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RESEARCH PAPER

Impact of Consistency of Input on Acquisition of English Front Vowels: An Acoustic Study

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ABSTRACT

The study observes the impact of consistency of input on the acquisition of English front vowels /ɪ/, /iː /, /e/, /æ/ concerning jaw opening (correlated with F1), tongue fronting (correlated with F2) and duration of vowels. This is a quasi-experimental study that has 'pre-test-post-test control group' framework. Three intact class groups, at middle level from a public girls' school, were assigned to experimental groups and control group. Experimental group A was consistently exposed to English RP based audios/videos for sixty consecutive days. Experimental group B was inconsistently exposed to input in alternative days. Control group C was not given treatment of any kind. The target front vowels were embedded into / hvd / syllables in the carrier phrase 'say --- please' as a stimuli. Data comprising of thirty six hundred tokens of English front vowels were analyzed using FormantPro (Xu, 2013) software. The results show that front vowels of group A, particularly vowel sound /æ/, /iː/ are considerably affected by consistent exposure to RP vowels contrary to the front vowels of group B and group C. This study recommends consistent exposure of input for effective acquisition of English phonology.

KEYWORDS 2nd Language Acquisition, Consistent Exposure, Front Vowels

Introduction

The researchers agree upon the definition of 'second language' as a language other than the mother tongue of the speaker used/ spoken inside or outside a classroom (Ellis, 1985; Fazel, 2014). SLA is a subfield of linguistics that studies the development of a language in the non-native learners of a language (Saville-Troike, 2006). For acquiring a language, input is a prerequisite as it is language data either in "written form, or from the spoken language, or, in the case of sign language, from the visual mode" (Gass, 2010, p. 195). However, availability of input does not assure successful acquisition of L2 as there are many factors involved in turning input into intake for language acquisition.

The factor of consistency of input is hypothesized to be significant in the continuum of quality-quantity for language acquisition. The variable of 'consistency' was defined by Kanno (1998) as something *constant* in terms of acquisition of UG rules. She drew line between lateral consistency and longitudinal consistency. Childers and Tomasello (2001) related consistency with the occurrence of target forms in input. They concluded that consistent presence of target forms in input increases learners' awareness of the linguistic construction. Nakamura (2012) considered consistency as 'balance' and 'proportion' of the target forms in the language input. In this study, the researchers operationally defined 'consistency' as regular and 'steadfast adherence to the same course without intervals and

gaps'. The researchers took variable of consistency of input as regular exposure of non-native (Pakistani) learners of English to RP vowels for 60 days.

In Pakistan, children learn English as a compulsory subject at the age of 5. The teacher explicitly presents the rules of grammar to the learners. In this technique of explicit rule presentation, communicative and phonological aspect of English language is heartlessly ignored.

English Phonology

Vowel Sounds

Vowel sounds are the product of an open approximation in the oral cavity. Their production 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). When vocoid egressive pulmonic airflow is periodically interrupted by frequent and fast closure and opening of the glottis in the larynx, these vocalic sounds are produced. That's why all the vowels are classified as voiced (Fromkin et al., 1999). Daniel Jones (1917) measured the approximant movement of the tongue in the oral tract for the production of vowels and devised a chart of the cardinal vowels which serves as a reference point for the study of the vowels.

Spectral Aspect of Vowels

The most distinctive quality of vowels is their spectral feature which reflects the part of the tongue raised during production of vowels and to what extent relative to the roof of the mouth (Algeo, 2010). However, some phoneticians (e.g. Heinz, 2011) are of the opinion that the opening and closure of jaw is the second spectral aspect of vowel quality instead of tongue height. Lip-rounding is the third spectral aspect of vowel quality; however, this spectral feature is related with the spectral features of tongue fronting and jaw opening. All these spectral features along with pitch and loudness are clue for distinguishing one vowel from the other.

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). This dimension of 'duration' distinguishes short vowels from long vowels vowel quality. In various languages i.e. English, duration differentiates between pairs of words such as 'kneel' and 'nil'. The 'extrinsic' duration of vowels is affected by 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).

Front Vowels in Received Pronunciation

A front vowel can be defined as a vowel which is pronounced when the highest part of the tongue moves forward in the mouth duration the production of vowels (Ladefoged & Johnson, 2011). English RP has four front vowels i.e. /ɪ/, /iː/, /e/, /æ/ described in IPA.

