P-ISSN: 2709-6254	Journal of Development and Social Sciences	April-June 2023, Vol.4, No.2
O-ISSN:2709-6262	http://dx.doi.org/10.47205/jdss.2023(4-II)11	[110-118]

Journal of Development and Social Sciences
www.jdss.org.pk

RESEARCH PAPER

An Acoustic Study of the Role of Consistency of Input in Acquisition of English Central Vowels in Pakistan

[1]Dr. Shazia Kousar* [2]Muhammad Amir Abbas [3]Semab Abrar

1. Assistant Professor, Department of English, University of Narowal, Narowal, Punjab, Pakistan
2. Lecturer, Department of English, University of Technology and Applied Sciences, Sultanate of Oman
3. M. Phil Scholar, Department of English, University of Narowal, Narowal, Punjab, Pakistan

***Corresponding Author:** shazia.kousar@uon.edu.pk

ABSTRACT

The study is aimed at observing the effect of consistency of input on the acquisition of English central vowels /ə/, /ɜ:/, /ʌ/regarding jaw opening (correlated with F1), tongue fronting (correlated with F2) and Duration of vowels. This is a quasi-experimental research that has a frame of 'pre-test-post-test control-group'. The researcher took three intact class groups, at middle level from a public girls school, and assigned them to experimental groups and control group. Experimental Group A was consistently exposed to English RP based audios/videos for 60 consecutive days. Experimental Group B was inconsistently exposed to input in alternative days adding up to 30 days. Control group C was not given treatment of any kind. The target central vowels were embedded into / hvd/ syllables in the carrier phrase 'say --- please' as a stimuli. Each phrase was recorded five times in pre-test and five times in post-test adding up to twenty seven hundred tokens of English central vowels. FormantPro (Xu, 2013) software was run to obtain average values of F1, F2, and Duration of vowels of each participant. The results of the data show that central vowels of group A, particularly vowel sound /ʌ/, are significantly affected by consistent exposure to RP vowels contrary to the central vowels of group B and group C. This study recommends consistent exposure of input for effective acquisition of English phonology related to administrative and pedagogical practices.

KEYWORDS 2nd language Acquisition, Central Vowels, Consistent Exposure

Introduction

Second Language Acquisition is generally defined as a language other than the mother tongue of the speaker which can be used and spoken inside or outside of a classroom (Ellis, 1985; Fazel, 2014). SLA also refers to the field of linguistics that studies the processes underlying the development of second language among the learners of non-native language (Saville-Troike, 2006). In this process of language acquisition, input is very crucial that can be in "written form, or from the spoken language, or, in the case of sign language, from the visual mode" (Gass, 2010, p. 195). However, input does not guarantee the successful acquisition of L2 as only a subset of all language input becomes intake that actually becomes a part of long-term memory of the learner.

The factor of consistency of input is critical in the continuum of quality-quantity of input for successful language acquisition. Kanno (1998) defined 'consistency' as something *constant* and opposite to variation in terms of acquisition of UG rules. She distinguished between lateral consistency and longitudinal consistency. Childers and Tomasello (2001) related consistency with the occurrence of target forms in input rather than in output/acquisition of the learners. They came up with the conclusion that consistent occurrence of target forms in input improves learners' awareness of the frame of construction. Nakamura (2012) dealt with the variable of consistency as 'balance' and 'proportion' contrary to skewdness of the target forms in the language input. In the current study, 'consistency' is operationally defined as regular and 'steadfast adherence to the same

course without intervals and gaps'. The variable of consistency of input is taken as the regular exposure of Pakistani learners of English as L2 to RP vowels for a period of 60 days.

English is taught as a compulsory subject to Pakistani children starting from the age of 5. The technique of explicit rule presentation is immensely applied for teaching English grammar to the learners. This textbooks-based and form-focused method of English teaching heartlessly neglects communicative aspect of English.

Vowel Sounds

Vowel sounds are the result of an open approximation which does not involve any obstruction, partial or complete, in the airstream flowing from the larynx to the lips in varying geometry of the pharyngeal and oral cavities (Roach, 2009). These vocalic sounds are produced by vocoid egressive pulmonic airflow periodically interrupted by repeated and quick closure and opening of the glottis in the larynx. That's why all the vowels are among the sounds classified as voiced (Fromkin et al., 1999). Daniel Jones (1917) devised a way of mapping the movemnent of the tongue in the oral tract during the production of cardinal vowels which serve as standard reference point.

