



Happy Faces Outshine Memory Loss: A Study of Facial Emotion Processing in Alzheimer's Disease, Mild Cognitive Impairment & Healthy Aging

Rajesh PG^{1,2*}, Ramshekhar Menon² and Rashmi Gupta¹



¹Cognitive and Behavioural Neuroscience Laboratory,
Department of Humanities and Social Sciences,
Indian Institute of Technology Bombay, Powai, Mumbai, INDIA

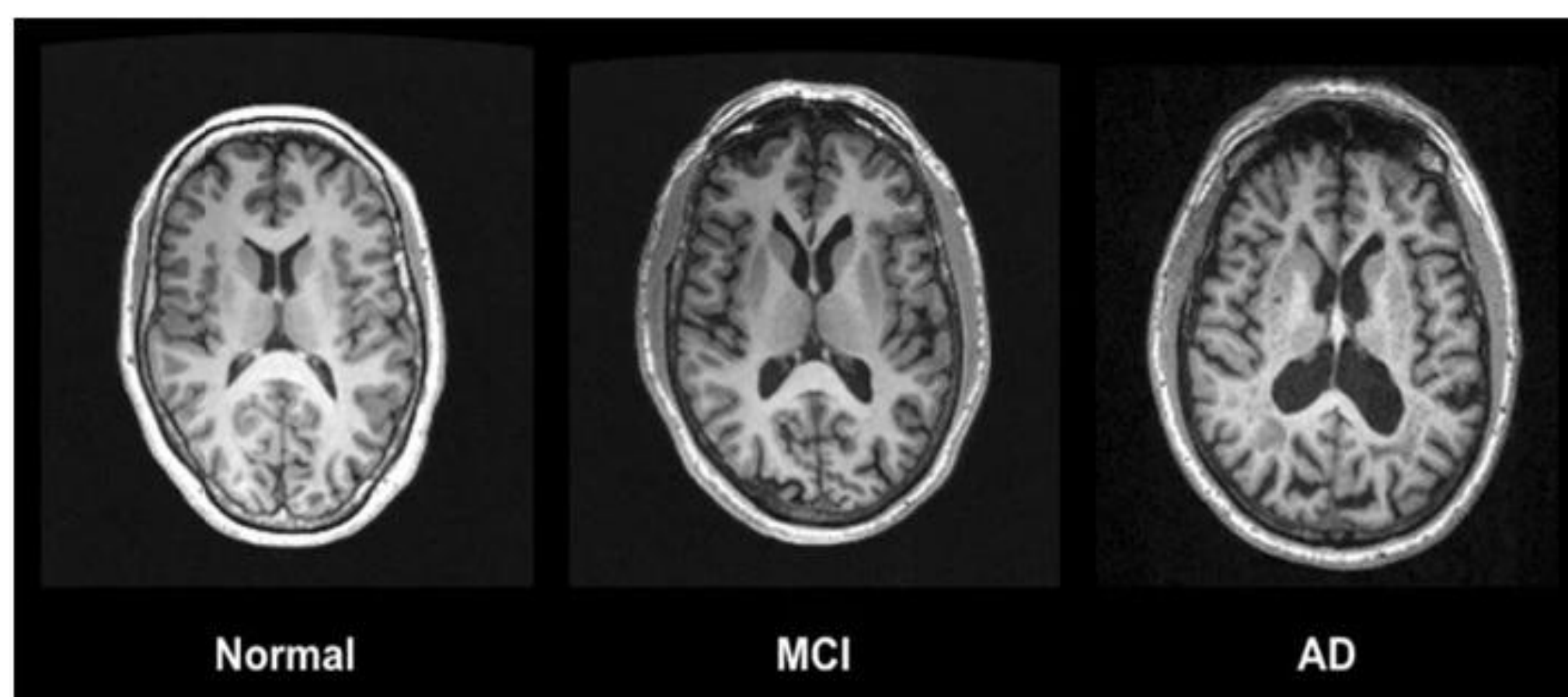
²Cognition and Behavioural Neurology Section,
Department of Neurology,
Sree Chitra Tirunal Institute for Medical Sciences & Technology, Trivandrum, INDIA
pgraieshpillai@gmail.com *

PURPOSE

- The aim of this study is to design and validate facial emotion processing paradigms and study its efficacy in screening patients with MCI or early AD, compared with normal elderly individuals.
- Facial emotion processing can inform significant aspects of cognitive decline in MCI and AD. However, it is not considered as significant domain of neuropsychology testing in current clinical scenario, hence cognitive testing protocol in dementia need to be revised by incorporating modules for emotion processing.

