Acquisition of English [ɹ] by adult Pakistani learners

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Abstract

The paper is based on perception and production tests conducted with 90 adult Pakistani learners of English with the aim to study their acquisition of English [ɹ]. The study is conducted in the SLM paradigm hypothesizing that learnability of an L2 sound is proportional to the perceived phonetic distance between the target L2 and the corresponding L1 sound. The results show that Pakistani learners can discriminate English [ɹ] from [w] and [l] but they develop strong equivalence classification between English [ɹ] and the L1 [ɾ] in their L2 phonemic inventory.

1. Theoretical background

Various models have been developed to account for acquisition of L2 sounds by adult learners. The Speech Learning Model (hereafter SLM) by Flege (1995) is one such model which particularly focuses on advance/experienced learners (Best & Tyler 2007). The model predicts a correspondence between perception and production of L2 sounds. According to the SLM, L2 learners produce sounds of an L2 in the way they perceive them (Flege 1995:239). The model further predicts that if a particular sound of the L2 is perceived by L2 learners as different from the closest L1/L2 sound(s), a new phonetic category is developed by the learners for the L2 sound. But, if they cannot perceive a difference between an L2 and the closest L1 (or L2) sound, equivalence classification between the two sounds (where two sounds are equated to each other) takes place which blocks the establishment of separate phonetic representation for the L2 sound. According to Flege (1995), learnability of an L2 sound is proportional to the perceived phonetic distance between the L2 sound and the closest sound(s) of either the L1 or L2. The SLM provides seven hypotheses which predict learning outcomes in different contexts. Out of those, 3 hypotheses which are related to the current study are reproduced below from Flege (1995:239):

Part of
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> 1. "A new phonetic category can be established for an L2 sound that differs phonetically from the closest L1 sound if bilinguals discern at least some of the phonetic differences between the L1 and L2 sounds."
> 2. "The greater the perceived phonetic dissimilarity between an L2 sound and the closest L1 sound the more likely it is that phonetic differences between the sounds will be discerned."
> 3. "Category formation for an L2 sound may be blocked by the mechanism of equivalence classification. When this happens, a single phonetic category will be used to process perceptually linked L1 and L2 sounds (diaphones). Eventually, the diaphones will resemble one another in production."

Studies conducted in the SLM paradigm normally use 'goodness of fit' tests arranged with either monolinguals or early stage adult L2 learners to gauge how similar or different an L2 sound is from the closest L1 or L2 sounds. On the basis of such tests, perceptual mapping of L2 sounds in the phonemic inventory of learners is determined and predictions about expected learning pattern are made. For example, Guion et al. (2000) conducted an experiment with inexperienced Japanese learners of English to determine perceptual mapping of the Japanese learners for English consonants. Levy (2009:2680) developed a "cross-language assimilation overlap method" which assumes that the percentage of overlap between L1 and L2 sounds in the perception of monolingual speakers of the L1 of a group of learners may be used to determine the perceptual distance between the L2 and the corresponding L1 sounds. In this study (Levy 2009) the results obtained with one group of subjects were used to develop hypotheses for other groups of L2 learners.

The current study focuses on perception and production of English [ɹ] by adult Pakistani learners who speak Saraiki as L1. Saraiki is an Indo-Aryan language spoken in central Pakistan (Shackle 1976) which has a rolled [r] with phonemic aspiration contrast. (See the phonemic inventory of Saraiki in Appendix A) Saraiki [r] has been defined by Varma (1936:80) in the following words:

> "[r] is a rolled consonant generally accompanied by two rapid taps of the tongue against the teeth-ridge […]. In the initial position as in [ris (əris)] 'envy', it often tends to begin with a vocalic on-glide and sounds somewhat like [ər]."

Saraiki [r] is produced as a trill in stressed syllable, emotional speech or in some rural dialects. There is a free variation in Saraiki between rolled [r] with two taps and trilled [r] with continuous taps.

