LLCd Symposium.
SPEAKERS AND PRESENTATIONS.

Name: Nandini Chatterjee Singh

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Brief Bio: Nandini Chatterjee Singh is a cognitive neuroscientist at the National Brain Research Centre in Manesar, Harayana, India. Her laboratory is focused towards unravelling cortical networks for spoken and written language in typical and atypical populations using a combination of behaviour and functional neuroimaging.

and

Name: Chaitra Rao

Affiliation: National Brain Research Centre, Manesar, India

Brief Bio: Chaitra Rao earned her first doctoral degree in Psychology from the University of Mysore, where she examined different aspects of literacy, including simultaneous reading and spelling acquisition among children learning Kannada and English, skilled word recognition in Kannada and remediation of poor reading in simultaneous learners of Kannada and English. The work for a second doctoral degree in Psychology at Texas A&M University focused on the role of orthography in mediating the representation and access to word morphology in the mental lexicon, with particular reference to Hindi and Urdu. Investigating language behaviour for the better part of a decade led to a strong desire to learn more about the neurocognitive correlates of language perception and production. This led to a postdoctoral fellowship at the National Brain Research Centre in Manesar (Gurgaon, India), where Chaitra is currently engaged in mapping the neural networks underlying word recognition in alphasyllabic Indian languages such as Hindi, besides exploring the neural processing of text messaging. Plans for the immediate future include neuroimaging studies of metalinguistic awareness among bilingual-and-biliterate Indian readers, as well as studies of hemispheric asymmetry in reading Urdu.

Theme: Language and literacy development in the alphasyllabaries

Title of Presentation: Word processing in a non-linear alphasyllabary – the reading network for Devanagari.

Abstract: **Introduction:** Alphasyllabaries are writing systems which have features of both alphabetic and syllabic scripts. Similar to alphabetic systems, alphasyllabaries distinguish vowels and consonants, and like syllabic systems, the grapheme is mapped to a syllable. The basic phonological unit that corresponds to a grapheme in Devanagari, called an akshara, is a syllable but the component consonant and vowel within akshara can

always be visually analyzed, giving it the appearance of an alphabetic system. In Devanagari, the script used for Hindi, most graphemes or aksaras (/ʌkʃʌra:/) represent CV syllables, in which the in-built schwa vowel of the basic consonant aksara is replaced by one of a set of standard diacritics written to the left, right, top or bottom of the aksara, yielding a new syllable. (For example, ट stands for /ʈʌ/, and combines with ◌ी– /i:/ to yield टी – /ʈi:/, and ◌ू – /u:/ for टू – /ʈu:/.) Consonant clusters are similarly written by fusing parts of consonant graphemes with or without a vowel diacritic (e.g., ट्री – /ʈri:/). A large proportion of written Hindi words is therefore visually non-linear and spatially complex. Despite the over 200 million readers of Hindi/Devanagari (extrapolated from Census 2011), scant reading research has so far focused on Devanagari.

Methods:

Behavioral Task: Sixteen, right-handed Hindi readers aged 21 to 46 read aloud 120 Hindi words in twelve alternating 20s-blocks of linear and non-linear words of 10 items each, interleaved with 20s rest blocks (fixation '+'). Stimuli were presented via E-Prime compatible IFIS.

Stimuli: Stimuli comprised of 240 nouns, of which 120 were *linear*, that is, they had no vowel diacritics placed above or below the central plane of text (e.g., रात – /ra:t/ meaning <night>) and the remaining were *non-linear*, that is, they included above-line and/or below-line diacritics (e.g, रेत – /ret/, <sand>).

fMRI: Thirty axial T2 slices were acquired (TR/TE = 2s/35ms, flip angle = 90°, FOV = 230mm, 64 × 64 matrix, in-plane resolution 3.59mm × 3.59mm, slice thickness = 4mm, 1mm gap), making 160 volumes per participant. Pre-processing and analyses utilized the SPM5 toolbox.

Results:

Group-level activations vs. baseline (rest block) were then separately computed linear and non-linear words.

Reading in Devanagari was characterized by robust activations in the Occipito-temporal regions, Superior Temporal Gyri (BA21) and cerebellar regions of both hemispheres. Other common areas of activation included frontal regions in the left precentral gyrus (BA4) and SMA (BA6).

Primary differences were seen between non-linear and linear word reading networks ($p < 0.005$) wherein increased activation was seen in the right hemisphere primarily in the middle temporal gyrus and occipito-temporal regions.

Conclusions:

Unlike the literature on alphabetic scripts, which has suggested a primarily left lateralized network for word reading, our results clearly indicate a bilateral reading network for Devanagari.

The additional activations seen for reading non-linear words may be attributed to increased visual processing demands arising from the complex visuo-spatial arrangement of symbols in Devanagari