INTRODUCTION

- Alzheimer's disease (AD) is the most common form of dementia which disrupts a person's memory, language, emotion processing, and the ability to think. It is an age-related neurological pathology, which predominantly induces severe dysfunctions to memory, especially in the formation of new memories. Everyday memory gradually gets deteriorated on the course of healthy aging. Moreover, emotion processing and memory abilities deteriorate considerably in Mild Cognitive Impairment (MCI) and in AD.



Brain MRI of Healthy Individual, MCI & AD (Chandra et al., 2019)

- Facial emotion processing is the essential component of nonverbal communication. In normal ageing as well as in age related pathologies, facial emotion processing gets affected. There is lack of studies pertaining to assessment of emotion processing in dementia and hence there are no standardized emotion-based paradigms for its assessment. Studies are essential for establishment of emotion-based memory assessment paradigms for dementia screening, and it need to be standardized to use in Indian population, emphasizing Indian languages. Novel neuropsychological-diagnostic markers rooted on emotion processing need to be established for early screening and diagnosis of dementia.

METHODOLOGY

- The study methodology was adapted from previous study by Gupta & Srinivasan, 2009, and was customized to administer in elderly individuals and patients, in vernacular language of Malayalam.

EXPERIMENT DESIGN

- The experiment involves 2 phases- (i) **learning phase**, (ii) **test phase**. In learning trial, the face stimulus (happy, sad, or neutral) was randomly presented with the name underneath it.
- Two-choice recognition test was administered with the whole-face and parts of face (eyes, mouth) together with foils and participants were instructed to find the target face.

(i) Learning phase



Arun (Name presented in Malayalam)

(ii) Test phase



Which is Arun?



Which is Arun's Eyes?



Which is Arun's Mouth?

PATIENT SELECTION

- Sample size of the study was 50, which included 25 patients (female 12, male 13, mean age = 71 years) and 25 elderly controls (female 9, male 16, mean age = 67.6 years)
- Patients with Early AD/MCI were recruited through the Memory clinic at SCTIMST, Trivandrum.

RECOGNITION ACCURACY

Calculated as the ratio of correctly recognized observations to total observations for faces and parts of face (eyes, mouth) corresponding to emotional expression (happy, neutral and sad) and plotted the result.

MR IMAGING

- A 3T GE Discovery MR750w scanner was used to acquire anatomical images based on a high-resolution 3D SPGR sequence with parameters TR=14.052, TE= 6.36ms, flip angle = 10°, matrix size = 512 × 512, and slice thickness = 1.2 mm.
- Volumetry analysis was performed using the Computational Anatomy Toolbox (CAT12), which is an advanced extension of SPM for voxel-based morphometry. Extracted region wise grey matter volume and correlated with emotion recognition score.

RESULT

- A $2 \times [3 \times 3]$ Mixed analysis of variance (ANOVA) with group (Patient vs controls) as a between group factors, emotion (happy, neutral, sad) and stimuli type (eyes, mouth, or whole face), as within group factors was analyzed in SPSS.
- The main effect of Emotions $F(2, 116) = 5.03$, $p < 0.008$ was significant, similarly Stimuli type, Group and interactions StimuliXGroup, EmotionXStimuli was significant.
- Recognition accuracy of whole-faces for all emotions were similar in controls. Patients were better in recognizing whole faces with happy expressions compared to sad, $t(46) = 3.52$, $p < 0.001$; and neutral expressions, $t(46) = 3.52$, $p < 0.001$.

