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Acquisition of Hindi's 4-way Laryngeal Contrast by the speakers of 2-way Contrast Languages

In this paper, we investigate how two languages which differ from Hindi along the laryngeal dimension fare with the category perception of the Hindi's laryngeal contrasts. Hindi, with phonemic contrast in aspiration and voicing, differs from Malayalam which lacks phonemic aspiration and Meeteilon which lacks phonemic voicing in word initial position (see table 1). The study begins with the following theoretical predictions:

i. Due to the existing perceptual category of L1 sounds, perception of novel L2 sounds would be coloured by L1 categories (Best 1994, Best & Tyler 2007)
ii. The constraint rankings of L2 grammar would be influenced by the constraint rankings in L1 grammar. (Eckman et al. 2003).

Table1: Laryngeal contrast for the three languages

Contrast	**Hindi**	**Meeteilon**	**Malayalam**
Plain voiceless (T)	pal 'sail'	pa 'eyelash'	ɖaɭəm 'petal'
Voiced (D)	bal 'hair'		ʈaɭəm 'courtyard'
Voiceless aspirated (TH)	p^hal 'ploughshare'	p^ha 'catch'	
Voiced aspirated (DH)	b^hal 'forehead'		

Since correctly categorizing the perceived L2 segment requires the learner to parse it from the L2 phonological grammar (Boersma & Hamman 2009, Hancin-Bhatt 2008), a sub-optimal categorization of the target segment will reveal the interaction between L1 and L2 grammars: categorization of absent contrasts (D, DH in Meeteilon and TH, DH in Malayalam) is predicted to be suboptimal. Further, interaction of the universal phonological forces may yield an effect: *markedness reduction* is predicted to enforce reduction of marked structures whereas *preservation of the marked* is predicted to enforce their preservation in prominent positions (de Lacy 2006). If the 4-way contrast of Hindi is given in a category perception task, the L2 learners of Meetei and Malayalam may make two types of error motivated by these forces:

Error type	**Effects on category presented**	**Phonological force**
The selected phoneme is less complex	DH→D, DH→TH, TH→T, D→T	Universal principle of markedness reduction
The selected phoneme is more complex*	TH→DH, D→DH	Preserve and maximise the markedness awareness

*:T type contrast is predicted to not participate in this process because the markedness (privative) constraints do not operate on it.

Literature on acquisition shows that L1 learners make only type 2 error (Smolensky 1996, Gnanadesikan 2004). Does the same hold for L2 acquisition? We investigate these predictions in word initial position through a forced-choice category perception task and analyse the data through markedness and faithfulness constraint interaction within Optimality Theory (Prince and Smolensky 1993/2008, McCarthy 1993).

Design: Based on two preliminary investigations that we previously undertook (laryngeal and place co-occurrence restrictions), we selected 2 independent factors: laryngeal contrast with four levels (T, D, TH, DH) and place contrast with two levels labial (L) and velar (V) places, yielding 8 conditions: T-V, D-V, TH-V, DH-V and T-L, D-L, TH-L, DH-L.

Items and participants: The target segments were placed in the template /-a:n/, yielding 8 strings. Two native Hindi speakers (one male and one female) produced these strings embedded in a preverbal position, three times. The target strings were spliced keeping the phonetic cues as is and were pitch-normalized. There were 20 adult participants in each test group. Participants' fluency in Hindi was measured by averaging the scores of a sentence comprehension task and their self-reported fluency rating.

Control	**Target**
Hindi (mean age 25.5; Hindi fluency: 91%)	Meeteilon (mean age 24.1; Hindi fluency: 59%)
	Malayalam (mean age 21.9; Hindi fluency: 56%)

Method: The target stimulus was presented as an audio and four contrastive options were subsequently displayed on the screen. The participants had to select the option they found the most similar to the audio input heard. Feedback on correctness ("correct"/"incorrect") was provided on each trial to bootstrap the learning. Each participant saw exactly 6 novel tokens of each condition interspersed with an equal number

of fillers, in a randomized order. The experiment was conducted on PCIbex PennController 2.0 (Zehr and Schwarz 2018) web-based interface.

