reduce the magnitude of the required eye movements, a measurable decrement in acuity was observed for the near condition. Acuity improved systematically as the walking velocity was reduced during Study 2, but decrement in acuity was present during near viewing even at the slowest walking speed. Results from Study 1 showed that walking acuity is equivalent to standing acuity for far viewing distances. However, Study 3 showed that acuity is not consistent across the step cycle with a measurable decrement observed at heel strike when compared to the between heel strike presentations.
Conclusions: Facilitated by coordinated movements of the head and body, visual acuity of far objects is maintained while walking. However, these mechanisms, in conjunction with the associated eye movements, are not able to fully compensate for near target fixation and heel strike perturbations. The direct measure of walking acuity demonstrated may be a useful for diagnosing abnormal gaze stabilization mechanisms and quantifying their functional consequences.

MP-3

Landing when stepping down to a new level: insights on the sensory control used when 'online' vision is blurred or occluded

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Introduction: When stepping down from one level to another, the landing limb has to arrest downward CM momentum and subsequently receive and safely support bodyweight before level walking can begin. Such step downs are performed over a wide range of heights and predicting when the instant of contact with the lower level will be made is likely a critical factor. Landing unexpectedly could mean the limb is not appropriately prepared to attenuate the body's downward momentum and/or not optimally positioned to receive and safely support bodyweight. As with other forms of locomotion, stepping down is regulated through both feed-forward and feedback mechanisms. Predicting the time and place of contact is determined visually prior to initiating the stepping movement and then regulated online using visual and proprioceptive feedback. The present study explored the contribution from online visual feedback by investigating how landing when stepping down was affected by blurring or occluding vision immediately prior to movement initiation.
Methods: Ten healthy participants (32.3 ±7.9 yr) stepped, from a standing position, down from 3 levels (7.3, 14.6, & 21.8cm) onto an adjacent forceplatform, either coming immediately to rest or proceeding directly to walking across the laboratory. Repeated trials were undertaken under habitual vision conditions or with vision blurred or occluded 1 to 2 seconds prior to movement initiation. Landing mechanics for the initial contact period were characterized using landing limb knee and ankle angle, vertical loading and stiffness, and support limb un-weighting. Landing stability was assessed by determining a/p and m/l stability margins ($SM_{a/p}$, $SM_{m/l}$) and a/p and m/l CM velocity, at the instant of landing.
Results: Movement time and ankle plantarflexion were significantly greater when vision was blurred or occluded, whereas knee flexion, vertical loading and stiffness and support limb un-weighting were significantly reduced. $SM_{a/p}$ and $SM_{m/l}$ at landing increased significantly when vision was blurred or occluded, whereas a/p and m/l CM velocity decreased. Adaptations under occluded conditions tended to be greater than those observed for blurred conditions but these differences were only significant in 1 or 2 cases. Most variables were significantly affected by stepping task and step height.
Conclusions: Findings indicate that under blurred or occluded vision conditions subjects 'sat back' on their support limb and used their lead limb to probe for the ground. Hence, they did not fully commit to weight transfer until somatosensory feedback confirmed they had safely made contact. These findings confirm the role of 'online' visual feedback in determining the time and place of contact when stepping down. In the absence of online visual feedback, stepping dynamics are modulated in advance of contact to utilize/optimise proprioceptive feedback to ensure landing occurs safely.

MP-4

The influence of optic flow on gait initiation

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Introduction: While walking, we perceive the environment as motionless despite the shift in the visual image on the retina. In order to perceive the environmental constancy, an appropriate internal transformation of optic flow is needed. To be efficient, such sensory transformation should be initiated somewhat before the gait onset. This hypothesis implies that, by artificially changing the optic flow from a stationary to a moving pattern, one can influence the latency of gait initiation. We tested this suggestion by analyzing the latency of gait initiated in response to expansion or compression of a virtual hallway at different rates. For comparison, we also analyzed the latency of gait initiated in a physical environment at different speeds in response to a sound signal
Methods: Virtual optical stimulation was delivered to healthy subjects (n=10) via a head-mounted display. The virtual expansion or compression of the hallway resembled to the natural changes in the optic flow occurring during walking forward or backward, respectively, in a physical hallway. In each of the two types of stimulation, 9 rates ranged from 0.5 to 8 m/s were used in randomly selected trials. Standing subjects were instructed to initiate walking forward (2 steps) as soon as they detected a change in the optic flow. In another set of trials, subjects started walking in real space in response to a sound tone. They were instructed to initiate gait at a preferred speed or at a faster or

slower self-chosen speed. The latency, duration, length, maximal and average velocity of the first step were analyzed.
Results: The rate of change in optic flow strongly influenced the latency of gait initiation and kinematic characteristics of the first step. In all subjects, the latency of the first step systematically decreased whereas the length, maximum and averaged velocity of the first step increased with the increasing rate of expansion or compression of the virtual hallway. In contrast, the latency of sound-initiated gait remained the same regardless of walking speed.
Conclusions: Results show that by unexpectedly changing optical flow, one can influence the latency of gait and its speed, thus confirming the hypothesis that walking is associated with an active internal transformation of optic flow in order to perceive the environment as motionless. The same mechanism might be functional in sound-initiated gait but in this case, the transformation of optic flow is chosen beforehand, according to the desired speed so that gait at different speeds could start at the same latency. Results can be used in rehabilitation, in particular, to facilitate gait initiation in Parkinson's patients.

