



**LLCd Symposium.**  
**SPEAKERS AND PRESENTATIONS.**

- Name:** Thamodharan.A
- Affiliation:** Cognitive Neuroscience Centre, Department of Clinical Psychology, NIMHANS
- Brief Bio:** I am from Narthampatti village in Dharmapuri district of Tamilnadu. I was the Topper in schooldays, stood third in school and first in the class in SSLC examination with 87.45% of marks. I got the first rank in the class in HSC examination with 85.25% of marks. I have participated in various Academic Competitions and won many prizes. I have completed B.E. in 2008 from Anna University-Chennai with specialization in Computer Science. During my college days I had presented a paper about "Mobile Computing" at Govt college of Engineering-Krishnagiri, Tamilnadu. I worked in Tamilnadu Electricity Board as trainee engineer for 1 year. Subsequently I served as Lecturer at Greentech College of Engineering for Women for 6 months. Since the past 11 months I am working as a Junior Research Fellow under DST project "Generativity in Cognitive Networks" in the Cognitive Neuro Science Center, Department of Clinical Psychology, National Institute of Mental Health & Neuro Sciences (Deemed University), Bangalore.  
Area of Interest: Experimental Software Designing, EEG-fMRI Data Processing, Neuro-Computational Theory, Spirituality.
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**Theme:** Language Diversity and Cognitive Science  
**Title of Presentation:** Brain organization of language in Tamil-English bilinguals from rural Tamil Nadu, India

**Abstract:**

**Introduction:**

Multiple languages and multiple language identities are defining features of Indian society. In South India the norm is to speak more than one language. The study attempted to evaluate the brain correlates of language through fMRI in individuals who use two languages for communication at personal and formal context

**Aim:**

To study the brain organization of language in normative Bilinguals

**Method:**

**Sample:** Sixteen right handed young normal male volunteers formed the sample. They were from middle socioeconomic background from rural Tamil Nadu. The age range was from 18 to 26 years with a mean of 22 years and S.D. of 3 years. Education ranged from 12 years to 17 years of schooling with mean of 15 years and SD of 1.81 years. Tamil was their mother tongue which was also taught in the formal setting since inception of schooling at the age of 6 years. English was learnt as second language at school from the age of 8 years. Language proficiency was assessed by subjective report and objective tests of picture description and comprehension of a paragraph read out to them. Tamil was spoken in the home and school/college settings. English was studied in only the formal school and college setting. It was not spoken either at home or with friends. They were fluent in speech and comprehension of spoken and written Tamil. Writing and reading Tamil was also excellent. English reading was fluent, writing was average in fluency. Spoken English was poor. All the volunteers knew only Tamil and English. The sample could be categorized as late and unbalanced bilinguals.

Abstract and concrete nouns and verbs were presented visually in Tamil (e.g. ஒருமை/Orumai-Single, இல்லை/illai-No, ஆண்/Aann-Male, மூடு/Moodu-Close, உயர்வு/Uyarvu-High, பகல்/Pagal-Day) or English (north, pure, good, wet, happy, left). The volunteer generated an antonym for each word. The words were on an average of 2 to 4 syllables in length, were commonly used in that language, and contained 2 to 6 letters (English) and akshara (Tamil). The words were chosen from a pool of 100 commonly used

words in Tamil and in English. Twenty native speakers of Tamil or 20 persons fluent in English were asked to generate antonyms to these words. Only those words to which the same antonym was generated by more than 17 persons in either group were chosen to form the stimuli for the experiment. This ensured uniformity in the difficulty level of the stimuli. Some words were conceptually similar across the two languages while some words were conceptually unique to each language. There were no repetitions of the words within a language.

**fMRI scanning:** MRI scanning was conducted in a 3 Tesla Siemens Magnetom Skyra scanner. Anatomical scan was acquired with a T1 MPRAGE sequence. fMRI was acquired with an EPI sequence. TR was 4 seconds, TE .03 seconds, FOV of 192 mm and slice thickness was 4mm, number of slices obtained was 36, voxel size was 3\*3\*4mm and the matrix was 64\*64. Two block design paradigms with 4 blocks of rest (####) alternating with 4 blocks of active conditions with 10 dynamics in each condition was used. In the first paradigm Tamil words were given in the 4 active conditions. In the second paradigm English words were given in the 4 active conditions. In each paradigm during the active condition the volunteers silently generated antonyms in the same language to the visually presented words. Paradigm 1 with Tamil words was given first followed by paradigm 2 with English words for all the volunteers.

**fMRI analysis:** Version 8 of Statistical Parametric Mapping was used. Realignment, Normalization and Smoothing were done at preprocessing level. General Linear Model with FWE,  $p < 0.05$ , cluster threshold of 5 were applied (1st level analysis). One sample t test was used in the 2nd level analysis.

**Results:** Convergence analysis found common activations between Tamil and English in Bilateral cerebellum, left claustrum, left occipital, left insula, right anterior cingulate areas. Unique activations to Tamil were present in bilaterally in multiple areas of the cerebrum without any activations in the cerebellum. English uniquely activated a smaller number of areas. But activations were present bilaterally in cerebrum and in left cerebellum.

**Conclusion :** In late unbalanced bilinguals, convergence analysis has shown that Tamil and English share pathways of visual (left occipital), subvocal speech (bilateral cerebellum and claustrum) emotional processing (left insula), executive processing (right anterior cingulate). The more widespread brain activations present uniquely in Tamil maybe attributed to the fact that it is their primal native language.