Expectations: (i) Since Meeteilon and Malayalam's laryngeal contrasts are subset to that of Hindi, overall, the Hindi group would fare better than both groups. **(ii)** Since Malayalam and Hindi exhibit voicing contrast but Meeteilon does not, Malayalam and Hindi groups would fare better at voicing perception. **(iii)** Since Meeteilon and Hindi exhibit aspiration contrast but Malayalam does not, Meeteilon and Hindi groups are predicted to fare better at aspiration perception. **(iv)** Place L will facilitate voicing perception and V will facilitate aspiration perception due to their inherent phonetic biases.

Results: All expectations hold for statistically significant difference (α=0.05) except for **(ii)**: the Meeteilon group did significantly worse at voicing conditions (p=0.015), but the Malayalam group did worse at both voicing (p=0.0001) and aspiration (p=1.35E-07) conditions (see graph1&2). Moreover, the types of errors made is negatively correlated with participants' fluency in Hindi: -0.52 for Meeteilon and -0.97 for Malayalam.

Analysis: A qualitative analysis of these differences reveals that when learners (from both the target groups) wrongly categorize aspiration or voicing, they tend to favour markedness and categorize them as voiced aspirates (e.g., $p^h \rightarrow b^h$ and $b \rightarrow b^h$) instead of disfavouring markedness (p=0.01 and 0.001 for Malayalam and Meeteilon, respectively). This effect stems naturally when we envisage that the markedness preservation (and amplification) takes central stage in the L2 learners (see graph 3&4). This route is exactly opposite to the first language acquisition where the initial state yields unmarked structures (Smolensky 1996, Gnanadesikan 2004). Further, there is a negative correlation between the error type count and fluency which shows that interlanguage grammars stabilize as learners attain greater target language fluency, as shown below.

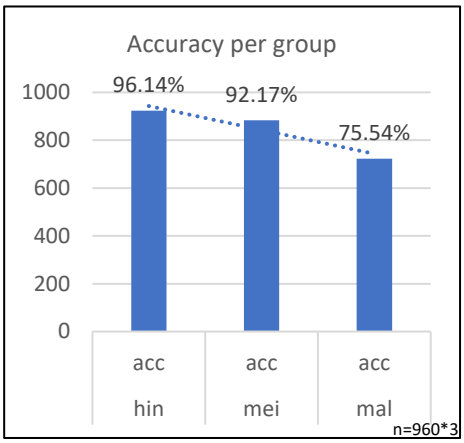
Table2: Error types by target groups compared to Hindi's ranking (Faith[vc], Faith[sg], Faith[vc]+ Faith[sg]>>*[vc], *[sg], *[vc]+*[sg])

Meeteilon							
Average Hindi Fluency (%)	**Participant**	**Error type count**	**Voice insertion**	**Voice deletion**	**Aspiration insertion**	**Aspiration deletion**	**voicing and aspiration deletion**
87.5	Ki, Oi, Pi, Ri	0					
44.5	Ai, Ci, Di, Qi	1			×		
40	Li	1				×	
61.6	Ei, Fi, Gi, Hi, Ii, Ji, Mi, Ti	2			×	×	
55	Bi, Si	3	×		×	×	
40	Ni	4	×	×	×	×	
Malayalam							
90	Mii	0					
70	Oii	1	×				
56.7	Nii, Pii, Lii	2	×	×			
56.7	Dii, Eii, Iii	2			×	×	
56.8	Bii, Cii, Gii, Kii, Qii	3	(×)	×	(×)	(×)	
38.3	Aii, Fii, Rii, Tii, Hii	4	(×)	×	×	×	
20	Sii, Jii	5	×	(×)	×	×	×

