

Math anxiety affects conscious and unconscious math performance

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Introduction: Mathematical anxiety (MA) causes worry and fear in performing mathematical tasks, potentially leading to avoidance of math-related situations and careers. This study aimed to explore the correlation between event-related potentials (ERPs) during conscious and unconscious math performance and the level of MA.

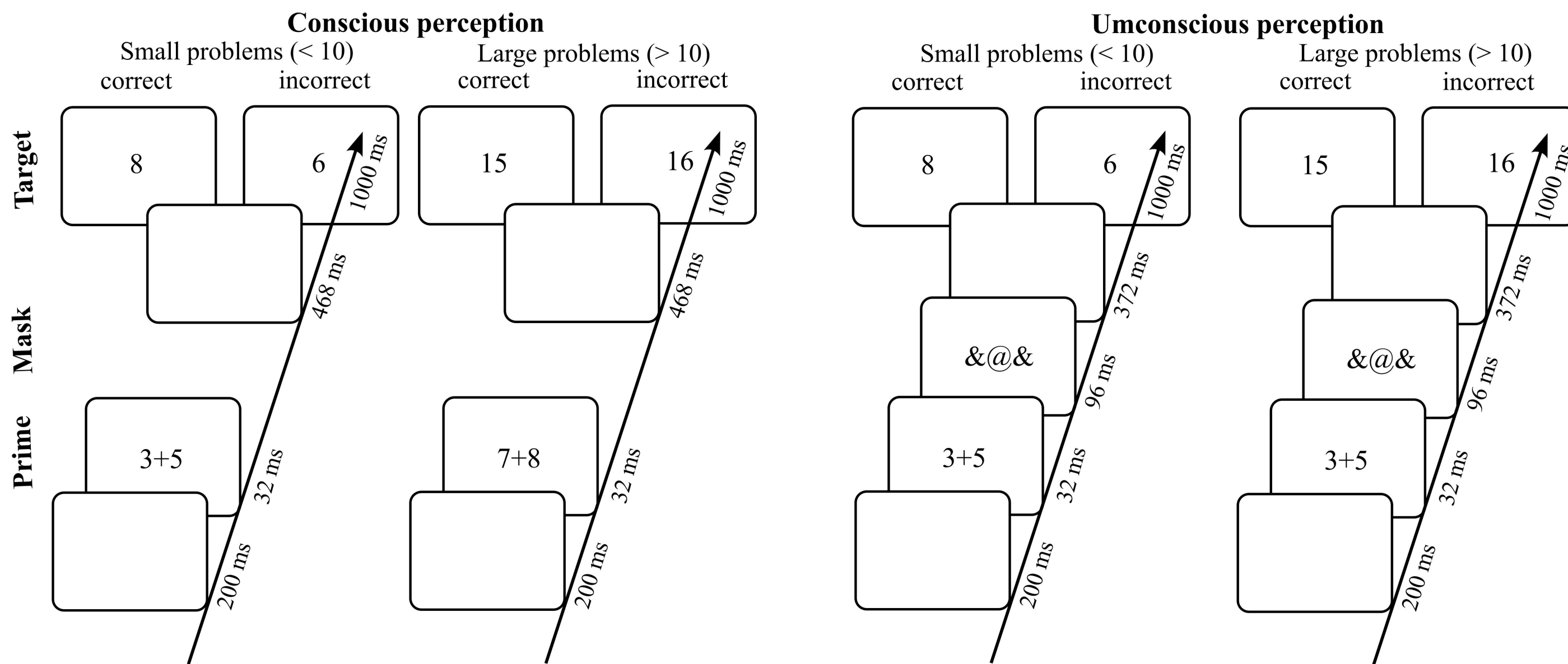


Fig. 1 Temporal sequence of stimulus presentation in blocks with conscious and unconscious stimuli perception

Methods: The research involved 24 participants (13 females, mean age 21.4 years) assessed using a shortened MA rating scale (mean sMARS results: 60 ± 19). Single-digit addition problems (large and small) were presented, followed by correct and incorrect answers in two experimental blocks with conscious and unconscious perception of arithmetic tasks. Spearman rank correlation coefficient was used to analyze the correlation between sMARS results and average ERP amplitude in the 300–400 ms interval (N400/P300) after the solution presentation.

