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Symbolic and non-symbolic numerical representations in elderly and young adults: an exploratory EEG study

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Numeracy has significant implications throughout the life course, and its age-induced decline represents a vulnerability factor in elderly population. We studied the impact of healthy aging on the ability to access basic symbolic and non-symbolic numerical representations using a parity judgment task (PJT), with three numerical formats: Arabic digits (N), Finger representations (F), and Dots (D). During PJT administration we recorded participant responses using high-density electroencephalography (hEEG).
Population under study included elderly (68.8±5.09 years, n=10, F = 5) and young (23.1±3.54 years, n=10, F = 5) participants. We measured response Accuracy, along with the characteristics of key neural correlates of numerical processing—namely, the N200 and P100 components. Additionally, we employed Multivariate Pattern Analysis (MVPA) to assess differences in hEEG responses across the three numerical formats (N,F,D).
Results show no difference in Accuracy between young and elderly in all three PJT conditions (N,F,D). Moreover, we observed a difference in N200 Amplitude between young and elderly participants in the D condition only, while N200 Latency differed between the two groups across all PJT conditions. The P100 results showed an Amplitude difference in the F condition compared to the N and D conditions, but no difference between young and elderly participants. Additionally, there were no latency differences among the three conditions or between age groups. Lastly, MVPA results indicate that hEEG responses can successfully distinguish between different numerical representations.
We conclude that age-related numeracy decline reflects reduced processing efficiency across distinct numerical neural networks.

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