The implicit and explicit components appear to compete in the morning but not in the afternoon

Johanna Mathiot*[1], Charlène Truong[1], Charalambos Papaxanthis[1], and Célia Ruffino[2]

[1]INSERM UMR1093-CAPS, Université Bourgogne Franche-Comté, UFR des Sciences du Sport, F-21000, Dijon. – Université Bourgogne Franche-Comté, Institut National de la Santé et de la Recherche Médicale, Institut National de la Santé et de la Recherche Médicale : U1093 – France
[2]Laboratory Culture Sport Health and Society (C3SUR 4660), Sport and Performance Department – Université de Franche Comté – France

Résumé

Introduction: Motor adaptation relies on two distinct processes: explicit (conscious, intentional) and implicit (unconscious, automatic), which operate to progressively minimize errors and ensure accurate movements. Recent studies have highlighted a competitive interaction between these two processes (Albert et al., 2022), which could explain variations in motor adaptation tasks under different conditions, such as age (Cisneros et al., 2024) or mental fatigue (Apreutesei & Cressman, 2024). Although other factors, such as time-of-day, are known to influence motor learning (Truong et al., 2022), their effects on motor adaptation, particularly on explicit and implicit components, remain unclear. In this study, we investigated the potential diurnal fluctuations of visuomotor adaptation when both components are expressed in Experiment 1 (Exp.1) and when either the implicit (Experiment 2, Exp.2) or the explicit (Experiment 3, Exp.3) components were isolated.
Method: For all experiments, participants (Exp.1 n=34; Exp.2 n=30; Exp3. n=34) performed a 45∘CCW (counterbalanced clockwise) visuomotor adaptation task. They were divided into two groups, half performed at 10 am (morning) and half at 3 pm (afternoon). They started with a familiarization (40 trials) and a baseline (40 trials) session. Only the adaptation phase varied between groups. In Exp.1, participants performed 320 trials of visuomotor adaptation and reported their adaptation strategies (explicit adaptation) every 3 trials with the 'verbal report' method (Maresch et al., 2021). In Exp.2, participants performed 480 'clamped visual feedback' (Cisneros et al., 2024) trials to isolate the implicit component. In the third experiment (Exp.3), we isolated the explicit component using the 'delayed visual feedback' method (Cisneros et al., 2024) and we measured explicit adaptation through 128 trials. For each experiment, the adaptation session was divided into early and late adaptation phases, representing, respectively, the beginning (40 trials) and the end (40 trials) of the adaptation.

Results: When both components are expressed (Exp.1), a rmANOVA with two groups (morning/afternoon) and two phases (early/late) revealed a significantly better (i.e., faster) adaptation in the afternoon during the early phase for Exp.1. This difference appears to be driven by the significantly greater reliance on explicit strategy the afternoon. In contrast, the implicit component did not reveal any difference between groups. For Exp.2 and Exp.3, we analysed the same parameters, but the results did not reveal any differences between

*Intervenant

groups during the early phase of adaptation.

Discussion: When we are interested in the early phase of adaptation, neither the explicit nor the implicit component fluctuates during the day when both are isolated. Interestingly, the speed of adaptation and the explicit component are affected when both components are expressed (Exp.1), but only in the morning. It appears thus that the systems compete at the beginning of adaptation with the explicit component showing a fragile expression, resulting in slower adaptation.

Conclusion / Perspective: In the afternoon, implicit and explicit components seem to "cooperate", leading to more efficient and faster adaptation, while in the morning they seem to compete. Further investigations are necessary to elucidate the underlying mechanisms.

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