Literature Review

The role of input in learning L2 phonology is emphatically studied. Many scholars explored that direct instruction may help students' pronunciation (Derwing, Munro & Wiebe, 1997; 1998; Lord, 2005; Saalfeld, 2011). However, many other researchers (Carlet &

Kivisto, 2018; Charles, 2014) held up that exposure to the target language community is also necessary for successful acquisition of L2 phonology. Among the first set of findings, Lord's (2005) study is noteworthy here. His investigation was about the advanced Spanish learners of learning phonology after attending a course of phonetics. He observed that students' pronunciation was enhanced over the course of a semester. However, the findings of the study were not quite reliable as the study lacked in a control group for comparison of the experimental group. That's why it is uncertain whether the phonetic course had anything to do with the improvement or some other factor was responsible for the improvement. Saalfeld (2011) conducted an experimental study with an experimental group of learners registered in a Spanish phonetic course (n=11) and a control group of learners attending advanced Spanish courses (n=17). All the participants were placed in the third and fourth year of Spanish courses. Their reading was recorded during the first four weeks of semester, and the final four weeks of the semester. The results reveal that the learners taking the phonetics course statistically significantly performed better than the learners in the control group, supporting the hypothesis that phonetic input affects acquisition of Spanish vowels

Carlet and Kivistö (2018) investigated how input affected English vowels in their perception and production as L2. The learners of the target language received input of vowels in formal setting clearly instructed how to pronounce the vowels. Pre-test and post-test were administered before and after the treatment of 8 weeks. It was observed that the learners' skill to perceive vowel sounds was greatly improved. However, instructional input did not affect the learners' pronunciation of vowels significantly. This study came to conclusion that for L2 phonology acquisition to be successful, studying outside the classroom setting and instruction on phonology both are necessary.

Charles (2014) took input as exposure to a real-world linguistic environment. His sample comprising of English speakers learning Spanish as L2 was divided into two groups: those who had spent a significant amount of time in a Spanish- speaking nation (RM) and those who had only visited a Spanish speaking nation for a brief length of time (AH). Spanish native speakers were taken as a control group to compare how the first two groups pronounced and centralised the Spanish letter /a/. Different formal and informal activities such as a short tale, a word list, and an interview were employed to examine how these groups differ in pronouncing the Spanish /a/. The study revealed that the participants who stayed in a Spanish-speaking nation (RM) for long time showed a significant difference ($p<0.05$) between their production of the stressed /á/ and the unstressed /a/ in Spanish in informal and formal tasks. But the at-home (AH) group showed a significant difference ($p<0.05$) between the two tokens in informal activities. The study concluded that a longer period of exposure in the target language community is beneficial for learning the target vowels. The focus of the aforementioned empirical investigations, as well as similar ones, has been on the provision of input, whether in the form of explicit phonological instructions or exposure to the target language community. The element of input consistency has never been investigated before in the context of learning L2 phonology.

Materials and Methods

Research Design

The current study is quantitative. It is quasi-experimental due to the practical restraints in educational contexts (Dornyei, 2007). To control probable threats to the internal validity of the experiment, the researchers applied 'pre-test-post-test control-group' (**O»X»O, O»-»O**) framework to the study. The variable of 'consistency of input' of RP vowels is the independent variable as its conditions are manipulated by the

experimenter (Best & Kahn, 2007). The variable of 'acquisition of RP vowels' is the dependent variable as its performance is dependent on manipulation of the variable of 'consistency of input'. The variable 'acquisition of vowels' has three values: duration of vowels, jaw opening (correlated with F1), and tongue fronting (correlated with F2). The researchers kept some extraneous variables constant i.e gender, age, and language proficiency level to maintain some internal validity and external validity of the research.

Sample

Three class groups of female learners (middle level) from a public school in District Sheikhupura, Pakistan, were taken as a sample of the study. These three class groups were assigned to the experimental group A, experimental group B, and control group C. The experimenter tried to control the non-randomness of sampling and group assignment in two ways recommended by Heinsman and Shadish (I996): by discouraging volunteer participation of the participants in any of the groups; by excluding the data of the participants who did not have a close equivalent in other groups to ensure comparability of participants before the treatment was applied.

Stimuli

The researchers applied the structure of CVC syllable /h-v-d/ to embed the target front vowels because its phonetic context 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 (Cox, 2006; Perry, Ohde, & Ashmead, 2001) to examine the effects of articulation of the sounds preceding or following [h]. Similarly, [d] is appreciated for having 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). In the current study, the /hvd / syllables are heed, hid, head, had. These /hvd/ syllables are put 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 treatment of input of RP vowels was provided to the experimental groups for 60 days. The participants of Group A received the treatment consistently for 60 days (45 minutes daily) except for the gap of Sundays; however, the participants of group B were given treatment inconsistently on alternative days. So, they were exposed to RP vowels for 30 days. Nevertheless, the experimenter increased the time of treatment for group B i.e. 45 × 2 = 90 minutes. The group C did not receive treatment of any kind. The experimenter applied explicit teaching method to introduce the individual vowels to the experimental group A and group B and also used the videos with RP variety of English (website of the British Council of Pakistan) as research material of naturalistic method of teaching. Afterwards, the experimenter provided exposure to mixed vowels to the participants to make them 'notice' the front vowels in the videos and pronounce them.

Data Collection

The researchers collected the average performance of the participants rather than tentative one by instructing them to read each carrier phrase five times in pre-test and five times in post-test. The data of the participants who were not regularly present in classes (experiment) were not included in post-test data as well as pre-test data. The 'hvd' syllable

was preceded and followed with gaps to make the acoustic properties of the target vowels sounds prominent in clear speech. In post-test, the order of the carrier phrases was changed so that the ordering effects of pre-test should be avoided.