2. Hypotheses

In order to develop hypotheses on the expected pattern of learning in light of the predictions of the SLM, we need to calculate perceptual distance between English [ɹ] and the closest L1 and L2 sounds. The distance was calculated on the basis of overlapping in perception of Saraiki monolinguals following the "cross-language assimilation overlap method" (Levy 2009). For the purpose, a perception test was conducted with 10 Saraiki monolinguals. The experiment was based on two discrimination tasks. The first was a 3 alternative forced choice (3AFC) discrimination task. In this task, the participants were asked to listen to three sounds and determine if any two of those were similar. The instructions were given to the monolinguals in the L1. There was one trial for each of the following set of stimuli used in this test. The following nonsense syllables of English sounds spoken by a female native speaker of English (aged 27) were played in the following sequence:

1. [ala], [ana], [aɹa]
2. [aɹa], [awa], [aja]

The purpose of this test was to assess whether the Saraiki monolinguals assimilate English [ɹ] to [l], [w], [n] or [j]. In the discrimination of the [l], [n] and [ɹ] set, out of total 10 participants, 4 participants assimilated [ɹ] with [l] while 6 did not assimilate it with [l]. None of the monolinguals assimilated [ɹ] with [n]. In the set of stimuli which carried [ɹ], [w] and [j], 4 monolinguals discriminated [ɹ] from [w j] accurately. The remaining 6 assimilated [ɹ] with [w]. None of them assimilated [ɹ] with [j]. Thus the 3AFC discrimination test shows that the Saraiki monolinguals perceptually assimilate English [ɹ] with [l] and [w] but not with [j] or [n]. The sounds [w j l n] exist in the phonemic inventories of both Saraiki and English.

The second part of the experiment was an AX discrimination task in which a pair of VCV stimuli was played to the monolinguals who were asked to determine whether these sounds were the same or different. The first member of the set of stimuli was a nonsense syllable [ara] comprising of Saraiki [r] with low vowel [a] on both sides spoken by a female native speaker of Saraiki (aged 39) and the second one was English [aɹa] spoken by a female native speaker of English. Each of the stimuli had three repetitions in this test. The purpose of this test was to see if the Saraiki monolinguals could perceive a difference between English approximant [ɹ] and the L1 rolled [r]. Out of 10 monolinguals, only two discriminated English [ɹ] from the L1 [r] in all three trials consistently and 2 of them discriminated it in one

out of three trails. Thus the total percentage of accurate discrimination was 26.7% while 73.3% of the time the monolinguals assimilated English [ɹ] to the L1 [r]. The overall results of the experiment are summarized (in percentage) in Table 1 below.

Test	Stimuli	Discrimination	Assimilation	Total
3AFC	English [ɹ] & English [l]	60	40	100
	English [ɹ] & English [w]	40	60	100
	English [ɹ] & English [j n]	100	-	100
AX	L1 [r] & English [ɹ]	26.7	73.3	100

Table 1 – Perception test results with Saraiki monolinguals (in percentage).

Table 1 shows that Saraiki monolinguals perceptually assimilate English [ɹ] with the L1 [r] 73.3% of the time while 26.7% of the time they discriminate it from the L1 [r]. And the 3AFC test shows that they assimilate English [ɹ] with English [w] and [l] 60% and 40% of the times, respectively. Following the idea of overlap between sounds (Levy 2009) we assume that there may be a maximum of 73.3% overlapping between English [ɹ] and Saraiki [r], 60% overlapping between English [ɹ] and [w] and 40% overlapping between English [ɹ] and [l] in the L2 phonemic inventory of the Saraiki learners of English. On the basis of these results we develop the following hypotheses about expected learning pattern of Pakistani learners of English:

