

# Give me a feedback! Neural bases of feedback effects on behavioural performance

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## Abstract

To successfully interact with the environment, we need to receive continually information from the outcomes of our actions. To successfully interact with the environment, we need to receive continually information from the outcomes of our actions. This return information is defined feedback and allows us to optimize behaviour with the aim of responding accurately and adaptively to surrounding stimuli. Feedback is a relevant factor in learning and achievement processes, and it is used to modify behaviour in the intended direction. Feedback is a popular variable of interest, and few studies have recently investigated its neural bases. Previous ERP studies on the effects of feedback on cognitive brain functions have neglected what happens to components related to anticipatory, attentional and insular processes, focusing only on feedback evaluation.

Here we used event-related potentials (ERPs) to understand the impact of feedback on cognitive functions in both anticipatory and post-stimulus processing. Twenty-nine healthy participants performed both a standard visuomotor task (go/no-go type) and a modified version of the same task in which a buzzer was emitted when participants committed an error.

We predicted that if feedback improves the behavioural performance increasing accuracy, we should find a modification of the anticipatory pN component associated with cognitive preparation (top-down attention and inhibition), and of the post-stimulus components associated with selective attention (the N1 component) and sensory and sensory-motor awareness (the pN1 and the pP1 components).

Behavioural and neurophysiological results showed that in the feedback task people tend to have better cognitive control of external events than in the standard task. Indeed, the percentage of false alarms and omissions was reduced in the feedback task. At the brain level, the pN, pN1, pP1 and N1 were affected by the feedback presence.

The present findings extend previous literature about the positive effects of feedback on performance showing increased anticipatory activity in the prefrontal cortex and a change of perceptual awareness and selective attention in the insular and sensory cortices. This study helps to clarify the neural basis of the performance improvement in a decision-making task due to the effects of external and constant factors, such as feedbacks. Results are discussed in light of the *constrained action hypothesis* and the *dual-networks top-down model*, supporting the view that when people perceive the outcomes of their actions as uncertain, a feedback could help them to improve not only their performance but also their cognitive and motor strategies to manage their behaviour.

400/400 words