Spectral Aspect of Vowels

The spectral features of vowels reflect which part of the tongue is raised to what extent relative to the roof of the mouth (Algeo, 2010). However, some phoneticians (e.g. Heinz, 2011) consider the feature of opening and closure of jaw, rather than tongue height, the second spectral aspect of vowel quality. The third spectral aspect of vowel quality is lip-rounding; nevertheless, this spectral feature is closely linked with the spectral features of tongue fronting and jaw opening. These spectral features are helpful for distinguishing one vowel from the other along with pitch and loudness.

Temporal Aspect of Vowels

Temporal aspect of vowels deals with the time during which the vowel signal remains passive in terms of other precepts (Algeo, 2010). Duration is a distinctive feature of vowels, next to vowel quality. In different languages such as English, duration is vital for differentiating various words such as 'heel' and 'hill'. The 'extrinsic' vowel duration is affected by various contextual factors contrary to their 'intrinsic' duration and 'temporal pattern of formant movements' (Lehiste, 1976) such as phonemic vowel length, Vowel height, Syllable structure, Polysyllabic words, Lexical stress, Following consonant, Domain position, Tone, and Speech rate (Ali, 2013).

Central Vowels in Received Pronunciation

A central vowel can be defined as a vowel which is pronounced when the position of the tongue remains normal (Ladefoged & Johnson, 2011). English RP has three central vowels i.e. /ə/, /ɜ:/, /ʌ/ described in IPA. Among these central vowels, /ə/, and /ʌ/ are mid short vowels while /ɜ:/ is an open long vowel.

Materials and Methods

Research Design

The design of the current study is quantitative as the data is analyzed statistically in form of numbers. Besides being quantitative, this study is quasi-experimental because of the practical constraints in educational contexts (Dornyei, 2007). The frame of the study is 'pre-test-post-test control-group' (**O»X»O, O»-»O**) to control various threats to the internal validity of the experiment. Independent variable of the study is 'consistency of input' of RP

vowels whose conditions are manipulated by the experimenter (Best & Kahn, 2007). The 'acquisition of RP vowels' is the dependent variable that depends on manipulation of the independent variable of 'consistency of input'. The variable of acquisition of vowels has three values: duration of vowels, jaw opening (correlated with F1), and tongue fronting (correlated with F2). To ensure some sort of internal validity and external validity of the research, the researcher kept some extraneous variables constant i.e gender, age, and language proficiency level.

Sample

The researcher took three genuine class groups of learners at middle level from a public school for girls in District Sheikhupura, Pakistan. These classes were assigned to experimental group A, experimental group B, and control group C. The researcher tried to minimize the non-randomness of sampling and group assignment in two ways recommended by Heinsman and Shadish (I996): by not involving the volunteer participation of the participants in any of the three groups; by excludingthe participants in data collection phase who did not have a close counterpart in other groups to make the participants comparable before the treatment was applied.

Stimuli

The researcher embedded the target central vowel sounds into the CVC syllable /h-v-d/ that is enormously used in literature (e.g. Cox, 2006; DeJoy & Barnes, 2011).The phonetic context of /hvd/ syllable is called 'null environment' (Stevens & House, 1963). The [h] has the quality of the vowel it precedes because the configuration of the vocal tract in producing [h] is determined by adjacent sounds supplying a neutral phonetic context (Perry, Ohde, & Ashmead, 2001) to observe the articulatory effects of speech preceding or following articulation of [h]. Likewise, [d] has least anticipatory coarticulatory effect on the vowel followed by [d] except the effect of the pre-boundary voicedness on the length of the preceding vowel (Pickett, 1999). Moreover, the combination of the phonemes [h] and [d] in /hvd/ syllable assures more standardization of the syllable shape and minimizes intonational as well as co-articulatory influences (DeJoy & Barnes, 2011*).* The /hvd/ syllables used in the current study were ha, hud, herd. The /hvd/ syllables were inducted in the carrier phrase 'say hvd please' to control the intonational influences, to provide the required number of tokens of each vowel, and to get the prominent acoustic properties of speech sounds (Ali, 2013; Cox, 2006).

Procedure

The total period of treatment was 60 days for provision of input of RP vowels. Both the experimental groups received the treatment in form of exposure to the RP vowels. However, Group A was given the treatment consistently without gaps over the period of 60 days except for Sundays; while group B was exposed to RP vowels inconsistently with gap of one day. Hence, group B was exposed to the RP vowels for 30 days with gaps of 30 days. To ensure the equality of amount of input for both of the experimental groups, the researcher doubled the treatment time of group B i.e. 45 × 2 = 90 minutes. The participants of group C were not given any sort of treatment. In the first 40 days, the participants of the experimental group A and group B were introduced to vowels by explicit teaching method and were exposed to the RP vowels by playing the videos with RP variety of English (downloaded from the website of the British Council of Pakistan) as research material for the participants. In the remaining 20 days, the mixed exposure and practice of the vowels was made to make the participants 'notice' the central vowels in the videos.