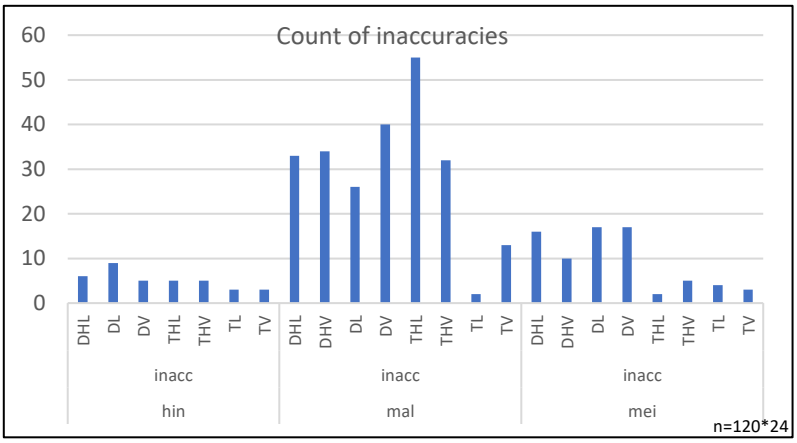
Note: parentheses indicate error variation among participants in the fluency set.

Discussion: This study highlights a crucial difference in the initial state of first and second language acquisition. In that, the second language learners prefer marked structures over faithful structures (FAITH[M]>>*M) whereas consistent research has shown that in child language acquisition unmarked structures are preferred (*M>>FAITH[M]). This finding may not be limited to segmental or phonological acquisition but may be sufficiently extended (with due research) to syntactic acquisition as well. We will further investigate the depth of this insight from multiple angles. Moreover, the failed hypothesis **(ii)** suggests that Malayalam speakers parse the unfamiliar words from the default *native* Malayalam phonological strata (*LAR>>FAITH[LAR]) instead of the *non-native* Sanskrit phonological strata (FAITH[LAR]>>*LAR) (Shridhar 2017, Mohanan 2012). This inference is further supported by the finding that none of linguistic groups show any significant difference between T-type condition (p=0.051), where markedness constraints do not interact.

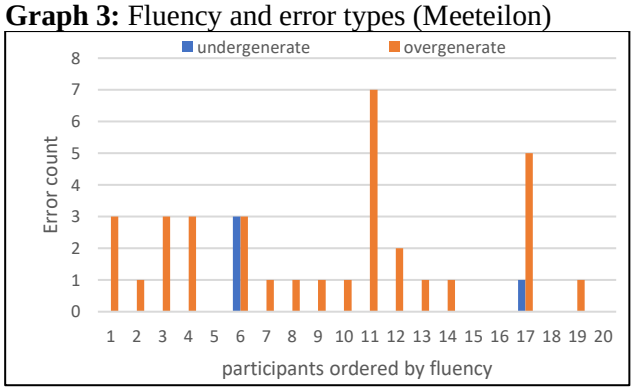
Graph 1: Language wise accuracy



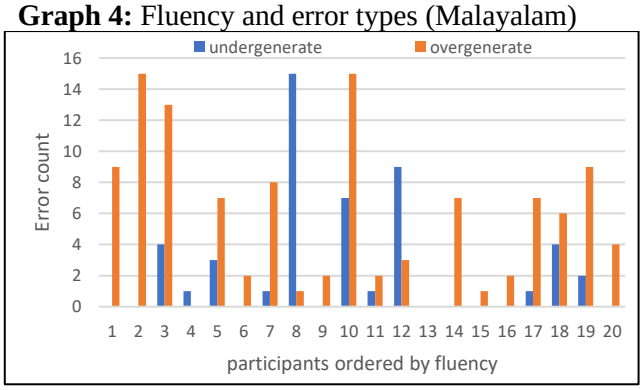
Graph 2: condition and language wise inaccuracy



Graph 3: Fluency and error types (Meeteilon)



Graph 4: Fluency and error types (Malayalam)



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