Flanker and Garner conflict resolution – Insights from an fMRI Study

Advisors: Herrmann/Korsch

The human ability to selectively attend relevant information and to ignore irrelevant information is an essential property of cognitive and executive functions. To test this cognitive ability common conflict paradigms such as the Eriksen-Flanker conflict paradigm (Eriksen & Eriksen, 1974) and the Garner conflict paradigm (Garner, 1974, 1988) are used. The Eriksen-Flanker paradigm is a well established experimental procedure to induce cognitive conflicts and there are many behavioral, EEG and fMRI studies, which draw a clear picture of its effects on a behavioral and neural level. However, little is known about the underlying neural processes involved in the resolution of Garner conflict effects. The Garner conflict effect is typically investigated by comparing two different kinds of experimental conditions. In one condition the task-irrelevant dimension remains constant (baseline condition) whereas it varies randomly in the other one (filtering condition). A significant Garner conflict effect is indicated by increased reaction times and error rates during the filtering compared to the baseline condition since the random variation of the task-irrelevant dimension in the filtering condition imposes additional processing demands on the cognitive system.

Compared to the Eriksen-Flanker conflict paradigm, the Garner conflict effect can only be investigated along with another conflict dimension. Therefore Boenke, Ohl, Nikolaev, Lachmann and Van Leeuwen (2009) conducted an ERP study where they combined a Garner and a Stroop conflict. In this study they found a late Garner effect and a reduced P3 in the filtering condition indicating an involvement of memory related processes in the resolution of Garner conflicts. Another study by van Leeuwen and Bakker (1995) showed that Stroop effects can occur without Garner interference. On the other hand, Pomerantz et al. (2003) revealed that Garner interference effects could occur without Stroop effects.

Even though there are behavioral (e. g. Pomerantz et al., 2003) and EEG studies (e. g. Boenke et al., 2009), to date there is no neuroimaging study which can give further insights into the brain regions involved in Garner conflict resolution. Therefore, the aim of the present study is to reveal the neuronal correlates of the Flanker and especially the Garner conflict resolution by means of event-related functional magnetic resonance imaging (fMRI).

For the Flanker conflict we expect to find activations in frontal regions, e.g. in the anterior cingulate cortex (ACC) and the dorsolateral prefrontal cortex (dlPFC) which have been previously found to be involved in conflict resolution, especially for the Flanker conflict (e. g. Casey et al., 2000). Concerning the Garner conflict effect we assume two possible brain mechanisms underlying the resolution of this conflict. On the one hand, the Garner conflict effect might refer to a problem of visual filtering of the task-irrelevant stimulus dimension (Desimone and Duncan, 1995). In this case, we expect to find activations in the posterior parietal cortex (PPC) and the visual cortex which have been commonly found to be involved in visual filtering task-relevant information (Friedman-Hill, Robertson, Desimone, Ungerleider, 2003). On the other hand, the Garner effect might reflect a general cognitive load problem since in a combined Flanker-Garner paradigm two conflicts have to be resolved simultaneously. In this case, we rather expect activations in frontal regions such as the dlPFC which have shown to be active in previous double conflict paradigms (e. g. Wittfoth, Schardt, Fahle, Herrmann, 2009). However, in either case we generally expect to find activations in memory related regions since the Garner conflict is assumed to appear on the level of short term memory which involves the representation of former trials.

References

Boenke, L. T., Ohl, F.W., Nikolaev, A.R., Lachmann, T., Van Leeuwen, C. (2009). Different time courses of Stroop and Garner effects in perception – An Event-Related Potentials Study. *NeuroImage*, 45, *1272-1288.*

Casey, B. J., Thomas, K. M., Welsh, T. F., Badgaiyan, R., Eccard, C. H., Jennings, J. R., Crone, E. A. (2000). Dissociation of response conflict, attentional selection, and expectancy with functional magnetic resonance imaging (fMRI). *Proceedings of the National Academy of Sciences, U.S.A., 97,* 8728–8733.

Desimone, R., Duncan, J. (1995). Neural mechanisms of selective visual attention. *Annual Review of Neuroscience,* 18, 193 – 222.

Eriksen, B.A., Eriksen, C.W. (1974). Effects of noise letters upon the identification of a target in a nonsearch task. *Perception & Psychophysics,* 16, 143 -149.

Friedman-Hill, S.R., Robertson L.C., Desimone R., Ungerleider L.G. (2003) Posterior parietal cortex and the filtering of distractors. *Proceedings of the National Academy of Sciences, U.S.A.*, 100, 4263-4268.

Garner, W.R., (1974). *The processing of information and structure.* Potomac, MD: Erlbaum Publishers.

Garner, W. R. (1988). Facilitation and interference with a separable redundant dimension in stimulus comparison. *Perception & Psychophysics*, 44, 321 - 330.

Pomerantz, J. R., Agrawal, A., Jewell, S. W., Jeong, M., Khan, H., Lozano, S. C. (2003). Contour grouping inside and outside facial contexts. *Acta Psychologica*, 114, 245 - 271

Van Leeuwen, C., Bakker, L. (1995). Stroop can occur without Garner interference: strategic and mandatory influences in multidimensional stimuli. *Perception & Psychophysics,* 57, 379 - 392.

Wittfoth, M., Schardt, D. M., Fahle, M., Herrmann, M. (2009). How the brain resolves high conflict situations: double conflict involvement of dorsolateral prefrontal cortex. *NeuroImage*, 44, 1201 – 1209.