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COGNITIVE PROCESSING FOR STEP PRECISION INCREASES BETA AND GAMMA MODULATION DURING OVERGROUND WALKING

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Safe overground walking requires constant evaluation of the environment and alternative strategies are needed to ambulate on uneven terrain, obstacles or wet floors. It is believed that overground displacement involves a combination of cognitive processing, sensorimotor integration and postural control. However, the influence of cognitive processing when defining the optimal overground walking trajectory is still unclear. In this study, we investigated whether human electrocortical activity changed during walking while following simple or complex movement pathways. We hypothesized that individuals walking through complex pathways would present slower walking speed and increased brain activity in cognitive and sensorimotor areas when compared to simple pathways. In this regard, ten healthy adults (21-36 years) were asked to walk overground (~120 gait cycles) in three different randomized conditions: 1) normal walking in a straight path (NW); 2) walking in a pre-defined pathway forcing variation in step width and length, in which each step was determined by a green mark (8×4 cm) on the floor (W1C), and 3) walking in the same pre-defined W1C pathway, however the place for each step would vary depending on the combination of three different colors (green, yellow and red) (W2C). In W2C, for each step the subject had to follow these rules: green+yellow = step on yellow, green+red = step on green and green+yellow+red = step on red, adding a cognitive decision process between each step. Walking speed and scalp electroencephalography (EEG) were recorded during the three conditions. Walking speed in W2C was significantly slower compared to W1C (~26%, $p<0.001$), suggesting that cognitive processing for evaluating the correct foot placement influenced walking pattern. Moreover, there was a significant effect of the condition on the absolute power for EEG channels FCz, C3, C4 and Cz ($p<0.05$). Power during W1C was ~60% and ~100% higher than NW for the beta and gamma band, respectively. Moreover, power during W2C was ~30% and ~70% higher than W1C for the beta and gamma band, respectively. These results suggest that complex environmental conditions demand higher brain activity in areas related to motor control. In addition, cognitive processing for defining body displacement directly interferes with the walking modulation and cause reduction in the locomotor speed in W2C. This protocol can be relevant for underpinning changes in motor control and cognition related to aging and neurodegenerative diseases towards overcoming challenges faced in real-world scenarios.