Department of Neuropsychology and Behavioral Neurobiology
Proposal Diploma Thesis –

Feature-based visual attention – An ERP study. Advisors: Galashan/Herrmann

The massive amount of information surrounding us in everyday life by far exceeds the given processing capacities of our brain. Thus, this overwhelming amount of information needs to be reduced in order to be capable of acting. There are two different mechanisms of reducing information. One lies within the structure of the visual system. As an example the retina provides the highest resolution at the fovea whereas the surrounding parts transfer information with lower resolution. Nevertheless, information reduction provided by these hardwired constraints alone is not sufficient. A second, flexible mechanism called attention helps us to discriminate between those stimuli that are to be processed primarily (rather relevant information) and those receiving less processing (rather irrelevant information) (Wolfe, 2004).

The selection of relevant information can be guided by two different principles. On the one hand, it can be stimulus-driven (exogenous). In that case, for example salient and/or unexpected objects or events capture attention involuntarily. On the other hand the selection can be driven by cognitive factors (endogenous) such as expectations and/or behaviorally relevant goals (Corbetta, 2002). An effect of endogenous visual attention has been shown to exist in case of spatial locations (Posner, 1980), as well as for object- (O'Craven, 1999) and feature-based attention (Saenz, 2002).

The thesis focuses on the aspect of endogenous, feature-based visual attention. In particular, the temporal dynamics of underlying neural mechanisms of feature-based attention to color and motion will be examined. One key component is the so called selection negativity (SN), a negative ERP deflection with an onset latency in the range of 120-300ms (Smid, 1999) predominantly over posterior sites, elicited by stimuli with an attended-feature value. The SN elicited while attending a stimulus feature is enhanced in amplitude compared with a non-attended stimulus feature. This component and its modulations have been observed quite frequently and are seen as a stable phenomenon (Annllo-Vento, 1998; Baas, 2002; Beer, 2004).

In order to assess this aspect of visual attention, a modified version of an experimental design created by Wegener et al. (2008) is employed. Two superimposed random dot patterns (RDP) moving in opposite directions are displayed. Both RDPs are moving at equal speed, one RDP is colored green, the other orange. At the beginning of each trial a cue indicates the feature to be attended (either motion or color). The cue validity for the feature to be attended is 50 % on all trials whereas the cue for the object (one of the two RDPs) to be attended is 100 % correct. Participants are asked to direct their attention as indicated by the cue and to respond as quickly as possible to any changes in feature-dimension (either motion or color). In addition, participants receive an auditory feedback on a trial-by-trial basis indicating the speed of their response to a change. This auditory feedback is supposed to motivate participants in employing attention according to the cue despite the relatively low cue validity. So far, studies examining neural correlates and temporal dynamics of feature-based visual attention typically employ experimental designs with a cue validity exceeding 50 %. Therefore, potential effects reported in these studies may be ascribed to effects occurring in odd-ball paradigms.

To assess the temporal dynamics of feature-based visual attention, the epochs following a feature change are compared regarding cue validity and feature dimension. Thus two comparisons are of main interest: first, are there differences between attended and unattended color-features? Second, are there differences between attended and unattended motion-features? Following the literature we expect to find a SN in the onset latency range between 120-300ms post-change. The SN amplitude is assumed to be larger for attended than for non-attended features.

Interestingly, recent work by Schoenfeld et al. (2007) has revealed a SN only for the feature motion but not for color. The authors assume that the missing SN might be attributed to the experimental design. Whereas other studies employed designs comparing feature values within a dimension (e.g. red and green), participants in the above mentioned study were required to select between different feature dimensions (eg. color and motion). If their assumption is correct, the experimental design adopted within this thesis should also reveal a missing SN for color features due to the requirement to select between different feature dimensions rather than between different feature values.

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