REDEFINING THE BOUNDARIES BETWEEN COGNITION AND ACTION THROUGH THE PSYCHOPHYSIOLOGICAL INVESTIGATION OF BINARY DECISIONS

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Background: Many actions stem from the evaluation of the environment until reaching a decision concerning how to act. Prominent psychological models describe decision processes in terms of evidence accumulating towards a response boundary. Once the boundary is reached, the decision is concluded and motor processes can initiate the response. Despite the differences in terms of specific processing dynamics and architectures, many models thus assume a functional segregation of decision and motor processes within serial stages.

Aims: This project questioned the functional segregation between decision and action by investigating the neurocognitive underpinnings of a potentially continuous stream of processes that progressively maps stimulus evaluation to the response channels.

Method: The first study focused on the electromyographic (EMG) signal to measure motor-response duration within lexical and object decision tasks featuring button-press responses. The experiments assessed the propagation of decision-related phenomena, such as lexicality (difference in RTs between words and pseudowords) and word-frequency (high vs. low frequency words) effects, to motor-response execution. The second study exploited both EMG and EEG measures to assess the influence of decisional effects across the multiple stages of the motor-control hierarchy indexed by electrophysiological indexes of response planning (lateralization of beta-frequency activity), programming (lateralized readiness potential), and execution (response duration), while also monitoring long-range interactions captured by cortico-muscular coherence.

Results: The first study revealed increased durations of motor-responses selectively for items with no representations in memory, such as pseudowords. Instead, difference between words remain bounded to the non-motor component of RTs, (the interval before the onset of EMG activity). The second study revealed that these effects are reflected just at the level of response planning and execution, with no involvement of motor-programming and cortico-muscular coherence.

Conclusions: Taken together, the results contradict the assumption of a serial transition from decision to motor stages. However, rather than pointing to the continuous propagation of a single decision variable, the results point towards multiple decision components that are selecively reflected at different stages of motor control.

Keywords: Decision making, Motor control, Electrophysiology

Publications:

Scaltritti, M., Giacomoni, F., Job, R., & Sulpizio, S. (2023). Redefining the decisional components of motor responses: Evidence from lexical and object decision tasks. *Journal of Experimental Psychology: Human Perception and Performance, 49*(6), 835-851. doi: doi.org/10.1037/xhp0001113.

Scaltritti, M., Greatti, E., & Sulpizio, S. (2023). Electrophysiological evidence of discontinuities in the propagation of lexical decision processes across the motor hierarchy. *Neuropsychologia 188*, 108630.

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