1. The Pakistani learners of English will acquire English [ɹ] accurately because they are likely to discriminate English [ɹ] from the closest sounds.
2. Alternatively, they will either assimilate it to [l], [w] or the L1 [r] with the directionality of difficulty of discrimination (from least to most difficult) as follows:

$$[l] \rightarrow [w] \rightarrow [r]$$

Thus, if Saraiki learners can discriminate between English [ɹ] and Saraiki rolled [r], they will acquire the English [ɹ]. The likelihood of this is a maximum of 26.7% according to the perceptual mapping of the Saraiki speakers of English [ɹ] based on the monolingual test. If a difficulty is experienced, the interfering sounds are likely to be [l w r] with varying levels of interference as determined by the monolingual tests discussed above. To test these hypotheses, we conducted an experiment which is detailed in the following section.

3. Research methodology

Perception and production tests were conducted with 90 adult Pakistani learners of English to test the hypotheses developed in section 2. The perception test comprised an AX discrimination task, two 3AFC discrimination tasks and an identification task. The 3AFC tasks and AX discrimination task followed the same procedure as with the monolinguals discussed in section 2. In the identification task, the stimulus [aɹa] spoken by the native speaker of English was played to the participants who were asked to write down in English and Urdu on a given answer sheet what sound they heard between the two vowels. They were further informed to point out if they think that the sound they heard did not match with any of the existing graphemes of Urdu and English. See Appendix for answer sheets.

The production test comprised a word-reading task. The target word was *reach* which the participants read along with some other words. Each of the words was read three times by each of the participants. The other words included in the list of the stimuli were distracters so the participants did not have an idea of the purpose of the test. The readings of the participants were recorded and out of the three repetitions, the best quality recording was provided to four native speakers of English who evaluated these productions on a Likert scale given below:

Criteria	Marks
Native-like	5
A little deflected away from native-like	4
Different from natives but understandable	3
Hardly understandable	2
Unintelligible	1

Table 2 – Scale of marking used by the native speakers.

A cut off point of 4 on the scale is set as indicative of near-native production. Thus any production of the target sound that gets a score of 4 or above will be considered as a correct production of the target sound. A score of 4 (not 5) is considered the cut off point for learning because it is extremely rare for the adult L2 learners to acquire quite native-like production. That is why the SLM also predicts that a new phonetic category for an L2 sound established by an adult learner may be deflected away from that of monolinguals of the L2 (Flege 1995:239).

3.1 Participants of the study

Three groups of learners were selected for this study with the goal of evaluating whether continued exposure improved learners' production and perception of English [ɹ]. In Pakistan English is taught as a compulsory module to students from primary to Bachelor's level and is used as the medium of instruction in many disciplines at post secondary level. All groups involved advanced learners who had been learning English for at least 14 years but they differed with respect to whether they (a) actively used English, (b) specialised in English at MA level, or (c) had exposure from English native speakers. Group (i) consisted of 30 educated adults based in Pakistan who were all graduates from Pakistani universities specialised in non-linguistic/English language courses. This group only uses English for academic purposes or for official correspondence. Thus we call them 'Inactive Learners' of English. Group (ii) consisted of 30 students of MA English studying English language, linguistics and literature in Pakistan. In the following discussion we shall refer to this group as 'Student' group. Group (iii) consisted of learners based in Essex (UK) who left Pakistan after getting their first degree from Pakistan. They will be referred to as UK-based learners in the following discussion.

The participants of all groups originate from the same area; all speak Saraiki as L1 and all studied in similar type of institutions in Pakistan. The purpose of including the UK and Student learners in the study is to assess the role of native-input in the former and that of the active learning in Pakistan in the latter group in acquisition of English [ɹ]. The performance of the Inactive Learners will be used for comparative analysis as all groups of learners were similar up to BA level. Afterwards, the Student group went to MA English courses and the UK group came to England. Thus, the better performance of the Student learners vis-à-vis the Inactive Learners will be ascribed to their active learning of English in Pakistani universities. Similarly, any improvement noted in the UK group vis-à-vis the Inactive Learners will be ascribed to the input that the former are getting in the UK.

