Results

The results of the first experiment show that the native Swahili adults perceived the English vowels they heard produced by the ENS relatively more accurately than the native Swahili children. Overall, the experiment's results show that the adults performed better than the children in the perception of the differences between the target vowels. Table 1 summarises the native Swahili children's and adults' mean perception scores:

Table 1. Raw Mean Scores for the Respondents' perception of English Vowels

	Perception of [ɑ - ɜ]		**Perception of [æ- ɑ]**		**Perception of [i - ɪ]**	
	At word level	*At sentence level*	*At word level*	*At sentence level*	*at word level*	*At sentence level*
Adults	78.5	90.0	78.5	78.5	61.5	90.5
Children	59.0	62.0	59.5	55.5	45.0	54.5
Total	**68.75**	**76.0**	**69.0**	**67.0**	**53.25**	**72.5**

The vowels [ɑ - ɜ] received mean scores of 78.5 percent and 90 percent both at the word and sentence levels, respectively, for the adults and 59 percent and 62 percent at the word and sentence levels, respectively, for the children. The vowels [æ - ɑ] received mean scores of 78.5 percent at both the word and sentence levels for the adults and 59.5 percent and 55.5 percent at both respective levels for the children. The table also shows that the mean scores of the perception of [i - ɪ] were 61.5 percent and 90.5 percent for the adults and 45 percent and 54.5 percent for the children at two levels. For individual in-group scores, Table 1 indicates that, though the mean score of the perception of all the vowels, except for [i - ɪ], was above 50 percent at the two levels tested for most of the adults, the mean score for the same vowels was below 50 percent at both levels for most of the children.

Further analysis of the results also indicates that the vowels [i - ɪ] were less accurately perceived by both groups, especially at the word level, whereby 11 respondents (3 adults and 8 children) received mean scores of between 0 and 40 percent. The vowel /i/ is found in the Swahili vowel system whereas /ɪ/ is not, which may explain the respondents' difficulties. The findings also indicate that the 11 respondents, or 27.5% of all the respondents, chose a word that contained the vowel /i/, when the native speaker had pronounced a word containing the vowel /ɪ/ and vice-versa. One could argue that, apart from the respondents' age and exposure to English, the respondents' first language, Swahili, may have influenced their perception of the two vowels.

The adults, unlike the children, had limited difficulty perceiving vowel contrasts [i - ɪ] at the sentence level, as more than a half (55%) of all the 20 adults received a maximum score of 100 percent. The mean scores for other adults (45%) were between 60 percent and 90 percent. Although differentiating the two vowels at the word level seems challenging, the difficulty seems to lessen at the sentence level for adults, which might be attributable to their age and higher cognitive development. Whereas adults perceived the vowels provided more accurately than the children at the two levels, the analysis of the results shows that the children's mean scores of all the vowels were above 50 percent (see Figure 1), except for the perception of [i - ɪ], at the word level. Generally, the performance in the perception of the vowels was slightly better at the sentence than at the word level for both the children

and adults. In other words, the respondents perceived the vowels easier at the sentence level than at the word level. The intra-group analyses indicate that the children were a little more accurate in perceiving the vowels [æ - ɑ] at the word level (59%) than at the sentence level (55.5%). Indeed, they chose more correct words in relation to the words and relatively less correct words in relation to the sentences produced by the ENS.

Furthermore, the intra-group analyses show that the adults perceived the vowels [æ-ɑ] at the word level and at the sentence level in the same way whereas the children perceived the same relatively better at the word than at the sentence level. The relatively higher performance in the perception of the vowels at the sentence than at the word level could be influenced by the word usage in the sentences. This, however, seems to have placed the adults at an advantage over the children, especially in the perception of the vowels [ɑ-ɜ] and [i-ɪ]. This could also be attributed to the influence of the level of cognitive development of the adults and children, which favours the former, not the latter (Muñoz, 2008). The analysis of variance has revealed that the difference between the two groups of respondents in their perception of the vowels was statistically significant. Table 2 displays the summary of one-way ANOVA between the two groups (adults and children) in terms of their perception performances:

Table 2. One-way Analysis of Variance for the Perception of English Vowels at Word Level and Sentence Level between young and adult learners

