Introduction
Over recent years, it has repeatedly been shown that optimal gaze strategies enhance motor control (e.g., Foulsham, 2015). However, little is known, whether, vice versa, visual performance can be improved by optimized motor control. Consequently, in two studies, we investigated visual performance as a function of motor control strategies and task parameters, respectively.

Study I: Variation of vibration frequencies and standardized postures
In Experiment 1, 72 participants were tested on visual acuity (Landolt) and contrast sensitivity (Grating), while standing in two different postures (upright vs. squat, see Figure 1) on a ZEPTOR-platform that vibrated at four different frequencies (0, 4, 8, 12 Hz). After each test, perceived exertion (Borg) was assessed.

Significant interactions were revealed for both tests, Landolt: F(3,213)=13.25, p<.01, η²=16, Grating: F(3,213)=4.27, p<.01, η²=.06, elucidating a larger loss of acuity/contrast sensitivity with increasing frequencies for the upright compared with the squat posture (Figure 2). For perceived exertion, however, a diametrical interaction for frequency was found for acuity, F(3,213)=7.45, p<.01, η²=.09, and contrast sensitivity, F(3,213)=7.08, p<.01, η²=.09, substantiating that the impaired visual performance cannot be attributed to exertion (Figure 3). Consequently, the squat posture could permit better head and, hence, gaze stabilization.

Study II: Lower Frequencies, higher amplitudes, self-imposed posture and kinematic measures
In Experiment 2, 64 participants performed the same tests while standing in a self-imposed squat position on a ski-simulator, which vibrated with two different frequencies (2.4, 3.6 Hz) and amplitudes (50, 100 mm) in a predictable or unpredictable manner (Figure 4). Control strategies were identified by tracking segmental motion, which allows to calculate eye-ball center positions and to derive damping characteristics (e.g. transmission factors).

Considerable main effects were found for frequency, all F(1,52)>10.31, all p’s<.01, all η²’s>.16, as well as, in the acuity test, for predictability, F(1,52)=10.31, p<.01, η²=.17, and by tendency for amplitude, F(1,52)=3.53, p=.06, η²=.06 (Figure 5). The high correlations between the horizontal eye-ball translations and the visual performance drops (Figure 6) as well as a significant correlation between the damping amplitude in the knee joint and the performance drop in visual acuity, r=-.97, p<.001, again point towards the importance of motor control strategies to maintain optimal visual performance.

General Discussion
The presented experiments indicate that visual performance can be sustained by optimal motor control strategies for the task at hand. As this is the case for unpredictable task settings as well, strategies that control joint stiffness, e.g. within the framework of impedance control (e.g. Franklin, Osu, Burdet, Kawato, & Milner, 2003), seem to be of particular importance. Currently, further experiments including joint stiffness measurements are undertaken with novice and expert skiers with the intent to reveal differences in impedance control.

Literature