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The influence of augmented feedback and prior learning on the acquisition of a new bimanual coordination pattern

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Abstract

The present research examined two variables regarding the acquisition of a new bimanual coordination pattern: the role of previous experience and the nature of augmented feedback. Two groups of participants acquired a new coordination pattern (135° relative phase) following two sessions of practice of another novel pattern (90° relative phase). Transfer of learning in these groups was compared to two groups that had not previously learned a new pattern, but were nevertheless influenced by coordination patterns that are intrinsic to the task of bimanual relative timing (in-phase, 0°, and anti-phase, 180°). The findings revealed that new learning overshadowed the influence of the intrinsic patterns. Learning was also greatly affected by augmented feedback: dynamic, on-line pursuit tracking information was more effective in transfer than static, terminal feedback. Implications of these findings regarding theoretical constructs in motor learning are discussed.

PsycINFO classification: 2300; 2330; 2340; 2343

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1. Introduction

Transfer of learning has remained a prominent topic during the past century of research in experimental psychology (McGeoch & Irion, 1952, Chapter 9, provided an excellent

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review of research during the early part of the century; Adams, 1987; updated the literature and provided historical context). A prime topic of transfer of learning research concerned the role of previously acquired skills on new learning, and so, the nature of the task played a dominant role. Earlier, Ebbinghaus (1885) had dealt with a problem in the study of memory by creating nonsense syllables, in order to control for the effects of previous experiences and associations. Researchers interested in motor learning also devised new tasks to study transfer of learning, such as the pursuit rotor (Koerth, 1922) and the mirror tracing apparatus (Snoddy, 1926). The effects of amount of previous experience, the level of expertise attained, and the nature of the motor skills required of the two tasks were all important, and at times, problematic factors in this research.

A novel approach to the study of transfer of learning was introduced by Zanone and Kelso (1992, 1994, 1997; Kelso and Zanone, 2002; Schöner, Zanone, and Kelso, 1992). Identifying and quantifying known stabilities in bimanual coordination as a basis (e.g., Kelso, 1995; Swinnen & Wenderoth, 2004), Zanone and Kelso demonstrated that new patterns emerged amidst the foundation of existing skills – new learning is both influenced by existing skills (intrinsically stable patterns) and, in turn, affects the performance capabilities of those existing skills. These findings have been replicated, extended, and challenged, but not refuted (e.g., Fontaine, Lee, & Swinnen, 1997; Hodges & Franks, 2002; Kostrubiec & Zanone, 2002; Lee, Swinnen, & Verschueren, 1995; Smethurst & Carson, 2001; Swinnen, Walter, Lee, & Serrien, 1993; Temprado & Swinnen, 2005; Wenderoth & Bock, 2001; Wenderoth, Bock, & Krohn, 2002).

In the present research we investigated two questions about learning a new coordination pattern, both of which were motivated by the theoretical agenda of Zanone and Kelso (1994) and more specifically, by the research of Wenderoth and Bock (2001). The first issue concerned the role of a newly-learned pattern on subsequent learning. Many studies have shown that two existing patterns, in-phase (a 0° interlimb relative phasing) and anti-phase (180°), influence the acquisition of a new pattern (e.g., 90°). The initial difficulties encountered in attempting to perform 90° are characterized by coordination tendencies that, in many individuals, are strongly biased towards anti-phase (e.g., Lee et al., 1995). However, once the bias is overcome and the pattern has been stabilized at the goal relative phasing, it is hypothesized that the new pattern will then bias the learning of other novel coordination patterns. The hypothesis was supported in research by Wenderoth and Bock (2001). Participants who had initially learned a 90° pattern were transferred to either a 70° or 110° relative phasing pattern. Wenderoth and Bock reported that learners were able to perform the new pattern (i.e., were not biased towards the learned pattern), but only in the presence of visual feedback. In the absence of visual feedback their performance was strongly biased towards the previously learned 90° pattern.

This interesting study by Wenderoth and Bock (2001) raised two important issues: (a) there was no control group that attempted to perform the 70° pattern *without* having learned the 90° RP pattern – evidence regarding the influence of previous learning would be stronger if a control group, that had not previously learned a 90° pattern, was biased towards one of the intrinsic patterns instead, and (b) the possibility exists that performance was biased towards the 90° pattern only because the required relative phase of the transfer pattern (70° or 110° RP) was so much closer to the learned pattern (i.e., a 20° difference from 90°) than to either the in-phase or anti-phase patterns (a 70° difference). The present study extends the work initiated by Wenderoth and Bock with the inclusion of appropriate control groups and a transfer pattern (135°) that was equidistant