Item	Sum of squares	Df	Mean squares	F	Sig.
Perception of [ɑ , ɜ] in words	3802.500	1	3802.500	10.444	.003*
	13835.000	38	364.079		
	17637.500	39			
Perception of [ɑ , ɜ] in sentences	7840.000	1	7840.000	33.399	.000*
	8920.000	38	234.737		
	16760.000	39			
Perception of [æ, ɑ] in words	3610.000	1	3610.000	11.479	.002*
	11950.000	38	314.474		
	15560.000	39			
Perception of [æ, ɑ] in sentences	5290.000	1	5290.000	16.545	.000*
	12150.000	38	319.737		
	17440.000	39			
Perception of [i, ɪ] in words	2722.500	1	2722.500	8.801	.005*
	11755.000	38	309.342		
	14477.500	39			
Perception of [i, ɪ] in sentences	12960.000	1	12960.000	52.447	.000*
	9390.000	38	247.105		
	22350.000	39			

* Significance at <0.05

A statistically significant difference emerged between the children and adults in terms of the perception of all the three vowel contrasts both at the word level and the sentence level. At an alpha of .05, the analysis of variance revealed a significant difference between them in the perception of all the vowels as follows: F (1, 38) = 10.444, p = .003 in the perception of [ɑ - ɜ] at the word level; F (1, 38) = 33.399, p = .000 in the perception of [ɑ - ɜ] at the sentence level; F (1, 38) = 11.479, p = .002 in the perception of [æ - ɑ] at the word level; F (1, 38) = 16.545, p = .000 in the perception of [æ - ɑ] at the sentence level; F (1, 38) = 8.801, p = .005 in the perception of [i - ɪ] at the word level; and F (1, 38) = 52.447, p = .000 in the perception of [i - ɪ] at the sentence level. This indicates that adults perceived all the vowels more accurately than the children at both the word and sentence levels. These results signal a positive influence of the time spent in formal instruction by the respondents on their perception of English vowels for the adults' group, who had more exposure to English through formal instruction (14+ years of formal instruction at the time of the study) than their younger counterparts (more than 3

but less than 4years of formal instruction), perceived the difference between the given English vowels relatively better.

Eta helped to investigate the strength of the association between age and exposure to the language and the perception of the vowels; r = .64 in the perception of [ɑ - ɜ] at the sentence level; r = .71 in the perception of [æ - ɑ] at the sentence level. These are larger than typical effect sizes. r = .65 in the perception of [i - ɪ] at the sentence level; this is larger than typical effect size. The effect size was much larger than typical, r = .74 in the perception of [ɑ - ɜ] at the word level. However, the effect size was medium for the following: r = .34 in the perception of [æ - ɑ] at the word level; and r = .55 in the perception of [i - ɪ] at the word level. The effect size indicates that the amount of time native Swahili EFL learners spend in formal instruction plays a positive role in their ability to perceive the difference between the English vowels tested, as the more exposed they were to the language the better their performance. Furthermore, the learners' age, which could be associated with their cognitive development, seems to play a vital role in their perception of the vowels, since the adults perceive the vowels better than the children, especially at the sentence level. Implicitly, they managed to use the context of the words to differentiate between the vowels provided, something which the children did not and could not do.

3.2 Experiment 2: Vowel Production Exercise

The second experiment was conducted immediately following the first one. The aim of the experiment was to test the native Swahili EFL learners' production of the target English vowels.

3.2.1 Procedures

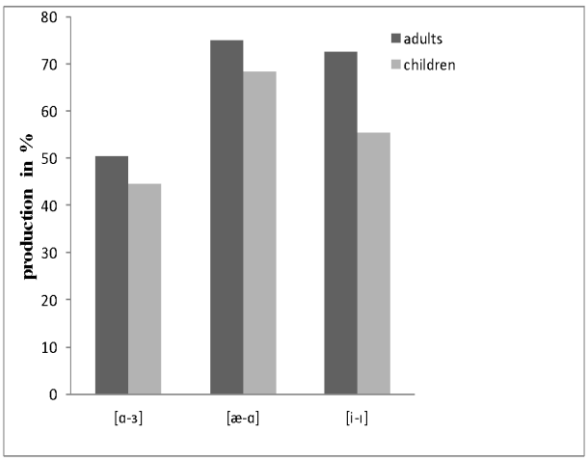
Under this second experiment, the respondents attempted to produce monosyllabic English words and short English sentences containing the target vowels (same as those used in experiment 1). The words and sentences were similar to those produced by the ENS before the first experiment. During this experiment, the children and adult respondents read out aloud the one-syllable English words and short sentences individually in a quiet room and were recorded using Shinco V-25, a voice recorder, and a computer.