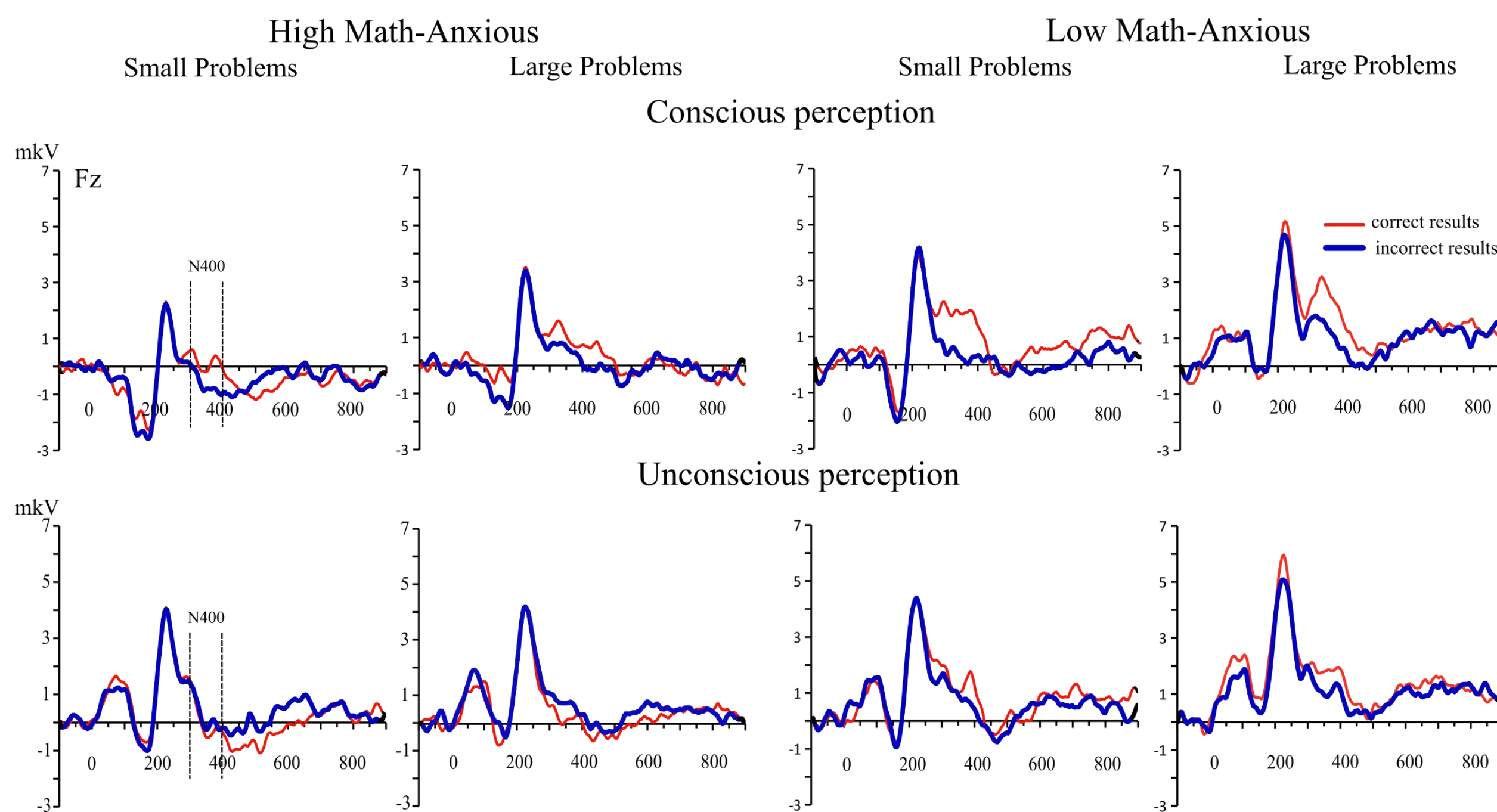


Fig. 2 Event related potentials in response to the correct (thin blue line) and incorrect (thick red line) results, recorded in Fz in the block of conscious and unconscious stimuli perception for small and large problems for participants with high and low level of MA. The dotted line shows the interval of analysis.

Results: A moderate negative correlation ($-0.450 < r < -0.650$) was found between MA level and ERP amplitude in fronto-central leads in response to correct solutions during conscious and unconscious small problems presentation. For conscious presentation of large problems, a moderate negative correlation ($-0.450 < r < -0.550$) was observed. No correlation was found for unconscious presentation of large problems or incorrect answers.

