# Neural activation associated with inhibition control in working memory maintenance and its correlation with brain volume changes in generalized anxiety disorder

Gwang-Won Kim[1], Moo-Suk Lee[2], Heoung-Keun Kang[3], Tae-Jin Park[4], Jong-Chul Yang[5], Gyung-Ho Chung[6], and Gwang-Woo Jeong[1,3]

*[1]Research Institute of Medical Imaging, Chonnam National University Medical School, Gwangju, Korea, [2]Psychiatry, Chonnam National University Medical School, Gwangju, Korea, [3]Radiology, Chonnam National University Medical School, Gwangju, Korea, [4]Psychology, Chonnam National University, Gwangju, Korea, [5]Psychiatry, Chonbuk National University Medical School, jeonju, Korea, [6]Radiology, Chonbuk National University Medical School, jeonju, Korea*

**Synopsis**: Patients with generalized anxiety disorder (GAD) is associated with abnormalities in the processing and regulation of cognition, and neuropsychological impairment as well. Despite recent studies for identifying the neural circuitry contributing to cognitive control, the differential neural mechanisms for a delayed-response working memory (WM) and cognitive inhibition components in GAD patients have not yet been specified.

The purpose of this study was to discriminate the brain activation patterns associated with the effect of distraction during the WM maintenance for the human faces in the healthy controls and patients with GAD by using a function MRI, and further to assess the relationship between changes of the activation patterns due to impairment of the inhibition control and reduction of the volumes of the corresponding brain areas in patients with GAD.

**Subjects and Methods**: A total of 15 patients (mean age = 36.4±11.2 years) with GAD and 15 healthy controls (mean age = 36.7±7.8 years) with no history of neurological or psychiatric illness were participated in this study.

The paradigm consisted of a string of "encoding - WM maintenance - distractor - retrieval". In the encoding task, three different human faces were presented once. During the delay time following the encoding, the subjects were asked to maintain the WM for the encoded faces. Then, a normal face and a scrambled face were presented as the distractors, and the subjects were instructed to look at the distractors while maintaining the WM. In the retrieval task, either of the face presented in the encoding task or a new face was presented.

**Results and Discussion**: Scores for the face recognition task of controls and GAD patients for human face distractor were 64.7±7.4% and 64.7±11.9%, respectively (p=0.948), while the corresponding scores for scrambled face distractor were 76.0±16.4% and 76.0±20.3%, respectively (p=0.765).

In within-group analysis, the human face distractor over the scrambled face influenced the same brain areas during the delay interval of a WM task between patients and controls (Fig. 1). On the other hand, in between-group analysis, the patients showed decrease of signal intensities in the superior occipital gyrus (SOG), fusiform gyrus, anterior cingulate gyurs (ACG), precuneus, and lingual gyrus in face distractor (p<0.001) (Fig. 2). In addition, the patients over controls showed decreases in the gray matter volumes of the fusiform gyrus, ACG, precuneus, and lingual gyrus (p<0.005) (Fig. 3).

**Conclusion**: These results demonstrate the differential functional neuroanatomy between patients with GAD and healthy controls during a delayed-response working memory with human face distractor, and furthermore, assessed the relationship between the brain activation changes and the brain volume reduction in patients with GAD. This finding will be helpful to assess the neural mechanisms related to general impairment of cognitive function observed in patient with GAD.

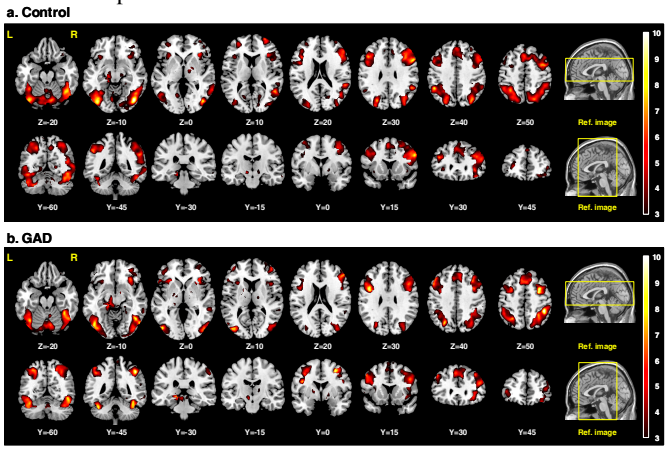


Fig. 1. Brain activation maps resulting from the contrast of the human face distractor relative to scrambled face during the working memory in healthy controls (a) and GAD patients (b).

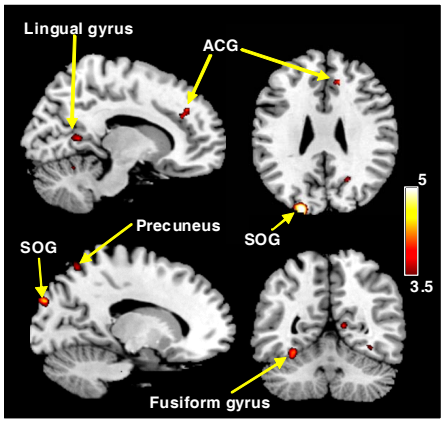


Fig. 2. Brain activation maps of the predominance of the healthy controls over patients with GAD during the WM for the target faces with the human face distractor.

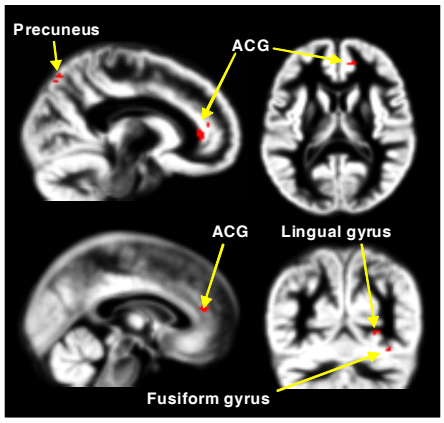


Fig. 3. Brain areas with significant volume reduction of the gray matter in patients with GAD as contrasted with healthy controls.

## References

1. Dolcos et al, *Brain Research* 2007;1152:171-181
2. Etkin et al, *Am. J. Psychiatry* 2011;168:968-978

**Acknowledgments**: This work was supported the NRF grant funded by the Korea government (MEST) (No. 2008-314-D00531 and No. 2011-0016291).