Picking and Choosing. An ERP Study of the Neural Correlates of Meaningless and Meaningful Actions

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With few notable exceptions [1, 2, 3, 4], research on the neural precursors of intention and voluntary action has mostly focussed on meaningless actions [5, 6, 7]. It remains therefore questionable whether analogous neural correlates, and in particular the Readiness Potential (RP), underlie meaningful actions, i.e., actions that select between alternatives leading to controllable different outcomes. In an experimental setting, it is notoriously difficult to investigate the motivational aspect of voluntary action without triggering automatic responses to externally provided cues. However, understanding the nature of these processes is crucial to the extent that our sense of agency and responsibility depend on our ability to execute meaningful actions we can control and that seemingly incorporate motivationally loaded intentions [8]. Similarly, conceptual models of intention and action emphasise the capacity to act for reasons (reasons-responsiveness) and in view of a goal (goal-directedness), often in relation to long-term planning (distal intention). This study set out to investigate the behavioural and neural correlates of reasons-responsive actions guided by distal intentions. To this purpose, we employed a modified version of a two-stage Markov decision task, a validated paradigm in economic decision-making investigating model-free/model-based behaviour, in which participants have to go through a two-stage selection process in order to earn points on a trial by trial basis [9]. The distinction between meaningful and meaningless actions was framed in terms of choosing and picking: We manipulated the level of control (high for choosing/chancy for picking) participants had over the consequences of their actions, by modulating the transition probabilities between the two stages. In choosing trials, participants had to constantly make up their mind about their preferred options at stage II (reason-responsiveness) in order to make their choice accordingly at stage I (distal intention). At the end of each trial, participants were asked to rate the level of control they felt over the (positive/negative) outcome they achieved. As predicted, participants felt significantly more in control when they had the possibility to choose (compared to pick) at stage I and when the outcome was positive. The lack of an interaction suggests that predictive and postdictive cues separately contributed to the agent's perceived control. While participants were performing the task, EEG signals were recorded. We focussed on the RP as the signal of planning, preparing and initiating the action, although the debate on its origin and role is still unsettled [10]. Our results clearly show the presence of the RP both for choosing and picking, ma no significant difference between the RP peaks for the two conditions. This hints at a resemblance in the neural precursors of meaningful and meaningless actions, thus potentially contributing to the ongoing debate on the mechanisms underlying intention and action.

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