Can Different Letter Position Coding Theories Apply to One Language? Interesting Evidence from Lexical Decision Task in Hindi

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In this study, five contrasting theories of letter position coding were tested for Hindi words by carrying out a masked priming Lexical Decision Task: Slot Coding, Wickelcoding, Discrete Open Bigram coding, Continuous Open Bigram coding and Spatial Coding. Relations between different coding schemes and match values between primes and target words are illustrated in figure 1. Opposite relation is expected between coding schemes and reaction times.

Participants: N=69 (Male=53, Female=16), Age range = 18 ~ 35 years (M=25.73, SD=4.94).

Stimuli: 305 4-segment (4 full aksharas) words with maatraas at least at first three segments were taken from Shabd [1]. A 1x9 design was chosen with one factor i.e., prime type with 9 levels i.e. Substitution Neighbours at akshara level (SN_A), Substitution Neighbours at maatraa level (SN_M), Substitution Neighbours at segment level (SN_S), Double Substitution Neighbours at akshara level (DSN_A), Double Substitution Neighbours at maatraa level (DSN_M), Double Substitution Neighbours at segment level (DSN_S), Neighbours Once Removed at akshara level (N1R_A), Neighbours Once Removed at maatraa level (N1R_M), Neighbours Once Removed at segment level (N1R_S). Examples of stimuli are in table 1.

Procedure: It was a lexical decision task. Detailed procedure is shown in figure 2.

Results: Model:log(response_time)~c_a_d_n+c_a_n_s+c_m_d_n+c_m_n_s+c_v_d_n+c_v_n_s+(c_a_d_n+c_a_n_s+c_m_d_n+c_m_n_s+c_v_d_n+c_v_n_s||subject_nr)+(1|target). Contrast codes are in table 2. Differences bet RTs of words preceded by DSN_A and N1R_A primes (Est = 8.543e-03, t = 2.194, $p < 0.05$), N1R_M and SN_M primes (Est=1.047e-02, t=3.188, $p<0.01$), DSN_S and N1R_S primes (Est=1.561e-02, t=3.518, $p<0.001$), and N1R_S and SN_S primes (Est=1.009e-02, t=2.652, $p<0.01$) were found to be significant. The diff bet RTs of words preceded by N1R_A and SN_A primes was found to be approaching significance (Est=6.596e-03, t=1.738, p=0.08). And, the diff bet RTs of words preceded by DSN_M and N1R_M primes was not found to be significant (Est=-4.661e-03, t=-0.876, p=0.38).

Discussion: The results show that RTs of words preceded by DSN primes were largest followed by N1R primes and lowest by SN primes for akshara level and segment level suggesting that letter position coding for aksharas and segments could be explained by spatial coding scheme. At maatraa level, RTs of words preceded by DSN primes N1R primes were similar and larger than that by SN primes suggesting that letter position coding for maatraas could be best explained by slot-coding scheme or wickelcoding scheme. Interestingly different coding schemes seem to apply for *aksharas* and *maatraas*.

References

[1] Verma, A., Sikarwar, V., Yadav, H., Jaganathan, R., & Kumar, P. (2022). Shabd: A psycholinguistic database for Hindi. *Behavior research methods*, 54(2), 830–844.

[2] Davis, C. J., & Bowers, J. S. (2006). Contrasting five different theories of letter position coding: evidence from orthographic similarity effects. *Journal of experimental psychology. Human perception and performance*, 32(3), 535–557.

Figures and Tables

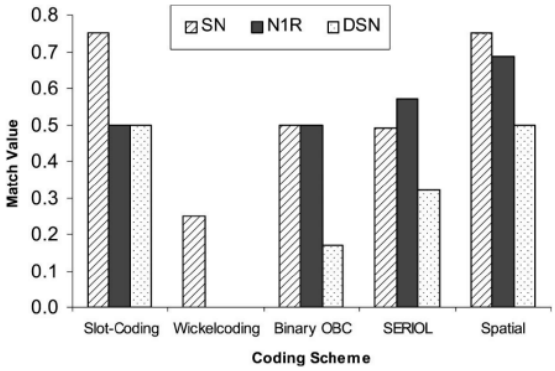

Figure 1: *Match values of different types of primes according to these five competing theories [2]*

Table 1: Description of properties of words selected for the experiments

Stimuli Type	Stimuli
Target word	संबोधित /səmbodʱɪt/ "addressed")
SN_A prime	संचोधित /səntʃodʱɪt/
SN_M prime	संबीधित /səmbidʱɪt/
SN_S prime	संचीधित /səntʃi:dʱɪt/
DSN_A prime	संचोहित /səntʃohɪt/
DSN_M prime	संबीधुत /səmbidʱʊt/
DSN_S prime	संचीहुत /səntʃi:hʊt/
N1R_A prime	संधोचित /səndˬʱotʃɪt/
N1R_M prime	संबिधीत /səmbidˬʱi:t/
N1R_S prime	संधिचीत /səndˬʱitʃi:t/

Figure 2: Procedure of Experiment.

Table 2: Values of contrast codes used in the model for analysing data.

Fixed factor	Condition	Value
c_a_d_n	DSN_akshara	1
	N1R_akshara	-1
	other conditions	0
c_a_n_s	N1R_akshara	1
	SN_akshara	-1
	other conditions	0
c_m_d_n	DSN_maatraa	1
	N1R_maatraa	-1
	other conditions	0
c_m_n_s	N1R_maatraa	1
	SN_maatraa	-1
	other conditions	0
c_v_d_n	DSN_segment	1
	N1R_segment	-1
	other conditions	0
c_v_n_s	N1R_segment	1
	SN_segment	-1
	other conditions	0

Description of Hindi (Devanagari) orthography:

Hindi (Devanagari) is a segmental writing system. A word can be broken down into segments. Each segment is made up of aksharas and maatraas. For simplicity, aksharas can be treated as letter units and maatraas as subsidiary units of these aksharas. A segment can have more than one aksharas and maatraas. Example: the word “कुमुदिनी” has 4 segments i.e. “कु” (made up of akshara “क” and maatraa “ु”), “मु” (made up of akshara “म” and maatraa “ु”), “दि” (made up of akshara “द” and maatraa “ि”) and “नी” (made up of akshara “न” and maatraa “ी”).