MP-5

Comparison of stair descent performance of healthy elderly users and non-users of eyeglasses: a preliminary study

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Introduction: At the transition from level walking to stair descent, visual information is important for successful and safe negotiation of stairs. Thus, loss of visual capabilities and the optical distortions created by lenses may alter the ability to negotiate stairs, particularly at rapid speed. The purpose of this study was to characterize the stair descent performance of healthy elderly persons, both users and non-users of spectacles, and to compare two types of multifocal lenses (bifocal vs. progressive lenses).
Methods: Twenty healthy adults over 60 were assessed during stair descent. Ten did not need spectacles for stair negotiation (controls; Ctrl) whereas others were regular users of bifocal (n=5; Bfcl) or progressive (n=5: Prog) lenses. Examination of their vision confirmed that the subjects' refractive errors in both the Bfcl and the Prog groups were appropriately compensated by their current spectacles. Stair descent was assessed at natural and fast speed on a four-step staircase having instrumented steps and handrails. Time-distance parameters and three-dimensional kinematics data were obtained using foot switches and an Optotrak system, respectively. Non-parametric statistical analyses were used to assess differences in cadence and foot kinematics between groups for three stair gait cycles.
Results: No participants used the handrails to manage the stairs. Stair descent time-distance (cadence) variables were not different except for a trend (P= 0.095) for the first step between the Bfcl group and the two others (133.5 steps/min ± 0.06 vs. 146.9 ±16.9 and 147.6 ±17.6 for the Bfcl, Prog and Ctrl, respectively) at fast speed. Regarding the heel and toe positions relative to the stairs, no differences were observed except for a 2-cm trend towards a more anterior foot position on the third step for the Bfcl group (P= 0.095) at fast speed. When the foot reached the level of the intermediate (or obstacle) step during the first stair gait cycle, the linear velocity and acceleration of the foot were slightly higher for the Prog group than the Bfcl group (e.g. mean horizontal linear acceleration: 7.45 m/s-2 vs. 4.18 m/s-2). However, none of the comparisons reached the level of significance (P<0.05) and no differences in these parameters were found between the Ctrl group and the healthy subjects wearing spectacles.
Conclusions: To reduce cadence might be the first adaptation used by elderly persons who wear bifocal lenses to ensure safe transition from level walking to stair descent at rapid speed. This might allow them to better cope with the optical distortion created by the distance- and near-vision segments of their spectacles without having to change the kinematics of foot clearance. Future research will need to confirm this finding in a larger group of subjects.

MP-6

Can Tai Chi Improve Spatial Orientation in Subjects with Visual Impairments?

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Introduction: People with visual impairments utilize their remaining senses to learn about their environment, and their cognitive ability to determine what the sensory information "mean" for spatial orientation. In this connection, Tai Chi has shown to improve joint proprioception, and cognitive abilities. A question therefore arises as whether spatial orientation can be improved by Tai Chi training for people with visual impairments.
Methods: This was a prospective single-blinded controlled trial. Twenty-eight subjects with visual impairments were recruited to join a 4-month Tai Chi (n=14, 9 partial and 5 complete blind)) or music appreciation (n=14, 11 partial and 3 complete blind) program. Subjects in the Tai Chi group received training in the Yeung style for 1.5 hours, 2 times per week for 4 months. The music appreciation participants attended similar number of sessions. All participants underwent pre- and post evaluation on spatial orientation within 2 week prior to and after the programme. The spatial orientation task required the subjects to walk from point-to-point along a 'trained" and 3 'novel" paths. The walking paths were captured by a motion analysis system (Vicon, UK) using passive reflective markers placing onto both shoulders. The errors in orientation along the "trained" and "novel" paths were calculated.
Results: The errors in orientation was significantly less during "trained' than "novel" paths (p<0.05). Subjects with partial blindness made greater errors during the "trained" path than subjects with complete blindness (p< 0.05). After intervention, Tai Chi participants with partial blindness showed significantly less errors in orientation along the "trained" (Fig. 1, p < 0.05), but not the "novel" paths (Fig. 1, p>0.05). Insignificant changes along both 'trained" and "novel" paths were observed in the Tai Chi