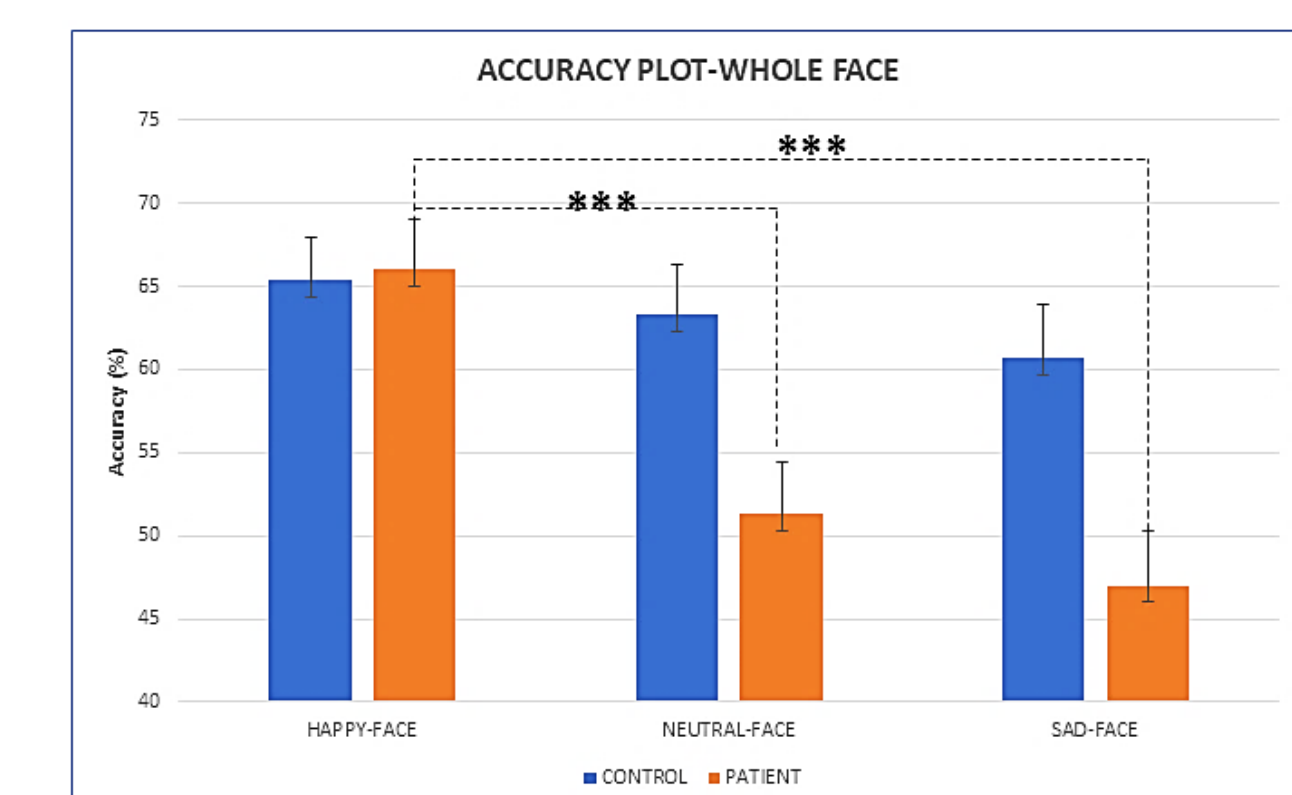


Figure: Accuracy Plot (Patient Vs Elder Controls)

IMAGING CORRELATIONS

- Pearson correlation performed between regional grey mater volume and emotion recognition score indicates negative correlation.
 - Happy-Face & Left Hippocampus ($r = -0.38$, $n=25$, $p = 0.04$)
 - Happy-Face & Right Amygdala ($r = -0.40$, $n=25$, $p = 0.03$)
- Larger hippocampal and amygdala volumes were linked to poorer recognition of happy expressions.

CONCLUSION

- Recognition of happy facial expressions, compared to sad and neutral facial expressions, are quite intact in individuals with AD.**
- Part-based processing is not helping recognition for emotions in both groups.
- Larger regional brain volumes in patients are not necessarily signs of preserved brain tissue. Instead, they may represent pathogenic processes of amyloid accumulation, inflammation, or compensatory hypertrophy, all of which can be associated with worse cognitive and emotional functioning.
- Our findings could guide designing of emotion based cognitive retraining strategies.

“Alzheimer's disease may challenge memory, but the ability to see joy in a happy face stands strong”

References:

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Ethical Statement: The study was approved by ethics committee of Sree Chitra Tirunal Institute for Medical Sciences & Technology Trivandrum.

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