VIII. 11. Effects of Emotion and Reward Motivation on Neural Correlates of Episodic Memory Encoding: a PET Study


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Emotional items are better recalled than neutral ones. Previous neuroscientific studies have reported that the enhancement of memory by emotion could be modulated by interaction between the amygdala and hippocampus. In addition, reward motivation also enhances learning and memory processes. Functional neuroimaging studies have demonstrated that interaction between reward-related regions including the orbitofrontal or ventral tegmental areas, and memory-related regions including the medial temporal lobe (MTL) structures, could contribute to the memory enhancement by reward motivation. However, little is known about the neural mechanisms how both processes of emotion and reward affect encoding-related processes in episodic memories. In this study, by using the positron emission tomography (PET), we investigated neural activations reflecting the effects of emotion and reward during the encoding of episodic memories. Healthy right-handed subjects (mean age: 21.2 years) recruited from the Tohoku University community were required to encode photographs under four conditions, which were categorized by two factors of emotion (negative or neutral) and monetary reward value (high or low reward for subsequent retrieval success). Encoding-related activations were measured by \( H_2^{15} \)O PET scanning. Behaviorally, emotional valence (negative > neutral) and reward value (high-value > low-value) enhanced retrieval performance of memory, but the interaction between the two factors was not significant (see Fig. 1). In functional neuroimaging data, the left amygdala showed greater activity during the encoding of negative pictures than that of neutral pictures, whereas the left orbitofrontal cortex activity was greater for pictures encoded with high reward value than with low reward value.
Moreover, the conjunction analysis between the two factors of emotional valence and reward value demonstrated significant activations in the right hippocampus (see Fig. 2). The present findings suggest that emotion, which is associated with the amygdala activity, and monetary reward, which is associated with the orbitofrontal cortex activity, could independently affect encoding-related activations in the hippocampus, in which the information of both processes could be integrated during the encoding of episodic memories.

References
A) Main effect of emotion
\[[\text{Negative/High} + \text{Negative/Low}] - (\text{Neutral/High} + \text{Neutral/Low})\]

B) Main effect of reward
\[[\text{Negative/High} + \text{Neutral/High}] - (\text{Negative/Low} + \text{Neutral/Low})\]

C) Common to emotion and reward
Conjunction analysis of A and B

Figure 2. Sagittal, coronal, and axial projections of the regions associated with negative emotion, high monetary reward, and both.