Effects of experience and task complexity on landing from a jump

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Introduction

The study of human subjects performing landings from a jump under various paradigms has provided insights into movement planning and coordination. Various researchers (McKinley 1992, McNitt-Gray 1991, Schot and Dufek 1993) have investigated the roles of height, subject skill levels, vision, take-off and landing stiffness or compliance. All have suggested that landings are the consequence of a preprogrammed response with strategy (technique) being dependent on task demands. Long term practice and thus experience has been implicated as a general mechanism responsible for coordinated motion. Gervais (1997) found significant movement alterations in children following a period of landing instruction based on imposed constraints. Pedotti et al. (1989) found that skilled performers were able to more easily adapt to perturbations when provided with a novel balancing task. The purpose of this study was to investigate the role experience might play on the execution of a novel yet related motor task.

Methods

Three volleyball players and 3 physical education majors gave informed consent and formed the experienced and inexperienced groups respectively. Subjects were asked to land on two feet onto an AMTI force-plate from a height of 40 and 70cm. Jumps were performed moving forward and backwards. The jumps were blocked into 10 trials and their order was randomly assigned. Kinematic data was acquired using 3 Qualysis ProReflex cameras. Reflective markers were placed over the joints of the leg and shoulder on the side of the body closest to the cameras. 3-dimensional coordinate data for all 40 jumps, for each subject were sampled at 200Hz. Force data was sampled at 1000Hz using the APAS system by Ariel Dynamics. A 3-way ANOVA with repeated measures for direction and height was used for analysis.

Results and Discussion

The participants were required to jump down from two different heights and directions. Their task was to land softly in the execution of these movements. There were no significant effects related to impulse during the landings from the jumps other than for height. All subjects illustrated greater mean peak vertical forces and mean landing times for the jump-downs from the higher height (70cm). The mean hip angle at ground contact was significantly greater for the landings from the backward directed jump-downs (F(1,4) =10.44; p<.032). The mean hip range of motion (ROM) was significantly greater in the landings from 70cm (F(1,4) =10.26; p<.033). There was greater variability in both the hip and knee joint angles, at ground contact in the inexperienced landers than in the more experienced landers (p<.001). In the jumps, the more experienced landers prepared for ground contact with greater knee extension. There were also main effects for the knee ROM for direction and for group by height interaction. All subjects used less knee joint excursion during the landings from the backward directed jumps. The skilled group employed a greater ROM in the knee joint during landings for the 70cm jumps than in the 40cm jumps whereas the inexperience group used less knee excursion in landing from the higher jumps.

Landing from a backward directed jump-down might be considered a novel task for both groups of subjects investigated in this preliminary study. One metric by which the assessment of experience can be ascertained is through the examination of the variability that the participants exhibit in their performances. For all of the critical measures examined, the standard deviations were explored to give an indication of consistency for each of the two groups. The analyses of variance showed a main effect for
group in all dependent measures examined. Figures 1 to 4 illustrate the variance observed in the initial contact position and variance in the hip and knee excursion during the landings, respectively.

The Volleyball players exhibited the influence of experience or practice in their lack of variance in these dependent variables in the landings from the various jump downs. Under the limitations related to statistical power it is important nonetheless that there were no group by direction interactions even though there were significant group differences. The experienced group differed significantly from the inexperienced group in their consistency of performances regardless of height or direction. Traditional views of performances and learning in motor behaviour would support the notion that increases in ability are associated with a decreased level of variability in performances. The data for the group differences shown here would concur with this view.

References