3.2.2 Results

The results indicate that the two groups of respondents differed from each other in their vowel production mean scores, as the adults' mean scores in all the vowels were relatively higher than the children's. Overall, the performance at the sentence level was slightly higher for both groups than at the word level. However, the adults still outperformed the children in the production of the vowels at the sentence level (cf. Figure 1).

Evidently, the analysis shows that the vowels [ɑ-ɜ] were difficult for all the respondents, but more so for the children, who registered mean scores of below 50 percent at both the word (44.5%) and sentence (46.5%) levels. Although the adults' mean score of the same vowels at the two levels was lower (see Figure 1) than the mean scores of the other vowels, their performance was above 50 percent. The total mean score (for the two groups) was 47.5 percent in the production of [ɑ-ɜ] at the word level. This score is the lowest of all the mean scores, which signals that the two vowels posed more challenges to the respondents than the others. The analysis further indicates that, although both groups produced the vowels [ɑ-ɜ] relatively more accurately at the sentence level than at the word level, the children faced more challenges than the adults, since their mean score at the sentence level was still below 50 percent.

a) Word level



b) Sentence level

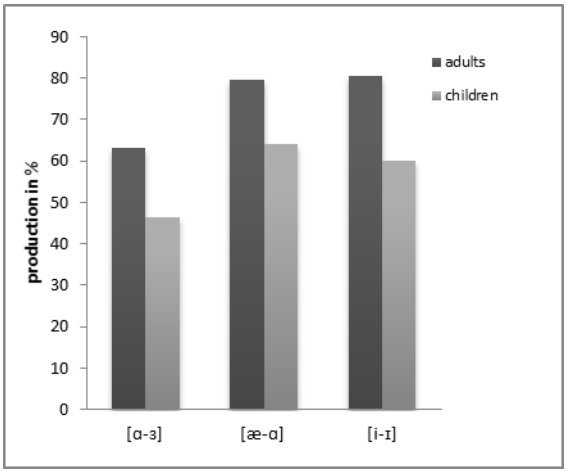


Figure 1. Percentages of the native Swahili speaker EFL learners' Production of English Vowels at (a) Word Level and (b) Sentence Level

Moreover, the relatively better scores the adults registered than the children in the production of English vowels signals the effect of age and more exposure to English in the production of the vowels at both the word and sentence levels. What this analysis illustrates, however, is that although the adults outperformed the children in the production exercise, to some extent, all the learners faced difficulties in producing English vowels, something which also emerged in the previous studies conducted in Tanzania (Maghway, 1980, 1981; Mwambapa, 2012). Further analysis of the variance between the two groups, however, did not yield a statistically significant level in the production of some English vowels by the participants as summarised in Table 3:

Table 3. One-way Analysis of Variance for English Vowel Production at Word and Sentence Levels between young and adult learners

Item	Sum of squares	df	Mean squares	F	Sig.
Production of [ɑ, ɜ] in words	9.025	1	9.025	2.937	.095
	116.750	38	3.072		
	125.775	39			
Production of [ɑ, ɜ] in sentences	30.625	1	30.625	8.233	.007*
	141.350	38	3.720		
	171.975	39			
Production of [æ, ɑ] in words	4.225	1	4.225	1.663	.205
	96.550	38	2.541		
	100.775	39			
Production of [æ, ɑ] in sentences	28.900	1	28.900	10.611	.002*
	103.500	38	2.724		
	132.400	39			
Production of [i, ɪ] in words	2890.000	1	19.600	5.444	.025*
	14870.000	38	3.600		
	17760.000	39			
Production of [i, ɪ] in sentences	50.625	1	50.625	14.383	.001*
	133.750	38	3.520		
	184.375	39			

*Significance at <0.05

At an alpha of .05, a statistically significant difference emerged in the children's and adults' production of the following English vowels: [ɑ-ɜ] at the sentence level F (1,38) = 8.233, p < .05; [æ-ɑ] at the sentence level F (1,38) = 10.611, p <.05; [i-ɪ] both at the word level F (1,38) = 5.44, p <.05, and