The researchers digitized the carrier phrases at 44100 Hz in PRAAT (Boersma, 2001). The average reading speed of the participants' phrases was examined as two syllables per second that was categorized as slow speech rate by Pickett (1999). A sound attenuated place was used to make recordings in the school. Distance of 20 cm was maintained between microphone and mouth. Each phrase was read 10 times in pre-test and post-test for four vowels adding up thirty six hundred tokens of English vowels (10×04=40×90=3600).

Research Validity

The researchers tried to maintain internal validity as well as external validity by controlling the threats pointed out by Perry (2008): Participant attrition dropout, maturation of the participants, the threat of participants' awareness, researcher effect, testing effect, threat of repeated task of reading the phrase, and control group contamination. The researchers did not tightly control the educational environment because it might result in the artificial framework in laboratory conditions affecting the external validity of the study (Clarke & Kitzinger, 2004). The researchers used authentic class groups to ensure external validity of the study.

Data Analysis

Segmentation and Labeling

Acoustic analysis of the vowels was initiated with segmentation of hvd syllable from the carrier phrase. This lexical segmentation was guided by visual cues from the intensity curves of waveform and formant contours of spectrogram on FormantPro (Xu, 2015). The boundary of /hvd/ syllable was marked from the fricative turbulence of /h/ and after the release of the burst of /d/ preceded and followed by pauses. When acoustic cues were not available, the auditory and visual cues from waveforms and spectrograms were relied to identify the most likely location of the approximant beginning of fricative [h] and closure and burst of [d] in the /hvd/ syllable (Figueroa & Evans, 2015). For phonemic segmentation, the interval from the approximate onset and offset of the vowel was marked (Ali, 2013; Di Canio, 2015; Hillenbrand et al., 2001). The release of the preceding consonant /h/ accompanied by the commencement of vocal folds vibration was taken as the onset of the vowel. This clue was further supported by wave amplitude and its complexity. To mark the offset boundary of the vowels, the researchers excluded the closure of [d] phoneme focusing on three co-occurring events: a sudden decline in amplitude and complexity in waveform; variation of energy in higher formants (F2, F3, F4) in spectrogram; the onset of aperiodicity. During process of phonemic segmentation, the segmented vowel phonemes were labeled according to the categories assigned to them.

Measurement Reliability

The reliability of the measurement of data was estimated by intra-judge measurement reliability (Cox, 2006; Robb & Chen, 2009). The researchers took ten percent of the total data set (360 token of vowels) across groups and reanalyzed them. Afterwards, the researchers calculated the mean values of the F1, F2, and Duration of the 1st and the 2nd measurement. This process led to computation of Mean Absolute Deviation of the F1, F2, and Duration values of the second measurement. The analysis show that the Mean Absolute Deviation of the F1and F2 of vowels ranges from 0 to 15.15 Hz from the mean values. This little deviation shows the reliability of measurement of current data is within

the accepted range of reliability of measurement i.e -+ 60 Hz (Monsen & Engebretson, 1983). In case of measurement reliability of duration, its MAD values range from 0 to 15.02 ms that is within acceptable boundaries of reliability of data.

Analysis of Data

The researchers ran Formant Pro software (Xu, 2013) to calculate average values of F1, F2, and Duration of five tokens of a vowel of thirty participants in each group in pre-test and post-test. ANOVA test in SPSS, accompanied by Fisher's LSD test analyzed the data to find difference among the means of groups.

Results and Discussion

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

Vowel	F1 in Pre-test			F1 in Post-test		
	Group A	Group B	Group C	Group A	Group B	Group C
ɪ	408	493	482	417	451	471
ɪː	492	486	444	406	444	442
e	739	578	684	757	601	710
æ	682	737	730	791	739	749

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

Vowel	F2 in Pre-test			F2 in Post-test		
	Group A	Group B	Group C	Group A	Group B	Group C
ɪ	1812	1678	1773	1855	1920	1809
ɪː	1739	1639	1752	1837	1717	1755
e	1716	1647	1703	1757	1677	1728
æ	1707	1610	1635	1659	1599	1654

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

Vowel	Duration in Pre-test			Duration in Post-test		
	Group A	Group B	Group C	Group A	Group B	Group C
ɪ	93	94	180	112	127	210
ɪː	140	123	274	190	222	287
e	122	126	190	139	153	191
æ	150	188	327	212	199	324

Group A is marked different in F1 of two front vowels (/ɪː/, /æ/) in pre-test and post-test. In case of F2, performance of group A is affected by the treatment in the same front vowels in pre-test and post-test. Similarly, front vowel of Group B /ɪ/ is also affected by the treatment as its values of F2 are observed changed in post-test. Parallel to F2 performance, duration of front vowels of Group A is marked different due to consistent exposure to RP vowels. The Group B also pronounced /ɪː/ differently in post-test. However, performance of Group C is not found different in pre-test and post-test.

Conclusion

In the process of acquisition of L2 phonology, learners' exposure to the frequent samples of the target sounds in input has a 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 the front vowels of the experimental group A. However, inconsistent provision of input slightly affected the spectral and temporal dimension of front vowels. No significant difference was observed in the pre-test and post-test vowels of control group C.

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 the 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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