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Jump performance and augmented feedback: Immediate benefits and long-term training effects

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Drop jumps and their adaptations to training have been extensively investigated. However, the influence of augmented feedback (aF) on stretch-shortening cycle (SSC) was not scrutinized so far despite the well-known positive effects of aF on motor performance and motor learning. The aim of the present study was therefore to investigate the effects of aF by evaluating immediate within-session effects and long-term adaptations. 34 participants were assigned to three groups that trained drop jumps with different relative frequencies of aF about their jump height: 100%, 50%, or 0%. A significant within-session effect of aF on jump height was observed before and also after the training period (pre: +4.6%; post: +2.6%). In the long-term (comparing pre- to post-measurement), the 100% group showed the greatest increase in jump height (+14%), followed by the 50% (+10%) and the 0% group (+6%). The importance of aF on drop jumps is therefore twofold: (i) to immediately increase jump performance and (ii) to improve long-term training efficacy. In contrast to the proposition of the guidance hypothesis, high frequency of aF seems to be beneficial when maximizing SSC-performance. As jump height cannot be quantified without objective technical measures it is recommended to include them into daily training.

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1. Introduction

Drop jumps can be classified as a stretch-shortening cycle (SSC) movement. The SSC is not only interesting from the perspective of motor control and motor learning but also with respect to sports performance in general. SSC-contractions constitute the natural form of muscle function in many, if not most, sports activities (Taube, Leukel, & Gollhofer, 2012). Therefore, many attempts were made in order to optimize the efficiency of training protocols to improve SSC-performance. These attempts included drop-jumps from different falling heights (Taube, Leukel, Lauber, & Gollhofer, 2012) and other protocols like heavy-resistance training, explosive resistance training (Wilson, Murphy, & Giorgi, 1996; Wilson, Newton, Murphy, & Humphries, 1993), electrostimulation (Malatesta, Cattaneo, Dugnani, & Maffiuletti, 2003) or vibration training (Cardinale & Bosco, 2003). In general, exercise protocols lacking the integration of fast SSC-contractions are less efficient to improve jump performance than training regimes that include SSC movements (for review see: Markovic, 2007). Consequently, the focus has to be set on how to improve SSC-training interventions in order to optimize SSC-performance. Although augmented feedback (aF) – referring to feedback that originates from an external source – was shown to be a very powerful tool to enhance motor performance (for reviews see: Langhorne, Coupar, & Pollock, 2009; Lauber & Keller, 2012; Winstein, 1991), no previous study investigated the influence of aF on SSC performance in general and drop jump performance in particular. This may surprise as aF proved efficient to improve task execution not only in the long-term but also within a session. More precisely, visual online force feedback resulted in instantly enhanced force and torque levels (Coplin, 1971; Figoni & Morris, 1984; Hopper, Berg, Andersen, & Madan, 2003). Longitudinal training studies also confirmed a positive effect of aF on performance such as tennis serves or shooting (Moran, Murphy, & Marshall, 2012; Landers et al. 1991; Mononen, Viitasalo, Konttinen, & Era, 2003).

The aim of the present study was therefore to evaluate the influence of aF on drop jump performance. Therefore, short- (immediate) and long-term effects (several weeks of training) of aF (displaying the rebound height of a drop jump) on drop jump performance were evaluated. Long-term effects were investigated with respect to different aF-frequencies (i.e. how often aF was provided) as the frequency was shown to strongly influence the effect of aF. More specifically, the guidance hypothesis claimed that the application of aF stimulates learning but feedback should not be provided after every single trial in order to avoid the problem of feedback dependency (Salmoni, Schmidt, & Walter, 1984). However, more recent studies investigating more complex movements are not in line with the guidance theory (Wulf & Shea, 2002). Therefore, Wulf, Shea, and Matschiner (1998) proposed that the optimal relative frequency of aF depends on task complexity as superior performance was evident after learning complex tasks with high frequency of aF. Based on these findings it is hypothesized that a high relative feedback frequency leads to better training gains (percentage increase). For the immediate effects, it is expected in line with previous studies (Coplin, 1971; Figoni & Morris, 1984; Hopper et al., 2003) to observe an instantly improved jump height (rebound height) as soon as aF is provided. Thus, the present study investigates for the very first time whether the provision of aF directly affects jump height and whether different relative frequencies of aF result in different training gains. The observations of this study therefore help to understand whether findings from classical learning studies can be transferred to the training of an already well known movement without limitations.

2. Materials and methods

2.1. Participants

Thirty-four volunteers participated in the present study after giving written informed consent. The participants were healthy with no history of neurological and orthopedic disorders or injuries. None of the participants had previously participated in systematic drop jump or high-resistance training. Participants were randomly allocated to one of three groups: (1) 100% aF group (n = 11; 22.1 ± 1.1 years; 175.7 ± 9.0 cm; 69.4 ± 9.0 kg), which received feedback about their jump (rebound) height after every