Data Collection

Instructions were given to the participants to read each phrase five times in pre-test and five times in post-test to get the average performance of acquisition of RP vowels of the participants rather than the tentative one. The participants who didn't either have a close counterpart in other groups in pre-test, or who didn't attend the classes (experiment) regularly were excluded from post-test data collection phase. They were instructed to read the phrases by giving short gaps before and after the 'hvd' syllable because the acoustic properties of speech sounds in conversational speech are different from those in clear speech. In creating the list of the phrases, the researcher randomized the order of all the phrases in post-test to remove the ordering effects of pre-test.

Each phrase of 'say hvd, please' was digitized at 44100 Hz using PRAAT (Boersma, 2001). The average of their syllable was noted as two syllables per second which is classified as slow speech rate by Pickett (1999). All recordings were made at a sound attenuated place in the school. Distance between mouth and microphone was maintained 20 cm. Every participant read the phrases 'say hvd please' 15 times in pre-test and 15 times in post-test for three vowels adding up twenty-seven hundred tokens of English vowels (15×2=30×90=2,700).

Research Validity

The researcher tried to maintain internal validity as well as external validity by controlling threats pointed out by Perry (2008): Participant attrition dropout, Maturation of the participants, threat of participants awareness of being studied, Researcher effect, Testing effect, threat of repeated task of reading the phrase in pre-test and post-test, Control group contamination. The researcher did not tightly control the educational environment because it may result in the artificial framework in laboratory conditions affecting the external validity of the study (Clarke & Kitzinger, 2004). This use of natural and authentic class groups reflects the representativeness of the sample to population which ensures external validity of research.

Data Analysis

***Segmentation and Labeling*:** The researcher used formantPro software (Xu, 2015) for acoustic analysis that started with lexical segmentation of hvd syllable from the carrier phrase. Lexical segmentation was done manually guided by visual cues from the intensity curves of waveform and formant contours of spectrogram. The researcher marked the boundary of hvd syllable from the fricative turbulence of /h/ and after the release of the burst of /d/ followed and preceded by pauses. In absence of acoustic cues, the researcher benefitted from auditory and visual cues from waveform and spectrograms to identify the most likely location of the approximant beginning of fricative [h] and closure and burst of [d] in the hvd syllable (Figueroa and Evans, 2015). For phonemic segmentation, the interval from the approximate onset and offset of the vowel was marked (Ali, 2013; Hillenbrand et al., 2001). The onset of the vowel was the release of the preceding consonant /h/ accompanied by the beginning of vocal fold vibration. At this point, the wave amplitude and complexity began to increase. Fricative noise of [h] in form of random pattern and aperiodicity in the waveform (Di Canio, 2015) was not included in the vowel domain. The offset of a vowel in non-final position was the onset of the following consonant. For setting the offset boundary of the vowels, the closure of [d] phoneme was excluded from the domain of vowels by looking for three co-occurring events: a sudden decrease in amplitude and complexity in waveform; a change/loss of energy in higher formants (F2, F3, F4) in spectrogram; the onset of aperiodicity. However, the burst of the /d/ was not always clear in the spectrogram.In spectrogram, the rhotacized vowel is marked with lowering of the frequency of the third formant (Ladefoged & Johnson, 2011). The areas of vowel where the

/ɾ/ sound was found quite dominating were excluded from the domain of the vowel. The process of labeling was performed along with the process of phonemic segmentation.

Measurement Reliability

The present researcher estimated the reliability of the measurement of data by correlating two sets of data (Cox, 2006; Robb & Chen, 2009) measured by the researcher at two points of time through calculating their Mean Absolute Deviation. The researcher re-analyzed ten percent of the total data set (270 token of vowels) randomly across groups to evaluate intra-judge measurement reliability. After re-measurement, the researcher calculated the mean values of the F1, F2, and Duration of the first and the second measurement. Later on, the Mean Absolute Deviation of the F1, F2, and Duration values of the second measurement were computed. The computation of the mean values of the first and second data sets show that the Mean Absolute Deviation of the F1 and F2 of vowels ranges from 0 to 15.15 Hz from the mean values. This little deviation shows that the measurement of data is within the range of reliability of measurement i.e -+ 60 Hz (Monsen & Engebretson, 1983).

Analysis of Data

The Formant Pro software (Xu, 2013) was ran for getting average values of F1, F2, and Duration of five tokens of a vowel. The researcher calculated the average values of the F1, F2, and Duration values of thirty participants in each group in pre-test. The same process of computing average values for F1, F2, and Duration for each group was run for post-test.

