A startling stimulus speeds up obstacle avoidance reactions

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Background and Aims: It has been reported that an auditory startle, when presented with an imperative signal for a voluntary movement, induces reaction time shortening (Valls-Solé et al., 1999, Carlsen et al., 2004). Obstacle avoidance reactions during walking are faster than voluntary reactions (Weerdesteyn et al., 2004). The aim of the present study was to investigate whether these fast responses could also be advanced with an unexpected auditory startle.

Methods: Subjects (n=12) walked on a treadmill and performed 60 obstacle avoidance trials in selected phases of the step cycle: late stance, early swing and mid swing. An unexpected auditory startle was delivered simultaneously with the obstacle in 15 trials, 5 in each phase. EMG activity was recorded from ipsilateral biceps femoris, rectus femoris, tibialis anterior and gastrocnemius medialis. Obstacle contacts (errors) and avoidance strategies (long step or short step) were noted.

Results: Trials with a startle showed significantly shortened response latencies (−20–30ms, p<0.05) and higher response amplitudes (p<0.05, except for gastrocnemius medialis). Error rates were reduced in trials with a startle. In relation to the strategies, startle increased the proportion of long step strategy to avoid the obstacle.

Conclusions: A startle stimulus is able to speed up voluntary reactions to avoid obstacles during gait. In view of the short response time under startle, it is proposed that the obstacle avoidance reaction may be fully represented at a subcortical level. Furthermore, being startled can have functional benefits on time-critical obstacle avoidance.

Cognitive and motor dual task effect on posture and balance impairment in Parkinson's disease patients

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Balance is a complex process that relies on vestibular, kinesthetic and visual systems, together with cortical representations, as well as on the actual cognitive processes. Poor postural balance is one of the major risk factors for falling and evaluation of postural stability is important to diagnose balance problems early in PD. Effects of cognitive and motor tasks on postural stability in PD were not fully examined and findings are controversial.

Postural data were assessed using a posturographic platform on 12 PD patients and 12 control subjects. During recording patients and subjects were standing barefooted, with their vision occluded, then with the visual feedback. Tasks requiring precise grip and/or mental calculation were performed. Calculated equilibrium score reflected the overall coordination to maintain standing posture.

No significant difference was found between posturographic parameters of patients while performing motor task. In comparison, the impact of visual deprivation was strong only combined with mental task. The sway velocity among patients was significantly different only during mental task. The center of gravity did not significantly differ from the controls, for both open and closed eyes.

The large observed SD may be related to the diversity with regard to the pathophysiological process and to the variability of the compensatory process. In conclusion, the sway coefficient proved to be the most useful parameter of equilibrium measurement. The results showed decreased efficiency of the equilibrium system in PD patients. However, including also more dynamic parameters, such as parameters of gait, would have provided more reliable results.

Top-down influence on a visually evoked locomotor steering response

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We investigated whether external visual yaw perturbations, applied during a virtual walking simulation, could elicit the reflex like locomotor steering synergy. Two virtual worlds were used, (1) a black and white tunnel environment devoid of landmarks, and (2) an outside environment with natural landmarks. These virtual scenes moved as if the participant was walking forward in the environment, creating the perception of forward self motion. Participants were asked to step in place at a self-selected comfortable pace during simulation. During stepping trials, the virtual world would unexpectedly undergo a left or right yaw rotation. Participants were asked to respond to these perturbations in a manner that felt most natural to them.

In the first experiment, participants were exposed to only the tunnel environment. Kinematic results revealed that head and trunk yaw movements could be elicited following unexpected yaw rotations of the virtual scene. Responses however, were small in magnitude (mean head yaw 4.4±0.93°) and could be voluntarily overridden (positive yaw responses present in 30.3±14.1% of trials).

In a second experiment, exposure to the tunnel virtual environment was interspersed with exposure to the natural virtual environment. In this experiment, head and trunk yaw responses to perturbations during tunnel ‘walking’ increased in occurrence (73.3±10.1% of trials), and were slightly greater in magnitude (mean head yaw 6.1±2.4°).

Results indicate that a change in visual information is sufficient to elicit a steering synergy response however; expectations or perceptual set can influence this reflex-like locomotor response.

Motor imagery effects on EMG activity of the walking in young and elderly subjects

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Background and Aims: Motor imagery (MI) is considered to have significant positive effects on motor learning. The purpose of this study was to investigate the effects of motor imagery on tibialis anterior (TA) and gastrocnemius medialis (GM) EMG activation during gait in healthy subjects of different ages.

Methods: The study included 6 young (3 men, age 26.1±2.9 years) and 6 elderly healthy volunteers (3 men, age 76.3±2.8 years). All participants had normal joint range of motion and muscle strength and had no gross gait abnormalities. Bilateral EMG activity of TA and GM were recorded in five different gait conditions, including walking after focused attention training and after MI training. Signals were normalized to maximal voluntary contraction (MVC) percentage. During all trials, participants walked with a cadence of 80 steps/min. Changes in magnitude of EMG were calculated with Root Mean Square analysis.

Results: Compared to free-walking, TA activity improved in both groups after focused attention training (+3.2% of MVC for young and +13.2% of MVC for elderly group) and after MI training (+2.8% of MVC for young and +16.9% of MVC for elderly group), and it returned to baseline values in the post-resting trial. Older participants showed a wider recruitment of TA and also of GM (+10.6% of MVC) muscles after MI training than younger participants (+3.5% of MVC).

Conclusions: Focused attention and MI seem to be effective to improve muscle activation during walking, regardless of age. MI is more effective than focused attention alone.