Conclusions: Visual tracking abilities decline with advancing age. The presence of a postural perturbation affects tracking precision equally in young and elderly subjects but not the target-gaze phase lags. The deterioration in gaze tracking abilities in the healthy elderly may result from the multiple but minor deficits in many sensory and motor systems.

TP-9

Influence of visual and support surface velocities on head position

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Introduction: The sensory-weighting model suggests that the central nervous system (CNS) ignores large amplitude visual cues [Oie et al. 2002]. However, we observed that high velocity and large amplitude visual motion dominated head and trunk postural responses when simultaneous visual and support surface perturbations were discordant [Keshner et al. 2004]. To examine if higher velocities of visual motion are ignored during multiple sensory disturbance, we have investigated the influence of visual velocity on head motion during quiet stance when velocity and frequency cues from the support surface did not match those of the visual field.
Methods: Five healthy young adults (30-33 yrs) were exposed to coincident anterior-posterior sinusoidal translations of the visual environment (scene) and support surface. Subjects received 6 scene velocities: 0.8, 2.4, 17, 20, 80 and 120 cm/sec at 0.1 Hz in a random order. Each scene velocity was combined with a support surface translation of 10 cm/sec at 0.25 Hz for 80 sec. In addition, subjects received support surface translations in the absence of visual inputs (DARK) and when the visual motion was matched to natural head motion (NV), i.e. without any driving visual stimulus. For each condition, the power spectrum of the head center of mass (COM) was calculated at the frequencies of the visual and support surface inputs. A one-way ANOVA followed by Tukey-Cramer multiple comparison tests was used to evaluate the power of the head COM at the visual and support surface frequencies (0.1 and 0.25 Hz, respectively) across different visual conditions.
Results: In all subjects, power increased at the visual frequency of 0.1 Hz for the head COM as the scene velocity increased. A significant increase ($p<0.05$) in the power of the head COM at 0.1 Hz was observed with a scene velocity of 120 cm/sec compared to NV, DARK, and scene velocities of 0.8, 2.4, 17 and 20 cm/sec. Power of the head COM also increased at the frequency of the support surface (0.25 Hz) when the scene velocity increased. In particular, a significant increase ($p<0.05$) in the power of the head COM at 0.25 Hz was observed with scene velocities of 80 and 120 cm/sec compared to NV, Dark, 0.8 and 2.4 cm/sec.
Conclusions: These data indicate that higher velocities of visual motion produced larger responses of the head at both frequencies of sensory disturbance. The intra-modal and inter-modal increases in the power of the head COM during coincident visual and support surface translations support earlier findings that subjects incorporate the parameters of multiple sensory inputs into their motor response (Keshner et al. 2004). At least for the head, large velocities of visual motion are not ignored by the CNS. This would suggest that the motion of the visual field can not only impact the response to visual motion, but will modulate the response to motion of support surface as well.

TP-10

Balance recovery is altered following knee anesthetization

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Introduction: Recent work has suggested that the knee joint plays a more prominent role in human postural control than has been previously considered (1,2,3). We explored the contribution of the knee joint sensory system to balance recovery following a balance disturbance.
Methods: Six young healthy male adults (26.8 ± 6.6 years) volunteered. Lower limb muscle activity onsets and amplitudes, and whole body kinematics were measured in response to multidirectional support surface rotations prior to and following anaesthetization (AN) of the right knee joint. Muscle activity was recorded from tibialis anterior (TA), medial gastrocnemius (GAS), soleus (SOL), rectus femoris (RF), biceps femoris (BF), and gluteus medius (GMED), bilaterally. Ten cc of 2% lidocaine were injected into the joint space of the right knee. Participants completed 2 blocks of 20 postural perturbation trials; one block was completed prior to knee joint AN, and the second block following AN. The support surface rotated 7.5° at 50°/sec in one of four directions, i.e. pitch forward (toes down; 0°), pitch backward (toes up; 180°), roll right (90°), and roll left (270°). Perturbation direction was completely randomized.
Results: Knee joint AN modified muscle activity onset latencies following frontal plane (i.e. 90°, 270°), but not sagital plane perturbations (i.e. 0°, 180°). BF onset was delayed bilaterally after AN, as was GMED onset on the downhill (DH) side following frontal plane perturbations. Knee joint AN modified the magnitude of muscle activity for both sagital and frontal plane perturbations. Following toes up perturbations, TA activity was reduced bilaterally, and GAS activity was increased bilaterally, late in the response after AN. RF activity was increased in the left limb and decreased in the right limb early in the balance correcting response after AN; right RF activity remained almost 20% lower throughout the remainder of the response. BF activity was increased bilaterally late in the response following toes up perturbations after AN. Following frontal plane perturbations, uphill (UH) RF activity was reduced from approximately 200 ms onward, regardless of perturbation direction. DH BF activity during this same period was increased. Center of mass displacement (COM) was reduced following sagital and frontal plane perturbations, possibly related to increased knee joint flexion. Peak knee flexion, at approximately 300 ms, following toes up rotations were greater after AN. Following frontal plane rotations in either direction, UH knee flexion was greater after AN.