

- 9) Bagby RM, Parker JD, Taylor GJ : The twenty-item Toronto Alexithymia Scale-- I . Item selection and cross-validation of the factor structure. *J Psychosom Res* 38 : 23-32, 1994
- 10) Bagby RM, Taylor GJ, Parker JD : The Twenty-item Toronto Alexithymia Scale-- II. Convergent, discriminant, and concurrent validity. *J Psychosom Res* 38 : 33-40, 1994
- 11) Parker JD, Taylor GJ, Bagby RM : The 20-Item Toronto Alexithymia Scale. III. Reliability and factorial validity in a community population. *J Psychosom Res* 55 : 269-275, 2003
- 12) Taylor GJ, Bagby RM, Parker JD : The 20-Item Toronto Alexithymia Scale. IV. Reliability and factorial validity in different languages and cultures. *J Psychosom Res* 55 : 277-283, 2003
- 13) Kano M, Fukudo S, Gyoba J, et al : Specific brain processing of facial expressions in people with alexithymia : an H2 15O-PET study. *Brain* 126 : 1474-1484, 2003
- 14) Craig AD : Emotional moments across time : a possible neural basis for time perception in the anterior insula. *Philos Trans R Soc Lond B Biol Sci* 364 : 1933-1942, 2009
- 15) Craig AD : How do you feel--now? The anterior insula and human awareness. *Nat Rev Neurosci* 10 : 59-70, 2009
- 16) Allman JM, Watson KK, Tetreault NA, et al : Intuition and autism : a possible role for Von Economo neurons. *Trends Cogn Sci* 9 : 367-373, 2005
- 17) Kugel H, Eichmann M, Dannlowski U, et al : Alexithymic features and automatic amygdala reactivity to facial emotion. *Neurosci Lett* 435 : 40-44, 2008
- 18) Eichmann M, Kugel H, Suslow T : Difficulty identifying feelings and automatic activation in the fusiform gyrus in response to facial emotion. *Percept Mot Skills* 107 : 915-922, 2008
- 19) Reker M, Ohrmann P, Rauch AV, et al : Individual differences in alexithymia and brain response to masked emotion faces. *Cortex* 46 : 658-667, 2010
- 20) Duan X, Dai Q, Gong Q, et al : Neural mechanism of unconscious perception of surprised facial expression. *Neuroimage* 52 : 401-407, 2010
- 21) Pouga L, Berthoz S, de Gelder B, et al : Individual differences in socioaffective skills influence the neural bases of fear processing : The case of alexithymia. *Hum Brain Mapp* 31 : 1469-1481, 2010
- 22) Mantani T, Okamoto Y, Shirao N, et al : Reduced activation of posterior cingulate cortex during imagery in subjects with high degrees of alexithymia : a functional magnetic resonance imaging study. *Biol Psychiatry* 57 : 982-990, 2005
- 23) Kano M, Hamaguchi T, Itoh M, et al : Correlation between alexithymia and hypersensitivity to visceral stimulation in human. *Pain* 132 : 252-263, 2007
- 24) Moriguchi Y, Ohnishi T, Lane RD, et al : Impaired self-awareness and theory of mind : an fMRI study of mentalizing in alexithymia. *Neuroimage* 32 : 1472-1482, 2006
- 25) Frewen PA, Lanius RA, Dozois DJ, et al : Clinical and neural correlates of alexithymia in post-traumatic stress disorder. *J Abnorm Psychol* 117 : 171-181, 2008
- 26) Moriguchi Y, Ohnishi T, Decety J, et al : The human mirror neuron system in a population with deficient self-awareness : an fMRI study in alexithymia. *Hum Brain Mapp* 30 : 2063-2076, 2009
- 27) Paula-Perez I, Martos-Perez J, Llorente-Comi M : [Alexithymia and Asperger syndrome]. *Rev Neurol* 50 (Suppl 3) : S85-90, 2010
- 28) Tani P, Lindberg N, Joukamaa M, et al : Asperger syndrome, alexithymia and perception of sleep. *Neuropsychobiology* 49 : 64-70, 2004
- 29) Fitzgerald M, Bellgrove M : The overlap between alexithymia and Asperger's syndrome. *J Autism Dev Disord* 36 : 573-576, 2006
- 30) Fitzgerald M, Molyneux G : Overlap between alexithymia and Asperger's syndrome. *Am J Psychiatry* 161 : 2134-2135, 2004
- 31) Moriguchi Y, Maeda M, Igarashi T, et al : Age and gender effect on alexithymia in large, Japanese community and clinical samples : a cross-validation study of the Toronto Alexithymia Scale (TAS-20). *Biopsychosoc Med* 1 : 7, 2007
- 32) Bird G, Silani G, Brindley R, et al : Empathic brain responses in insula are modulated by levels of alexithymia but not autism. *Brain* 133 : 1515-1525, 2010
- 33) De Gucht V, Fontaine J, Fischler B : Temporal stability and differential relationships with neuroticism and extraversion of the three subscales of the 20-item Toronto Alexithymia Scale in clinical and nonclinical samples. *J Psychosom Res* 57 : 25-33, 2004
- 34) Bailey PE, Henry JD : Alexithymia, somatization and negative affect in a community sample. *Psychiatry Res* 150 : 13-20, 2007
- 35) De Gucht V : Stability of neuroticism and alexithymia in somatization. *Compr Psychiatry* 44 : 466-471, 2003
- 36) Karvonen JT, Veijola J, Kokkonen P, et al : Somatization and alexithymia in young adult Finnish population. *Gen Hosp Psychiatry* 27 : 244-249, 2005
- 37) Mattila AK, Kronholm E, Jula A, et al : Alexithymia and somatization in general population.

Abstract

Neuroimaging Study of Alexithymia

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Alexithymia refers to difficulty in identifying and expressing emotion in self and is related to disturbed emotional regulation. Alexithymia was originally proposed as a personality trait which plays a central role in psychosomatic diseases. Although neuroscientific studies on alexithymia are requisite, there has been no integrative reviews so far which overview the entire neuroimaging studies of alexithymia. Here we overviewed the literatures of neuroimaging studies on alexithymia, and found that people with alexithymia showed reduced neural responses to emotional stimuli from external environment and reduced response to imagery in their limbic and paralimbic areas (amygdala, insula, anterior/posterior cingulate cortex). In contrast, they showed enhanced neural response to stimuli or tasks which involve any 'physical' contexts like somatosensory and sensorimotor function in the insula and other somatosensory/sensorimotor areas. They have hampered neural activity when they are involved in social tasks in the medial prefrontal and insula cortex. Their blunted response to external emotional stimuli and oversensitive response to sensorimotor stimuli should result in exaggerated physical symptoms which some individuals with alexithymia express.

Key words : alexithymia, neuroimaging, fMRI, PET, somatization