3.2 Stimuli

The stimuli were recorded in the voice of a female native speaker of English in a psycholinguistic laboratory of University of Essex. The target consonants were recorded with a low vowel on each side i.e. [aɹa] etc. The stimulus for Saraiki [r] was recorded in the same form i.e. [ara] in the voice of female native speaker of Saraiki. These stimuli were used in the perception test. The methodology used for these tests was the same as discussed in section 2.

4. Presentation of data

In this section the results of the perception and production tests are presented separately. The perception test results are presented first followed by the production test results.

4.1 Perception of [ɹ]

As mentioned above, the perception test consisted of an identification task, an AX discrimination task and two 3AFC discrimination tasks. Table 3 shows the perception test results in percentage. The results show that in the identification task and in the 3AFC-1 task the UK group performed better than the Student group who in turn performed better than the Inactive Learners group. However, in the 3AFC-2 discrimination task, the performance of all three groups is equally good. In the AX discrimination task, Inactive Learners group performed better than the other two groups in contrast to the trend seen for the identification and 3AFC-2 discrimination task. However, overall performance of all the groups is poor in the AX discrimination test. A non-parametric test confirms the group variance as statistically significant in the identification task (χ^2=17.603, p<.001), the 3AFC-1 discrimination task (χ^2=13.075, p<.001), and the AX discrimination task (χ^2=9.068, p<.01). The increasing trend in the performance of the groups is also significant (p<.001). However, group variance in the 3AFC-2 discrimination task is non-significant (p>.1).

	Identification	Discrimination		
Group	[ara]	3AFC-1 [r w j]	3AFC-2 [r n l]	AX (L1/r/-L2 /ɹ/)
UK	93.33	93.10	93.33	33.33
Student	788.9	80.00	83.33	26.67
Inactive learners	50.00	53.33	86.67	53.33

Table 3 – Accuracy (in percentage) in perception test.

4.2 Production of [ɹ]

The production test was based on a word-reading task. Four native speakers of English evaluated the productions. The overall reliability in evaluation by the judges was 62% (Cronbach's alpha=.622). The following are the average scores obtained by the participants for the production of English [ɹ] in the word *reach*. The standard deviations are given in parentheses.

Group	Mean score
UK	3.72 (.60)
Student	3.68 (.32)
Inactive learners	3.41 (.48)

Table 4 – Average scores in the production of [r].

A one-way ANOVA shows significant group variance ($F_{2,87}$=7.165, p<.001)[1] but a post-hoc analysis only confirms variance between UK and Inactive learners (p<.001). The results show that the learners did not perform well in this test. None of the groups could obtain an average score of 4 which was fixed as a minimum cut off point for learning. Although the scores only point out the relative performance of the participants in the production of the target sound (not the actual nature of the consonant produced by the participants), later acoustic analysis shows that the learners produced English [ɹ] as L1 rolled [r]. The results of perception and production test are analyzed and discussed in the following section.

5. Analysis and discussion

The production test results show that the learners have very poor production of English [ɹ] as in the production test none of the groups of learners could obtain an average score of 4 which is the cut off point for considering them as having acquired the target sound. The perception test results show that the performance of all groups including the Inactive learners is excellent in the discrimination of [ɹ] from [l] which indicates that the learners can discriminate English [ɹ] from [l] from early stages of learning. The reason of including [l] ~ [r] contrast in the perception test was to evaluate how well Pakistani learners can discriminate the two sounds since previous research on some L2 learners of English has shown perceptual assimilation of [r] with [l] (e.g. Brown 1998, 2000; Flege et al. 1996; Larson-Hall 2004). In the identification and 3AFC-1 discrimination tests, the UK and Student participants performed better than the Inactive learners. In 3AFC-2, all three groups performed equally well. The 3AFC-1 test was based on discrimination between [ɹ] and [w j] and the 3AFC-2 was based discrimination between English [ɹ] and [l n]. It means both the Student and UK learners have learnt to discriminate [ɹ] from [j w l n] and the Inactive group has learnt to discriminate it from [l n]. However, in the

1 A Kolmogorov-Smirnov test confirms the normal distribution of the data (p>.05).

AX discrimination test, all participants are poor as they cannot perceive the difference between English [ɹ] and the corresponding L1 [r].

