Exercise and Brain Blood Flow:
Title: Unique Leg-Specific Executive and Motor BOLD Activity with Visually-Guided Imagery following ACL Injury

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Given the change in sensorimotor system activation during limited movements of the injured leg after unilateral anterior cruciate ligament rupture, repair, and rehabilitation, we asked whether the frontostriatal network might be involved as revealed during visually-guided action-imagery. **PURPOSE:** To determine whether injured individuals displayed different activity during a proprietary cognitive motor-oriented imagery test. **METHODS:** Nineteen healthy women between 18 and 32 yr participated after providing written informed consent. Ten served as controls; nine others experienced unilateral ACL rupture, surgical repair, and rehabilitation between 6 months and 5 years from the start of the investigation. All participants completed a proprietary attention-switching task for 4 trials of 10 repetitions with a 60-second inter-trial interval. The test required subjects to react to congruent and incongruent signals while being prompted to jump and land with the right or left leg. To facilitate imagery, subjects wore a camera to record first person perspectives of test performance during an earlier session. Brain images were acquired with a three tesla Siemens Trio MRI with TIM system. Subjects watched the cues and their first person performance while imagining themselves physically reacting/jumping in response to the cues. A three-dimensional magnetization-prepared rapid gradient-echo (MP-RAGE) sequence acquired whole-brain structural scans. Voxel size was set at $1.0mm^3$ for structural scans and $3.0mm^3$ for functional scans. Significant map clusters were included on the basis of a six-voxel cluster threshold, in addition to a false discovery rate (FDR) significance threshold set at q=0.05. Retained map clusters were then converted to voxels of interest (VOIs), and small cluster suppression was used to focus the analysis on the most strongly affected brain regions. **RESULTS:** Activity increased in the occipital cortex in response to visual cues. Compared to control conditions, BOLD signal increases were observed in the prefrontal cortex, the primary somatosensory cortex, and the primary, pre, and supplementary motor areas ($p<0.01$). Activity in these regions was lower in ACLs than controls, particularly when using the injured leg. However, activity was increased in the right dorsolateral prefrontal cortex in both groups, but with more pronounced increases in the injured group; the highest dlPFC activity was observed when participants imagined jumping and landing with their injured leg. **CONCLUSION**: Prefrontal regions of the brain display heightened activity after ACL individuals, whereas motor regions tend to display decreased activity compared to controls.