Introduction

Past studies have shown that stimulation of the limbic system, particularly of the amygdala, in response to emotion stimuli increases the connectivity between the limbic system and the hippocampus, thereby enhancing the functioning of the hippocampus and creating a more stable memory trace [2]. This interaction occurs simultaneously with the flow of information from cortical sensory systems into the medial temporal lobes, placing the hippocampus in a unique position to act as a binding site, coupling emotional tone with sensory content [3]. After encoding newly stabilized memory traces are sent from the hippocampus back out to cortical regions for storage through the process of consolidation [4]. This model views the hippocampus as a “pass through” structure, responsible for associating various memory components to form a meaningful memory trace. Therefore, we hypothesize that the hippocampus will show extensive connectivity to the both the cortical sensory systems and limbic system.

Methods

Twenty one healthy, normal adults (10 males) participated (M_{age} = 25 yrs, SD_{age} = 4). After screening for neurological, psychiatric, and psychological disorders and for contraindications to MRI, participants were scanned using a 3.0 T scanner. Participants were presented with and asked to memorize emotional and neutral stimuli, including pictures, words, and environmental sounds. After presentation of the stimuli, resting state data was collected. Memory for the stimuli was assessed following the scanning. Participants were scored on recognition of stimuli. Data was analyzed using SPM and CONN software.

Analysis

Data preprocessing included slice time correction, realignment, coregistration (MNI), normalization (MNI), and smoothing (5mm). Functional connectivity analyses focused on Amplitude of Low Frequency Fluctuations (ALFF) measures of the amplitude of regional activity and intra- and inter-regional time series similarities. The data was analyzed in CONN using the posterior hippocampus as a seed region (as defined by fMRI analysis). An additional analysis contrasting recognized emotional stimuli with recognized neutral stimuli was also run.

Primary Results

ROI resting state analysis between the hippocampus and limbic and cortical sensory systems revealed extensive connectivity of the left and right hippocampus to both systems (figures 1-3). Additionally, a limbic specific network reflecting just the emotional component of encoding was identified (figure 4).

Secondary Results

An extensive number of functional connections was observed between the hippocampus and the limbic and cortical sensory systems. This puts the hippocampus in an ideal position to act as an interface between the cortical sensory systems and the limbic system. The hippocampus has the unique ability to receive information from both systems and combine them in a meaningful way before passing the now associated memory components back to cortex for storage. We also identified a network contributing to the emotional component of memory encoding by contrasting emotional stimuli recognition with stimuli recognition in neutral.

Conclusions

The existence of this network supports the theory that emotion modulates hippocampal function and memory encoding through the connectivity of the limbic system to the hippocampus.

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