

## **THE EVOLUTION OF COORDINATION MODES DURING THE LEARNING OF A GROSS MOTOR SKILL**

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### **Introduction**

Motor learning is currently conceived as a discontinuous and non-linear process, with qualitative changes in coordination (Newell, 1991). According to Zanone and Kelso, (1992, 1997), learning can be considered as a phase transition between the initial pattern and the to-be-learned coordination. There is no experimental evidence, nevertheless, of an abrupt change of behavior in the course of learning, indicative of such phase transition. Nourrit, Delignieres, Caillou, Deschamps, and Lauriot (2003) showed in an experiment on the ski simulator that the transition from novice to expert behavior could appear quite progressively, with a long phase of alternation between the two behaviors. This experiment, nevertheless, was completely conclusive on the true nature of coordination changes. The aim of the present study was to characterize the coordination modes adopted by beginners learning to oscillate on a swing, and to analyse the evolution of these coordinations with practice.

### **Methods**

Six subjects participated in 5 learning sessions, each one consisting of ten 15-sec trials. This experiment was carried out on a swing, constituted of an oscillating wooden board linked up to a support fixed on the ground. Passive markers were positioned on the subject for recording the coordinates of the main body joints using a motion analyser VICON 370 (BIOMETRICS). Subjects were instructed to swing as fluidly as possible, keeping arm on the back.

We analyzed the evolution, over sessions and trials, of amplitude and fluidity (using the index proposed by Mottet and Botsma (1999)), by ANOVAs with repeated measurements. We computed cycle by cycle the phase lag between the platform's oscillations and the vertical displacements of the center of gravity. We then categorized the coordination modes, analyze their frequency of occurrence, and the nature of the associations between successive cycles. Then, we analyzed the evolution with practice of the mobilization of three articular angles (ankles, knees and hips).

## Results

An increase of performance was observed in all participants; with an increase of 28° in amplitude and a decrease of 0.04 in fluidity index ( $p < 0.1$ ). During the first session, most participants (5/6) forced the system only once by swing, during the last part of the cycle. During the following sessions participants explored the other part of the cycle, stabilizing a new coordination, allowing to force twice in some cycles, in alternation with the basic 1:1 coordination mode. For one participant, nevertheless, the 2:1 coordination mode was prevalent during the last session.

## Conclusion

Our results showed that subjects did not adopt identical spontaneous coordinations, but it could be possible to describe some general principles governing their evolution. Indeed, the first behavior can help to explore the perceptual-motor workspace (Newell, Kugler, Van Emmerik, & McDonald, 1989) and to discover more adaptive behaviors. The new coordination mode was established simultaneously with the destabilization of the spontaneous pattern, with an alternation phase between these two patterns. The learning process appeared in a progressive, rather than abrupt way.

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