A NOVEL TOOL FOR MEDIOLATERAL BALANCE ASSESSMENT.

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SUMMARY
A novel zero order visual tracking task (VTT), using the
centre of pressure (CoP), was used to assess balance
performance. The VTT consisted of tracking a target signal
on a screen in front of the subject, by a projection of the ML
displacement of the CoP. The frequency of the target
increased from 0.3 to 2.0 Hz. Two targets were used; a
predictable target that used single sines or an unpredictable
that used multisines with a bandwidth of 0.6 Hz, increasing
at steps of 0.1 Hz. For the predictable task, significant
learning effects were found at 1.5 and 1.7 Hz in phase shift,
and at 0.3-0.4 and 1.1-1.2 Hz in gain (all \( p < 0.01 \)). For the
unpredictable target, significant learning effects were
observed for phase shift at all frequencies analyzed
(\( p < 0.01 \)), except at 0.3 and 0.4 Hz, while gain exhibited a
significant learning effect only at 0.4 and 0.5 Hz. Overall,
close to optimal values and no major learning effects
indicate that physical constraints do not limit performance
when tracking the predictable target. When comparing both
tasks, larger phase shifts and lower gains in unpredictable
tracking indicate a visuomotor delay. For the unpredictable
task, the phase-shift decreased substantially over sessions,
indicating that information processing can be improved with
a single session and the effect can be maintained up to one
week.

INTRODUCTION
It is thought that mediolateral balance control impairment
may affect performance of important daily life activities
such as walking, especially in the elderly [1, 2]. It has also
been proposed that balance training in the frontal plane may
reduce the incidence of falls in the elderly population [3].
Quantification and training of one’s capacity to dynamically
control mediolateral balance might therefore be a powerful
tool in fall prevention. For this purpose, a zero order visual
tracking task (VTT), using the centre of pressure (CoP),
which demands the integration of multiple sensory inputs, is
proposed. Balance performance during either a predictable
or an unpredictable VTT can be described in the frequency
domain in terms of phase shift, and gain. The aim of this
study was to determine whether learning effects occur in
these tasks.

METHODS
For this experiment, 20 healthy young subjects (28±3 yrs)
stood barefoot on a force plate (Kistler) and performed a
series of 4 VTTs with a predictable target and 4 with an
unpredictable target, preceded by 2 practice trials for each
task. The VTT consisted of tracking a target signal on a
screen in front of the subject, by a projection of the ML
displacement of the CoP. The frequency of the target
increased from 0.3 to 2.0 Hz. For the predictable target, the
frequency increased with steps of 0.1 Hz every 5 seconds.
For the unpredictable target, multisines with a bandwidth of
0.6 Hz and lowest frequency increasing from 0.3 to 1.5 Hz
at 0.1 Hz were used. D-Flow (Motek Medical, The
Netherlands) was used to produce target signals and project
CoP feedback (spheroids). Performance was expressed as
the gain and phase-shift between the target and CoP
projection. Repeated measures ANOVAs were performed to
assess learning effects at frequencies from 0.3 To 2.0 Hz,
with an alpha of 0.01.

Figure 1: Averaged curves (± sd) for PS (top panel), G
(bottom panel) measures using both, predictable target (left
column) and unpredictable (right column) during first (blue
lined) and second (red line) sessions.
RESULTS AND DISCUSSION
For the predictable task, significant learning effects were found at 1.5 and 1.7 Hz in phase shift, and at 0.3-0.4 and 1.1-1.2 Hz in gain (all $p<0.01$). For the unpredictable target, significant learning effects were observed for phase shift at all frequencies analyzed ($p<0.01$), except at 0.3 and 0.4 Hz, while gain exhibited a significant learning effect only at 0.4 and 0.5 Hz.

CONCLUSIONS
Overall, close to optimal values and no major learning effects were found over the range of frequencies for the predictable task, indicating that physical constraints do not limit performance in CoP tracking up to 2 Hz. When comparing both tasks, larger phase shifts and lower gains in unpredictable tracking indicate that information processing may be a limiting factor. For the unpredictable task, the phase-shift decreased substantially over sessions. This may indicate the information processing required in the unpredictable task can be improved with a single session and the effect can be maintained up to one week.

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REFERENCES