LLCd Symposium.
POSTER PRESENTATIONS.

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Brief Bio: Rajakumri Krishna is currently employed in as a research fellow in Cognitive Neurosciences and Advanced Imaging centre, in NIMHANS. She has obtained a Masters degree in Psychology from Bangalore University, M Phil degree in Clinical Psychology and Doctorate in Neuropsychology from the Department of Clinical Psychology, National Institute of Mental Health and Neurosciences (NIMHANS; Deemed University), Bangalore, India. Her clinical and research interests are in the domains of Neuropsychological assessment, Neuropsychological rehabilitation of neurosurgical, neurological, and psychiatric disorders. She is currently Honorary General Secretary of Karnataka Association of Clinical Psychology (KACP). She would be pursing as a post doctoral fellow in the cognitive neurosciences.

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Title of Presentation: “Effect of education on neural correlates of visual working memory: An fMRI study”

Abstract:

Introduction: Working memory (WM) is responsible for temporarily maintaining and manipulating information during cognitive activity. WM is a functional component of cognition that allow humans to comprehend and mentally represent their immediate environment, to retain information about their immediate past experience, to support the acquisition of new knowledge, to solve problems, and to formulate, relate, and act on current goals. WM is closely related to high-level cognitive abilities such as reasoning, problem-solving, learning, academic achievement in the domain of reading, writing, mathematics, and science. WM models have evolved from a single unitary memory store to a system containing multiple cognitive subsystems responsible for different storage and executive control functions. Environmental influences such as levels of education influence working memory as seen in neuropsychological tests. Our experience at NIMHANS has found that the effect of education is greater than that of age or gender on performance of working memory tests. Compared with college educated subjects the school educated persons performed poorly on working memory tests such as the N back tests in both the verbal and visual modalities. The present study aimed to validate this finding by examining the effect of education on brain activations in an fMRI paradigm.

Aim: To study the neural correlates of visual working memory associated with education. The objectives were to study the neural correlates of visual working memory and to study the impact of educational level in visual working memory in healthy normal volunteers.

Sample: Sample consisted of 64 right handed young adult normal volunteers. There were 34 in the college educated (CE) and 30 in the school educated (SE). The colleges educated were those above 10 years of formal education where as school educated was below 10 years of education. The inability to pursue further years of education was related to lack of opportunities and financial constraints due to socio economic status. The school educated group was employees of the Institute who were posted in different wards to assist ward patients. The college educated sample was trainees/professionals (psychologists, psychiatrists, social workers, speech therapists, audiologist, engineers, nursing students, radiography student)

The mean age of the college educated was 23.67 ± 4.53 years and school educated was 26.06 ± 5.49 years. The mean number of years of education in CE group was 16.58 ± 2.8 years and in SE was 7.93 ± 2.34 years. There were 14 females, and 19 males in CE group. In SE group, the number of males was 18 and females were 12. Out of the 34 volunteers in CE, 8 were dropped from further analysis due to excessive movement or due to technical error of key (button press). The final samples in the CE thus were reduced to 25 volunteers, 12 females and 13 males. The mean age of females in CE group was 23.33 ± 3.26years, for males it was 24 ± 5.1 years, the mean number of years of

education was 17.33 ± 2.14 years for females, where as for males it was 15.84 ± 3.1 years. in the SE, the final sample consisted of only 16 due to either poor performance and lack of activity. There were 7 females with mean age of 30.42 ± 4.99 years and mean number of years of education was 9.42 ± 0.78 years. The mean age for males was 22.77 ± 3.03years, and number of years of education was 8.22 ±1.39 years.

Design. A block rest - active design paradigm was adopted for the study.

Task: The task consisted of rest – active paradigm. A block design paradigm was used with 10 active (with rangoli stimulus) and 10 rest scans (with cross hair stimulus) alternating 4 times totaling to 80 dynamics. Visual working memory was examined with rangoli patterns in a 2 back paradigm. The rangoli patterns were abstract visual stimuli. Rangoli is drawn in front of Indian houses as a sign of auspiciousness and welcome. The rangoli stimuli used in the study were thus culturally familiar to the subjects. There were 9 rangoli patterns which were of uniform complexity and consisted of intersecting lines and angles. The task was specifically chosen so that it can be administered on persons with different levels of education. Volunteers identified the occurrence of the same rangoli pattern after an intervening one by a button press. Rest condition consisted of passive viewing of a cross hair.

Procedure: After obtaining written informed consent, the volunteers were instructed about the paradigm. The task Visual working memory was examined with 9 abstract rangoli patterns in a 2 back paradigm.

fMRI scanning: MRI scanning was conducted in a 3 Tesla Siemens Magnetom Skyra scanner. Anatomical scan was acquired with a T1 MPRAGE sequence. The FOV was 240mm, slice thickness was 0.9mm and the number of slices per slab was 176, voxel size was 0.9*0.9*0.9mm. fMRI was acquired with an EPI sequence. TR was 4 seconds, TE .03 seconds, FOV of 192mm and slice thickness was 4mm, number of slices obtained was 36, voxel size was 3*3*4mm and the matrix was 64*64. A block design paradigm was used wherein 10 active and 10 rest scans alternated 4 times totaling to 80 dynamics. In the active condition the volunteers saw the rangoli patterns while in the rest condition they saw a cross hair. In the active condition the subjects were asked to press a button with their right index finger for the patterns which occurred alternatively (2 back). The reaction time of correct responses was used to calculate the speed of task performance. Hits and false alarms were used to calculate d' as a measure of accuracy of task performance. fMRI analysis: Analysis was done using Statistical Parametric Mapping 8. Preprocessing consisted of Realignment, Normalization and Smoothing. The first level analysis was done. General Linear Model with FWE, $p<0.05$ significance and cluster threshold of 5 were applied (1st level analysis). One sample t test was used in the 2nd level analysis.

Results: Task accuracy was higher in the college educated who activated only the right cerebrum. School education was associated with bilateral cerebral and cerebellar activations.

Conclusion: Increased levels of education are associated with improved visual working memory and activation of task specific area in the brain (right prefrontal cortex).