at the sentence level F (1,38) = 14.383, p <.05. Although the ANOVA shows a significant difference in the adults' and children's production scores for the vowels, the effect size in the production of [i-ɪ] at the sentence level was larger, r = .58. The effect size was larger in the production of [ɑ-ɜ] at the sentence level, r = 64; [æ-ɑ] at the sentence level, r = 63; and [i-ɪ] at the word level, r = 51. These findings indicate a significant effect of age and exposure to English on the production of vowels, as the adults produced the vowels more accurately than the children both at the word and sentence levels. However, no significant effect of age and exposure to English emerged on the production of [ɑ-ɜ] at the word level, F (1, 38) = 2.937, p > .05, and [æ-ɑ] at the word level F = (1, 38) = 1.663, p > .05. In other words, spending more time in formal instruction did not help the adults produce the vowels [ɑ-ɜ] more accurately at the word level and [æ-ɑ] at the word level. These findings are consistent with the SLM's prediction that all learners, regardless of their age differences, can develop a new category for L2 production, since the adults (although with the influence of the amount of the time spent in the formal instruction) produced nearly all the vowels more accurately than the children did. The findings are also like the results of MacKay and Fullana's (2007) that found that the amount of time spent on formal instruction was imperative for L2 learners' production of FL sounds.

Discussion

The present study examined the role of age and exposure in the perception and production of English vowels [ɑ-ɜ; æ-ɑ; i-ɪ] by Swahili native speakers who were classified in two groups; young learners and adult learners. The groups varied in age and exposure to the TL; both sets of participants were exposed to EFL through formal classroom instruction. Specifically, the study aimed to establish the degree to which age and exposure to the TL influenced the perception and production of the English vowel sounds under review. The results indicate that there were difficulties generally shared by the participants in both perception and production of vowels. Nonetheless, comparison shows that the adult learners outperformed the younger learners in this regard. These findings concur with observations by Jia, Strange, Wu, Collado, and Guan (2006), who established greater performance accuracy in older learners although later the advantage shifted to the younger learners over time. On the other side, these findings are incongruent with those from several perceptual studies that have indicated that young learners tend to perform better than adult learners in the acquisition of L2 phonology (Baker, Trofimovich, Flege, Mack & Hatter, 2008; Flege, McKay & Meador, 1999; Guion, Flege, Lin & Yeni-Komshian, 2000; Munro, Flege & McKay, 1996; Oyama, 1976).

The present study also found that age and exposure both influenced the performance of the study's participants. Although this finding is consistent with SLM, which suggests the ability to learn how to perceive and produce a new category to be availed throughout the lifespan of an individual. However, these findings differ from those findings of several perceptual studies (most of which were carried out in naturalistic language learning settings). To begin with, drawing upon studies that investigated the perception and production of similar vowel sounds particularly the /i-ɪ/ established that this contrast had to do with the difficult inherent in perceiving and/or even forming a new category for the English /ɪ/ (Bohn, 1995; Cho & Jeong, 2013; Escudero, 2006; Escudero & Boersma, 2004; Lin, 2013). These studies have also indicated that learners could be using durational instead of spectral cues in discriminating the sounds /i-ɪ/ (Jeske, 2016). Similar findings emerged in the current study whereby learners also faced difficulties in discriminating / i-ɪ/. The result signal the influence of Swahili on how they contrast the vowels but also signal that the adults' elongated period in EFL formal instruction gave cues for the discrimination. Between the two vowels, /i/ was more easily perceived and produced. However, there was no significant differences intra-group when it came to the perception and production

As for the vowel sound /æ-ɑ/, the study established that a significant difference p<.05 between the adult learners and younger learners at vowel contrast in the perception at the word and sentence level and in the production at sentence level only. There was no significant difference in production at the word level. Further scrutiny of the results indicate that age and exposure influenced both the perception and production. There was an indication that both groups depended on the contextual cues for perception at sentence level. Studies have indicated that learners can learn to distinguish phonemes if they know how the word is spelt (se, for example, Brown, 1998; Eckman, 2004; Komar, 2017). Based on the methodology and, particularly, the experiments on the sentences, the learners used the sentence

context to determine, first, the target word meaning before selecting the most accurate pair. The older learners had an edge over the young learners due to their longer exposure to EFL instruction. Regarding perception and production accuracy of /æ-ɑ/ in other studies, Jia, Strange, Wu, Collado and Guan (2006) found significant positive correlations in China that validated the fact that older participants achieved a higher level of accuracy than their younger counterparts. Their study reported that the group received English language instruction from non-native English language speaking teachers and their exposure to English ranged from 0 to 11 years, which was slightly lower than that registered for Tanzanian learners in the current study. Furthermore, their study indicated a lower production accuracy of 68.8 percent for /æ/ and 74 percent for /ɑ/. The results for the current study also fall within similar ranges of production accuracy with older learners at 75 percent at the word level and 79.5 percent at the sentence level with the younger learners performing at 68.5 percent and 64 percent, respectively. Both studies confirm that /æ/ was a difficult sound to discriminate against, a finding that has found support in several other studies (Cho & Jeong, 2013; Lin, 2013; Chen, Chang, Yang & Chou, 2006).