This performance of the learners corresponds with that of the Saraiki monolinguals who also assimilated English [ɹ] with [l], [w] and L1 [r] (see Table 1). However, the results show that the L2 learners are faced with the difficulty to acquire English [ɹ] in the initial stages but some learning must have occurred which reflects the improved performance of the 3 groups of learners. The performance of the 3 groups reveals a particular directionality of learning. The Inactive group who have the least use of English have learnt to perceive the difference between [ɹ] and [l] but are not able to discriminate English [ɹ] from [w] and L1 [r]. The UK and Student groups learnt to differentiate English [ɹ] from [l] and [w] with an accuracy of 80% or above (see Table 3). The two groups could however not discriminate between English [ɹ] and L1 [r] and only have an accuracy rate of <34% for this contrast. These subjects performed well in the identification task and the 3AFC discrimination task because these tasks involved their ability to differentiate English [ɹ] from all the other consonant sounds of English. But the AX discrimination task results show strong equivalence classification between English [ɹ] and L1 [r] in the L2 phonemic inventory of these learners. As a result they produced the approximant English [ɹ] as a rolled [r] as in the L1 (explaining the poor scores they received in the production task). The overall results show a clear learning pattern with respect to the discrimination of English [ɹ] from [w], [l] and L1 [r]. The directionality of difficulty for the learners (from least to most difficult) is as given below:

$$[l] \rightarrow [w] \rightarrow \text{L1 } [r]$$

Thus Pakistani learners first learn to discriminate English [ɹ] from [l] (as the performance of all participants shows) followed by the discrimination of [ɹ] from [w] based on training and greater input (see the performance of the Student and UK group). The greatest difficulty comes from the discrimination of English [ɹ] from the L1 [r] which even the UK-based group with the input from native speakers cannot overcome. The most advanced Pakistani learners are therefore only able to develop separate representations for English [ɹ] from [w] and [l]. We can depict the emerging learning process in the 3 groups in Figure 1.

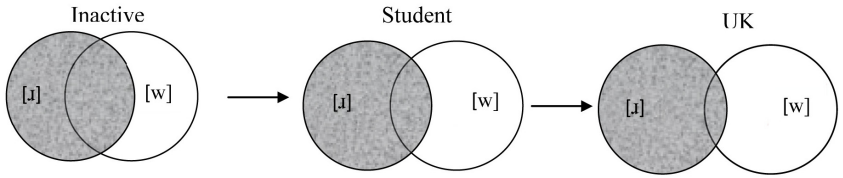

Figure 1 – Development of discrimination between L2 [ɹ] and L1 [w].

The above figure shows that in the L2 phonemic inventory of the Inactive learners [ɹ/r] and [w] overlap to a large extent while this is less so in other groups who manage to separate the two sounds and mainly treat them as separate categories. The UK group fairs best in the separation while the Student group can be predicted to show more variable discrimination because of the higher overlap.

The above results are based on collective group performance. If we consider individual performance and use 4 as the near native-like performance cut off point in the production test then there are 3 UK-based participants who have a near native-like performance in the production and perception of English [ɹ]. These 3 participants perceived English [ɹ] accurately in all repetitions of all the perception tasks and also obtained a score of 4 in production task. We can conclude that only 3 UK-based participants developed an independent phonetic category for English [ɹ]. This is illustrated in the following figure which contains two spectrograms of the word *reach* as produced by one of the 3 native-like participants (left spectrogram) and by another participant who is as yet unable to discriminate between English [ɹ] and L1 [r] (right spectrogram).