ANOVA test in SPSS was accompanied by Fisher's LSD test because: (1) definite difference may be observed in some of the variables even if difference was not found in all of the variables; (2) difference observed between the groups in post-hoc test is helpful for approving or disapproving the hypothesis even if the difference is not observed among the groups in ANOVA test. That's why the results of finding difference among the means of groups are largely based on the post-hoc test.

Results and Discussion

Table 1
F1 of Central Vowels of Group A, B, and C in Pre-test and Post-test

	F1 in Pre-test			F1 in Post-test		
Vowel	**Group A**	**Group B**	**Group C**	**Group A**	**Group B**	**Group C**
ə	833	768	800	817	752	797
ɜ:	682	645	679	720	699	673
ʌ	652	618	682	791	676	704

Table 2
F2 of Central Vowels of Group A, Group B, and Group C in Post-test

	F2 in Pre-test			F2 in Post-test		
Vowel	**Group A**	**Group B**	**Group C**	**Group A**	**Group B**	**Group C**
ə	1392	1459	1328	1382	1301	1350
ɜ:	1658	1617	1513	1535	1477	1518
ʌ	1473	1434	1450	1568	1372	1470

Table 3
Duration of the Central Vowels of Group A, B, and C in Pre-test and Post-test

	Pre-test Duration			Post-test Duration		
Vowel	**Group A**	**Group B**	**Group C**	**Group A**	**Group B**	**Group C**
ə	166	139	177	225	227	187

ɜ:	158	142	273	195	224	277
ʌ	106	117	111	153	136	122

Table 4
Difference in Central Vowels of Groups in Pre-test and Post-test in post-hoc LSD test with sig level < 0.05

Vowel	**Pre-test**			**Post-test**		
	F1	F2	Duration	F1	F2	Duration
ə	A	B	C	A	A	-
ɜ:	-	A/B	A	A	-	A
ʌ	-	-	-	A	A	A
	A	A+B+B	A+C	A+A+A	A+A	A +A

Group A is marked different in F1 of one central vowel (33%) in pre-test. However, this difference in performance of group A is observed in F1 of all the three central vowels (100%) in post-test. In case of F2, group A performed differently in 33% central vowels in pre-test. But in post-test, this difference increased to 66% in central vowels. Similar to F2, Duration of central vowels is slightly affected by the consistent exposure to RP vowels. The difference found in Duration of 33% of central vowels in pre-test rose to 66% in post-test. If we look at the overall scenario of the effect of consistent exposure of input on different dimensions of vowel acquisition, the F1 dimension of central vowels is the most affected by the treatment. Dimensions of F2 and Duration are also affected by the treatment as effect is noticed in two dimensions out of three of central vowels.

If we look at the most affected central vowel, the vowel /ʌ/ is found the most affected by the treatment. All the three groups pronounced the word **hud** alike in pre-test. But in post-test, F1, F2, and Duration of the vowel /ʌ/ are affected by the treatment as pronunciation of group A is marked different regarding F1, F2, and Duration of the vowel.

Conclusion

In the process of acquisition of L2 phonology, learners' exposure to the frequent samples of the target sounds in input has significant facilitative role (Gries, 2008). If these frequent samples of the target forms are consistently provided to the learners, the acquisition of the target sounds/accent becomes smooth. The results of the study supported this hypothesis explicitly. Consistency of input affected the spectral and temporal dimensions of central vowels of the experimental group A. However, inconsistent provision of input did not affect any dimension of central vowels. No significant difference was observed in the pre-test and post-test vowels of control group C except that the difference located in the duration of its pre-test vowels decreased in post-test.

To conclude it can be said that consistent exposure to input with reiterative experiences of the target sounds significantly affects the acquisition of L2 phonology because consistency of input increased the frequency of the target vowel sounds in the input to strengthen their representation and make them readily accessible for further use. Moreover, consistency of input drew learners' attention more to the target sounds for their noticing than the inconsistent input did (VanPatten & Leeser, 2006). The attention drawn to the target sounds in input is dissipated when the input is inconsistent.

Recommendations

The findings of the study make the following recommendations:

1) With regard to administrative aspect, English language classes scheduled on weekly bases should be rearranged for managing the classes on regular basis so that the

acquisition of English phonology may get greater gains. Moreover, regularity of teachers and learners in the process of acquiring target sound patterns should also be ensured.

2) In the field of pedagogy, consistency of input can also be achieved by focusing on the particular target sounds/items without introducing the new items until the first target sound pattern is turned into intake.

3) Teaching of English should be supplemented by audio and visual aids to make the input live and vital to remove difference between the orthography and phonology of English language.

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