Early Neurophysiological Signatures of Multi-digit Number Length Processing

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Abstract

The Hindu-Arabic numeral system associates number length and value. This study investigated number length encoding in multi-digit number processing while controlling for overall visual size. Using scribbled line patterns to equalize visual extent, participants (N=27) compared tie numbers to a fixed standard ("555"), creating congruent (e.g., "6666" vs. "555") and incongruent (e.g., "77" vs. "555") conditions where number/string length and numerical value matched or conflicted. Targets were compared based on numerical value or string length. Findings revealed three distinct processing stages: First, enhanced N1 negativity (120-150 ms) at parieto-occipital sites reflected early length encoding, with greater amplitudes for larger string-length distances. Second, decreased P2p amplitudes (150-190 ms) at parietal sites varied with both numerical and string-length distances, indicating refined magnitude processing. Finally, decreased P3 amplitudes (300-360 ms) at central sites for incongruent trials reflected cognitive conflict resolution. These findings provide novel evidence consistent with an early number length encoding mechanism.

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