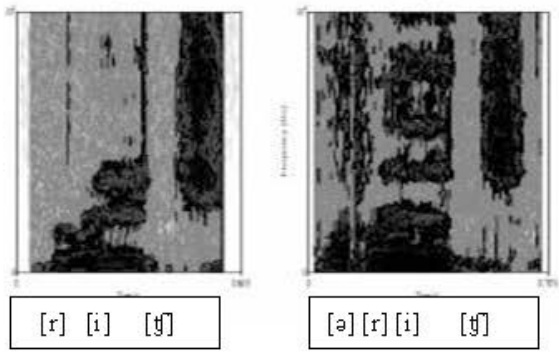

Figure 2 – Spectrograms of the word 'reach'.

The left-hand spectrogram shows that the participant who was able to discriminate English [ɹ] from the L1 [ɾ] produced the word *reach* with an approximant gesture word-initially but the participant who could not discriminate between English [ɹ] and the L1 [ɾ] produced the English [ɹ] in the word *reach* with a tap or trill as the right hand side spectrogram shows. Besides, on the pattern of the L1 [ɾ], the participant has also added a vocalic gesture in the beginning of the word *reach* virtually producing the word *reach* as [əriʧ]. This demonstrates that most of the learners could not acquire approximant [ɹ] in English; some of them even failed to suppress the epenthesis of initial vocalic gesture in the words of English starting with [ɾ] (a phenomenon transferred from the L1). The epenthetic vowel in the beginning of the word *reach* produced by the participant is clearly reflected in the following waveform highlighted in a rectangular box. This is an example of negative transfer from the L1 as a result of a strong equivalence classification between L2 [ɹ] and L1 [ɾ].

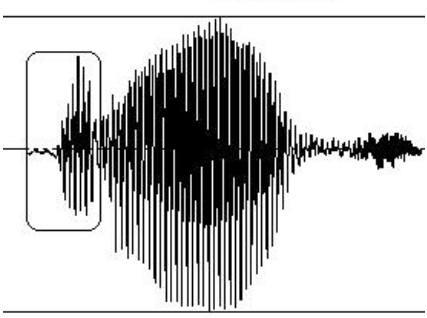

Figure 3 – Waveform of the word *reach* by one of the participants.

6. Conclusion

This paper reported on an experiment that whether Pakistani learners of English will acquire English [ɹ] accurately or assimilate it with [w], [l], or the L1 [ɾ]. The results show that although there has been some progress in the acquisition of English [ɹ], the learners have not accurately acquired English [ɹ] even though there are individual participants who show that such acquisition is possible. On the basis of the results from the 3 groups we are able to map out a clear developmental path in the discrimination of English [ɹ] from the closest sounds namely [l], [w] and L1 [ɾ]. The group with the least exposure to English post classroom learning (Inactive Learners) show the least acquisition and are

only able to discriminate English [r] from [l]. The intermediate group in terms of exposure (Student learners in Pakistan), who because they have specialised in English at MA level have a higher English usage than the first group, are better at the discrimination of English [ɹ] from [l] and can also discriminate it from [w]. The most advanced group in terms of more systematic day to day exposure to English in the UK have overall better results even though they still fall short of the accurate acquisition of English [ɹ].

The overall developmental path attested is parallel to the performance of the Saraiki monolinguals who showed a variation in the discrimination of English [ɹ] from the closest sounds, with accuracy gradually declining from [l] (60%) to [w] (40%) to [r] (26.7%). This verifies the idea of the SLM that "the greater the perceived phonetic dissimilarity between an L2 sound and the closest L1 sound, the more likely it is that phonetic differences between the sounds will be discerned". The SLM is further supported by an individual analysis of the results which shows that the three participants of the UK-based group who could perceive a difference between English [ɹ] from the closest sounds including L1 [r] are also able to produce English [r] accurately.

