EVENT-RELATED POTENTIAL INDICATORS OF WORKING MEMORY ACTIVITY DURING SUBITIZING

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Contents

Abstract

Subitizing has been generally defined as the capacity limited process involved in swiftly, accurately, and effortlessly apprehending the numerosity of small collections of perhaps three or four items. Competing explanations have appealed to perceptual, configural, or WM processing mechanisms to explain subitizing. Over five experiments this thesis used event-related potential data to investigate whether working memory (WM) activity is involved in subitizing response contingent item arrays, and the related question of whether subitizing limits might be determined by some capacity constraints in WM.

Experiment 1 presented a response contingent enumeration task where both accuracy and speed of response were stressed. EEG was recorded from two anterior scalp sites Fz, and Cz. RTs for the combined sample showed the classic non-linear subitizing slope, and evidence of a discontinuity between subitizing and counting for all subjects. P3b latencies increased significantly across the slope and were closely associated with corresponding RT increments, suggesting WM involvement in generating the slope. At three items a strong N2 component and reduced amplitude P3b peak were evident, further suggesting WM involvement during subitizing.

Experiment 2 replicated the first experiment with Neuroscan equipment. ERP behaviour was very similar to Experiment 1, indicating robust component presentation during item enumeration. The predominantly anterior distribution of the LPC was confirmed. The sample generated a non-linear subitizing slope, but there was no direct support for a relationship between P3b latency increases and RT increases along the subitizing slope. However, at a load of three items there was P3b

latency increase and amplitude decrease, along with a pronounced N2 component, suggesting WM activity.

Experiment 3 contrasted ERP behaviour while subitizing one, three, or four items while recognising and naming dot patterns (Dot; Triangle; Square). Enumerating three and four items generated pronounced N2 components whereas identifying the same number of items as ‘Triangle’ or ‘Square’ produced none. P3b latency was also longer when enumerating. This suggested that processes related to quantification and not pattern recognition or association generate the robust ERP profile evident in the first two experiments.

The final two experiments contrasted ERP behaviour while subitizing one, two, and three item arrays without, and with a concurrent WM load of either verbal (Experiment 4) or spatial (Experiment 5) information. Verbal load generated increased P3b latencies along with marked N2 deflections when enumerating one, two, or three items. Spatial load generated latency effects in the P3b window but with no other clear effects on the LPC.

These results supported the functional interpretation of the P3b and N2 components proposed throughout the thesis as indexing time consuming, effortful processing in WM. This therefore suggested that effortful WM activity is involved in subitizing, supporting the serial counting explanation of subitizing over perceptual, or pattern matching explanations.

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