muscles, kind of contraction) make difficult to obtain a unique view (Baker & Newton, 2005; Maynard & Ebben, 2003). The purpose of this study was to determine if the contraction of antagonist muscles modify muscular fatigue during agonistic performance. Surface EMG was used to estimate biceps brachii muscle fatigue during isometric contraction made with/ without previous contractions of the antagonist muscle (triceps brachii).

Eight male body-builders, all right-handed, performed two training sets with a one-week interval: a conventional training with isometric contractions of the biceps brachii muscles at 90% of their maximum (five 30 s contractions, each paused by 4 min 30 s of rest), and a 'super-set' training where a 30-s triceps brachii contraction at 90% of maximum was followed by the same patterns of contraction of the biceps brachii muscle (2 min of interval between each muscular contraction). Surface EMG of biceps brachii was recorded during contraction.

Both protocols induced fatigue in the biceps brachii muscles, with a reduction in the median frequency of the EMG power spectrum as obtained by FFT Regression analysis showed that time explained 70-99% of the reduction in the median frequency. No constant patterns of muscular fatigue were found, with different right-left side behaviours in the same body-builder. Overall, in the right-side biceps brachii the 'super-set' protocol was somewhat more fatiguing than the conventional protocol, while the reverse pattern was observed in the left-side biceps brachii.

Pre-fatiguing the antagonist did not increase the negative effects of fatigue; this kind of exercise organization could be useful to develop motor patterns strategies for ballistic sports activities. Also, the super-set protocol allows the development of equilibrated forces in the involved joints.

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Does low and high contextual interference lead to different levels of noise?

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For motor skill acquisition and learning different approaches have been suggested. A unifying approach for several classical motor learning approaches on the basis of noise has been suggested most recently (Schöllhorn, et al., 2006). In the core of this suggestion most approaches for skill acquisition are considered as different levels of noise that result in different learning effectivity with a stochastic resonance like behaviour. Thus, only an optimal noise level can lead to maximal learning progress.

The purpose of this study was to compare the levels of noise in the movement pattern during a learning process of the tennis serve on the basis of low and high contextual interference.

Methods

Two experienced male tennis players were asked to execute 20 serves in a row with overall 10 first/straight serves (a) and 10 second/topspin serves (b). Subject 1 performed 20 serves under low contextual interference (blocked conditions: 10 x a, 10 x b). Subject 2 performed first and second serves under high contextual interference (serial conditions: a, b, a, b etc.). A three dimensional video recording was used for data acquisition. Variables were joint angles and angular velocities of a 14-segment body model. The kinematical data served for calculating similarities in the movement patterns by means of a hierarchical cluster analysis. Additionally, target-precision-data and ball-velocity were recorded.

Results

It was possible to identify the test persons via kinematical data in every single movement (assessment rate AR = 100%). An even more interesting result was the fact that the data of subject 1 (blocked) allowed for a clear differentiation of first and second serve. In contrast, the movements of subject 2 (serial) could not be separated into first and second serves. For subject 1 an increasing similarity during movement repetitions could be observed, even though a parallel improvement of ball-velocity and target-precisions could not be detected. Subject 2 showed fluctuating movement patterns in each technique, ball-velocities and target-precisions. Variances within each technique were mainly seen in the high contextual interference condition. The most successful serves (related to target-precision) of the same test person were the ones which showed the smallest similarity to all other serves.

Discussion

These results suggest that training under low contextual interference conditions is accompanied with low level of noise and, therefore, leads to increased stability in movement patterns. The findings for subject 2 provide evidence for the theory of noise

dependence of several learning approaches (Schöllhorn et al., 2006). In this case, the increased noise in the form of variation or differences between two subsequent movements during the training process has brought up a greater area of potential solutions. Consequently, these conditions should be accompanied with higher stability in the long term as it is observed in several contextual interference studies (Brady, 2004).

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Keywords

contextual interference, noise, stochastic resonance

Neural correlates of visual adaptation: An fMRI study

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The ability of our sensorimotor system to adapt to visual and mechanical distortions is well established. However, neuroimaging studies investigating the underlying neural mechanisms yielded inconsistent data as to the number and location of pertinent brain regions. This might be due to a methodological reason: Most studies contrasted the adaptation condition with a control condition where no distortion was applied. In consequence, conditions differed not only by the absence of adaptation, but also by the magnitude of motor performance errors. In order to distinguish between adaptation-related and error-related activation, we now introduce a method which equates the errors in both conditions. We apply this method to compare the distribution of activated areas when adapting to different types of visual distortion.

20 healthy subjects were scanned by fMRI during a tracking task. In the adaptation condition, visual feedback was distorted in proportion to hand *position*, or hand *velocity*. In the control condition, feedback was not distorted but target velocity was modulated such that the time-course of tracking errors approximated that under the visual distortions.

We found that under the position-dependent distortion, adaptation-related neural activation was limited to the left supramarginal and angular gyrus. Under the velocity-dependent distortion, activation extended bilaterally in the supramarginal gyrus, as well as in the left middle and right superior frontal gyrus.

Our findings confirm that equating the errors in both conditions will yield an anatomically restricted activation pattern, and suggest that this pattern depends on the type of distortion. The additional recruitment in right parietal and bilateral frontal

areas under the velocity-dependent distortion might reflect a higher computational demand, or the involvement of different adaptive mechanisms.

Why is manual performance with an isometric joystick impaired in hypergravity?

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Introduction

We have shown before that subjects exposed to three times terrestrial gravity (3G) produce exaggerated isometric forces in all directions of three-dimensional space. The present work investigates, whether this impairment is due to proprioceptive deficits (Exp1), increased cognitive demand (Exp2), a different level of arousal (Exp3), or vestibulo-spinal activity (Exp4), as all proposed in literature.

Exp1: Using an isometric joystick, volunteers produced visually prescribed forces of different directions and magnitudes without visual feedback in normal terrestrial gravity (1G) and in 3G We analyzed initial forces 100ms after response onset, at which time proprioceptive corrections are not yet effective. Results revealed that force exaggeration is already manifest 100ms after response onset. Thus, G-related changes in force production are most likely of central origin, and not due to proprioceptive deficits.

Exp2: We combined the joystick task of Exp. 1 with a secondary loading task (4-choice-reaction). Both tasks were performed separately, as well as under dual task conditions, in 1G as well as in 3G Both tasks showed dual-task costs which, however, were independent of G-level. Thus, we have no evidence that exaggerated forces in 3G are related to an increased cognitive demand.

Exp3: We collected blood samples to analyze stress hormones before and after a 15 min exposure to 3G Both epinephrine and cortisol levels were higher after 3G, suggesting an increased arousal, and possibly stress.

Exp4: In a joystick task similar to Exp. 1, subjects produced forces while observing horizontal stripes which were either stationary, or moved upwards. The latter are known to stimulate the central vestibular system in a similar way as otolith inputs, and thus to induce an illusory downward self-movement (downward vection). Indeed, our subjects reported a compelling downward vection, and at the same time, produced exaggerated forces. This result suggests that force production is modified by descending vestibulo-spinal activity.