There are two outstanding issues. The first one is regarding why the Inactive Learners group with the least English exposure performed better than the other two groups in the AX discrimination task (see Table 3). This may be better considered not within the framework of second language acquisition, but within a sociolinguistic one. It might well be that people employing English for professional purposes are more aware of the difference between their own and the native pronunciation, without being able to reproduce it. In this respect 'Inactive learners' are really inactive in their production, i.e. fossilized with respect to the other two groups currently exposed to different kinds of input, that they cannot produce the L2 sound different from the closest L1 sound although most of them perceive the difference between the L1 and L2 consonant.

The second issue is that of the insertion of an epenthetic vowel in the beginning of the words starting with [r] in Saraiki and its implications in the acquisition of L2. In this regard my point of view is that at some stage of its historical development Indo-Aryan languages did not accept word initial consonants (Masica 1993). At that stage all words started with vowels. Later on, it started accepting consonants word-initially but as a remnant of the old traditions the speakers added some vocalic gesture or schwa like insertion in the beginning of the words starting with consonants. Epenthesis of vowel before sonorants and strong pre-voicing in obstruents in Indo-Aryan languages like Saraiki is a remnant of that period of the language history. However, both these issues need further investigations and are left for future research.

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Appendix A: Phonemic inventory of Saraiki[2]

	voice	aspiration	labial	dental	alveolar	retroflex	alveo-palatal	velar	glottal
plosive	-	-	p	t̪		ʈ	c	k	
	-	+	p^h	$t̪^h$		$ʈ^h$	c^h	k^h	
	+	-	b	d̪		ɖ	ɟ	g	
	+	+	b^h	$d̪^h$		$ɖ^h$	$ɟ^h$	g^h	
implosive			ɓ		ɗ		ʄ	ɠ	
fricative	-		f		s		ʃ	x	
	+				z			ɣ	ɦ
nasal	+	-	m		n	ɳ	ɲ	ŋ	
	+	+	m^h		n^h	$ɳ^h$	$ɲ^h$		
flaps		-			ɾ	ɽ			
		+			$ɾ^h$	$ɽ^h$			
lateral		-			l				
		+			l^h				
approximant		-	ʋ				j		
		+	$ʋ^h$						

2 Shackle (1976:18) does not include the breathy voiced alveo-palatal nasal in the consonantal inventory of Saraiki but the sound does exist in the language. Examples are words like, /kaɲʰā,/ 'late' and /māɲʰar/ 'castrated'.

Appendix B: Answer sheets

1: Answer sheet for the identification test

Instructions for the participants: You will listen some consonants of English each flanked by a long vowel [a] on both sides. After listening the consonants, just note in the blank space provided in the sheet the consonant you have heard between two a's. Also note the same consonant in Urdu in the next column. If the sound does not exist in either of the languages, please point out in column three of the sheet.

S.No.	Consonant	Corresponding letter in Urdu	Remarks
1	aa…….aa		
2	aa…….aa		
3	aa…….aa		
4	aa…….aa		
5	aa…….aa		
6	aa…….aa		
7	aa…….aa		
8	aa…….aa		
9	aa…….aa		
10	aa…….aa		

2: Answer sheet for 3AFC discrimination test

Instructions for the participants: First the target sound will be played. After a pause a pair of sounds will be played. If the first sound of the pair matches the target, tick in column A of the answer sheet, if the second one matches the target sound tick in column B and if neither of the sounds matches with the target sound, cross (×) in column C.

S. No.	Column A (1)	Column B (2)	Column C (×)
1			
2			
3			
4			
5			

3: Answer sheet for the AX discrimination test

Instructions for the participants: Please listen to the pairs of sounds and determine if the consonants in the sounds are identical or different by ticking in the relevant column. Please ignore the difference in tone, pitch and intonation of the speakers and decide only on the basis of the consonant between two vowels.

S. No.	Identical	Different	Remarks
1			
2			
3			
4			
5			