# Event-Related Potentials and Processing of Wholes and Parts

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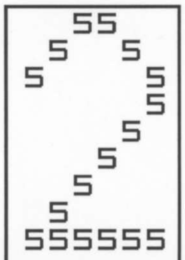
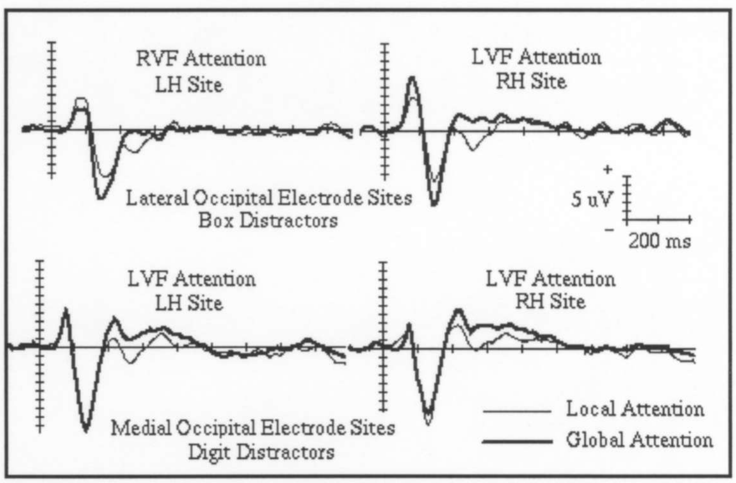
An object in the visual field can be perceived as a whole and as the parts from which the whole is composed. To test whole/part processing, Navon [1] used letter stimuli in which small (local) letters were spatially arranged to form a larger (global) letter. A global processing dominance was observed; global targets were identified faster than local targets and global information interfered with local processing, however local information did not interfere with global processing. Some investigators have interpreted these behavioural results to imply that global analysis occurs before local. More recent evidence [2] suggests that global and local levels are processed in parallel. In addition, neuropsychological evidence suggests a processing asymmetry such that the left (LH) and right hemispheres (RH) are biased for local and global processing respectively [3]. This is consistent with a hypothesis that parallel processing of global and local information occurs along two processing streams in the two hemispheres. Our experiments were designed to examine the time-course and lateralization of global/local processing in normal adult humans.



Compound Digits

**Method:** We examined ERP correlates of whole/part processing during a continuous performance task in which endogenous attention was directed to global or local elements based on experiment instructions. We used compound (whole/part) stimuli constructed from digits and boxes. A series of stimuli were presented (700-1250ms SOA) to the left and right of fixation while attention was directed to either the global or local level in the left (LVF) or right visual field (RVF). At the attended level, digits were presented in ascending order and subjects responded to all digits that were out of sequence. At the unattended level, the distractors were either other digits or neutral boxes. ERPs were acquired from an array of 64 scalp electrodes at a sampling rate of 400 Hz and averaged offline. ANOVA analyses compared component amplitudes at LH/RH electrode sites for global/local and LVF/RVF attention.

**Results:** When distractors were neutral boxes, we observed global/local differences over lateral occipital sites at very early processing stages. There was a larger P1 (80 ms) over the LH for local-RVF attention and over the RH for global-LVF attention. Global/local differences were also observed at N1 (145 ms) which was larger for global attention. These early global/local effects were not present in the digit distractor condition for which the earliest global/local differences occurred at the P2N2 complex (200-350 ms), maximal over medial occipital electrodes but evident over much of the scalp. The P2N2 effect also occurred in the box distractor condition, however in that case the global/local difference was primarily due to a negative deflection that occurred for local attention but not for global attention. This negative deflection (250 ms peak) was more pronounced for LVF attention in both distractor conditions.




Other differences in global/local topography of the P2N2 can be described as a broad *global* positivity over frontal electrodes in the digit distractor condition in contrast to a *local* positivity over frontal electrodes and *global* positivity over posterior electrodes in the box distractor condition.

**Discussion**: Differences in amplitude and topography of global/local processing suggests mediation by different cortical generators operating in parallel. These data also strongly support a global-RH/local-LH processing bias. The neutral distractor condition revealed lateralization and global/local differences at very early stages (P1 and N1) that were not apparent when distractors were of the same category as the stimuli at the attended level. One possible explanation is that as task difficulty and processing demands increase, resources in both hemispheres are recruited.

**References** ◆[1] Heinze, H. & Munte, T.F. (1993). Neuropsychologia, 31, 841-852. ◆[2] Navon, D. (1977). Cognitive Psychology, 9, 353-383. ◆[3] Robertson, L.C. & Lamb, M.R. (1991). Cognitive Psychology, 23, 299-330.