Conclusion: Increasing of MA levels corresponded to reduced ERP amplitude for correct solutions, both consciously and unconsciously. It was previously established that arithmetic skill correlated with P300 amplitude for correct answers. High MA individuals tend to avoid math situations, potentially affecting their ability to extract answers from memory, leading to diminished N400/P300 arithmetic effect in both conscious and unconscious perception.

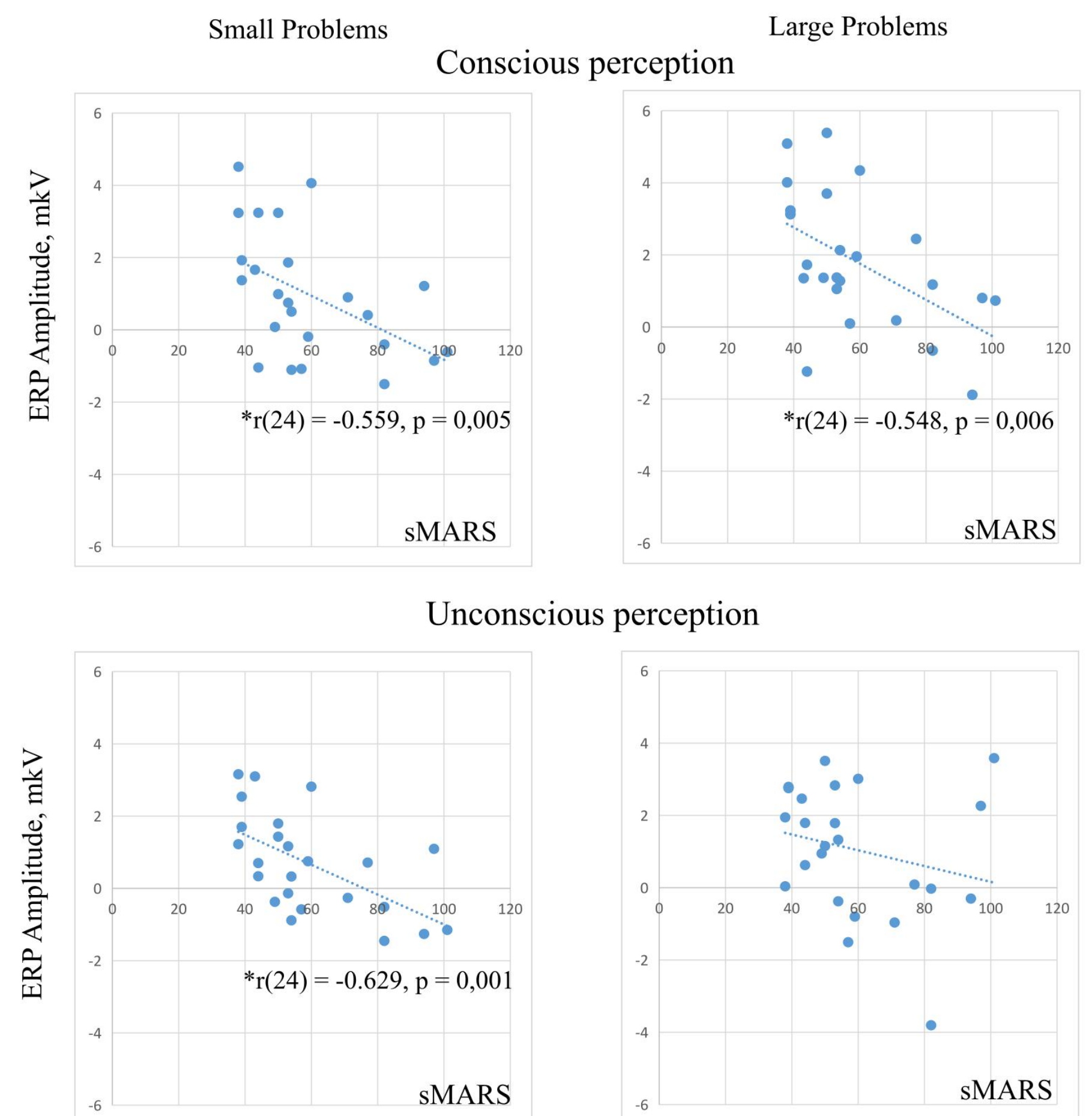


Fig. 3 Results of the correlation analysis of the MA level and ERP amplitude in response to correct results presentation, recorded in Fz in the block of conscious and unconscious stimuli perception for small and large problems