The last minimal pair /ɑ-ɜ/ has not been widely studied either in its entirety as a pair or as individual vowels (Das, 2014; Komar, 2017; Leeman, 2007). Das (2014) established that the vowel /ɜ/was substituted by the Assamese vowel /a/ and she described the phenomena as a ubiquitous feature. Also, Leeman (2007) noted that the vowel /ɜ/ existed in Swiss English and it was like the vowel in GA; however, the study participants pronounced it significantly at a lower level. Komar (2017) in his study found that the performance of /ɜ/ was considerably better (67.8%) than other vowels investigated; however, it had a high level of substitution (32.2%) to /ər/. He also noted that the vowel /ɜ/ was the 3rd most difficult vowel to perceive. Moreover, the study concluded that orthography has a misleading influence on pronunciation and, particularly, this vowel where students tended to pronounce the vowel with the postvocalic approximant /r/.

In the current study, substitution was a common feature as well as insertion of the postvocalic approximant /r/ after the vowel. r-Insertion was noted widely among the older learners than younger ones. However, a study by Komar (2017) used the GB vowel that was marked for length /ɜ:/ unlike the vowel in the study that was not marked for length. Irrespective of the length, both vowels are similar and are produced within the same vocal space. Indeed, low vowels have been proven to be difficult for participants to discriminate, as noted by Balas (2018). Balas (2018) attributed this difficulty to tongue advancement differences and tenseness. She noted that the sounds that were investigated included /ɑ/ that was perceived as the Polish /a/. Similar difficulties of perceiving /ɑ/ were noted by Perwitasari (2018) among Javanese and Sundanese speakers who had less accuracy levels. They also showed an attraction to incorrect alternatives and both groups of participants showed higher error rates.

In the current study, on the other hand, both the older and younger learners faced difficulties in discriminating the vowels /ɑ-ɜ/ at the word level whereas at the sentence level, the adults had the least error rates (10%) in comparison with the younger learners (38%). Also, the younger learners performed poorly in vowel contrast at both the word and sentence levels with a small difference (3%). Though these studies such as Balas (2018), Das (2014), Komar (2017), Leeman (2007), and Perwitasari (2018) do not necessarily focus entirely on the age and exposure distinction, they signal the vowels / ɑ-ɜ / as being the most confusing in FLA situations whereby the vowels are not an integral part of the speakers' language vowel inventory. This fact also emerged in this study.

4. Conclusion

This study has examined the perception and production of English vowels [ɑ-ɜ; æ-ɑ; i-ɪ] by native Swahili speakers whose exposure to the English language was through formal instruction. The study participants were classified in two groups, young and adult learners. In short, the findings of this study indicate that age and the length of exposure influence the perception and production of these vowel sounds. Moreover, the study continues to confirm an advantage of the adult over younger learners whereby the former exhibited greater accuracy in making vowel contrasts as well as production. Although both groups shared difficulties in discriminating the vowel sounds, the older learners relied on their exposure and creatively use their knowledge in sentence structure and meaning to aid discrimination in comparison to the younger learners. These results do not support the findings from various perceptual studies that indicate younger learners having an advantage over older learners (Baker, Trofimovich, Flege, Mack & Halter, 2008; Flege & MacKay, 2004; Flege, McKay & Meador,

1999; Guion, Flege, Liu & Yeni-Komshian, 2000; Munro, Flege & McKay, 1996; Pallier, Colomé, & Sebastián-Gallés, 2001; Pallier, Bosch & Sebastián-Gallés, 1997; Oyama, 1976). On the other hand, the results is supported by many studies that either involved non-native speakers in their native language environment for comparative purposes with those who are immersed in the TL community or non-native speakers of English that acquired English in a FLA situation (Boomershine, 2013; Jia, Strange, Wu, Collado & Guan, 2006; Perwistahari, 2018). Further support for the study results comes from the SLM theory (Flege, 1988, 1992, 1995, 1999), which maintains that adults retain capacities to acquire L1 to perceive the properties of L2 speech sounds and establish new phonetic categories. However, we acknowledge that the methodology used in this study may not provide conclusive results on the full assimilation because a cross-linguistic discriminant acoustic analysis was not performed. Thus, further studies need to be done to determine the acoustic quality of vowel sounds in Swahili for comparative purposes as well an application of current theories in perceptual research on the native speakers of Swahili.

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