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COMBINATION OF VISUAL AND BODY ORIENTATION CUES FOR ARM POINTING MOVEMENTS

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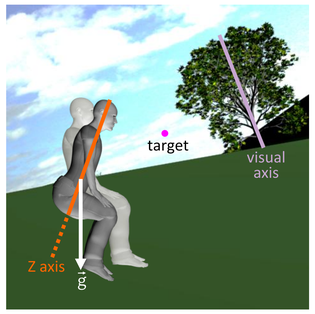
Introduction



- The position of a visual target can be determined relative to the **body** and/or **external references**
- Producing appropriate goal-directed arm movements involves continuous adjustments in response to active or passive body displacements/reorientations
- Target localization and arm motor control are based on the integration of multisensory cues about the ever-changing states of the environment and the body

Influence of correlation/dissociation of visual and/or body orientation on arm pointing movements

What is the combination process of visual and body-related cues underlying sensorimotor control during body and visual scene tilts?

Methods

APPARATUS

Experimental set-up

Participants: 15 right-handed subjects

- **Rotating chair**

Slow body pitch tilt from 0 to 18 deg: *0.05 deg.s^{-1} following an initial acceleration of 0.005 deg.s^{-2}*

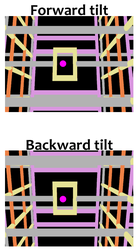
- **3D Head-Mounted Display**

Structured visual scene: *could rotate with the same profile as the rotating chair*

Target: *flashed dot at screen center*

- **Motion tracking system**

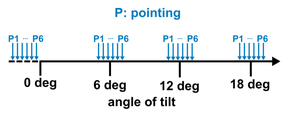
Infrared active markers: *at right index, eye-level and chair rotation axis*



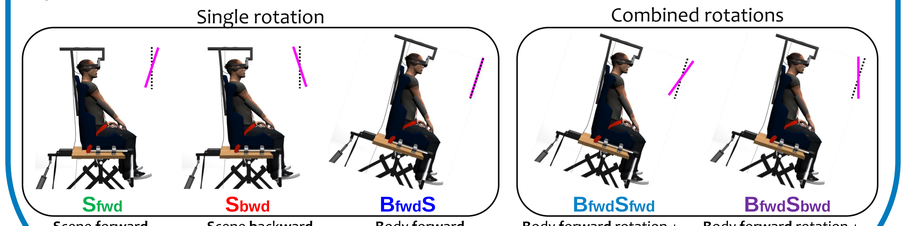
Screen captures: *18 deg tilt*

PROCEDURE

Instructions: 'Point toward the target as fast and as accurately as possible' *during body and/or scene constant rotation from 0 to 18 deg*

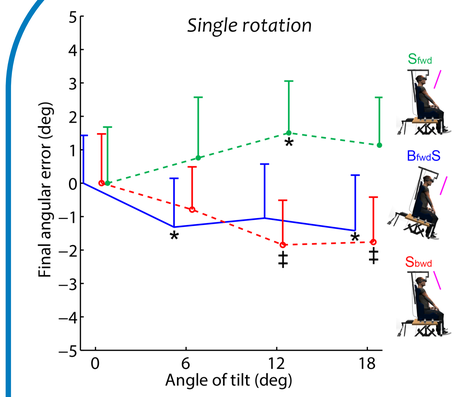


Experimental conditions:



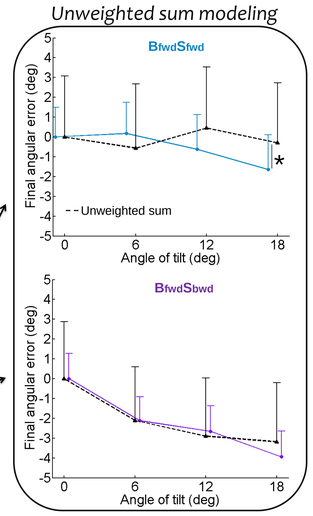
Results

FINAL POINTING ACCURACY



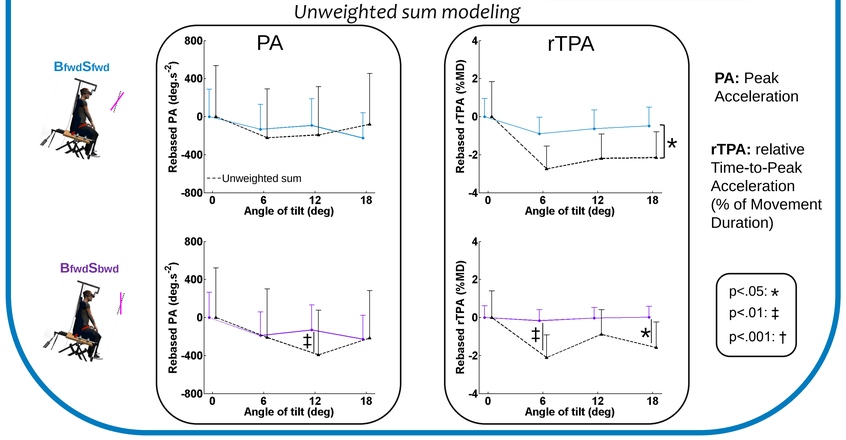
- **Final accuracy impaired by body and/or scene tilts**
- **Final accuracy can be predicted by an unweighted sum model only for BfwdSfwd**
- **Early kinematic parameters are not well predicted by an unweighted sum model**

Unweighted sum modeling



EARLY KINEMATIC PARAMETERS

Unweighted sum modeling



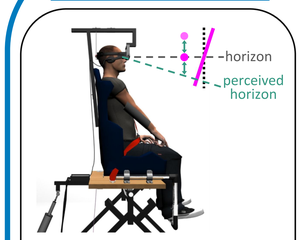
PA: Peak Acceleration

rTPA: relative Time-to-Peak Acceleration (% of Movement Duration)

p<.05: ∗
p<.01: ‡
p<.001: †

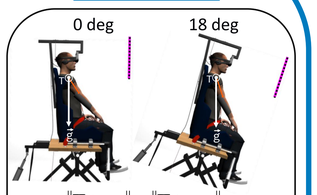
Discussion

VISUAL SCENE ROTATION



erroneous target localization relative to horizon
(Matin & Fox 1989)

BODY ROTATION



$\|T\vec{g}_{0\,deg}\| > \|T\vec{g}_{18\,deg}\|$

overcompensation of gravity consequences
~ microgravity (Watt et al. 1997; Carriot et al. 2004)

COMBINED BODY AND VISUAL SCENE ROTATIONS

- FINAL POINTING ACCURACY

Sensory combination rules depend on the direction of visual scene rotation

visual vertical **away from** gravitational vertical

poor relevance of visual cues
→*body-related cues dominance*
(Sciutti et al. 2012; Barnett-Cowan & Harris 2008)

visual vertical **at** gravitational vertical

high relevance of visual cues
→*additive combination of body and visual orientation cues*

Influence of the 'visual gravity' (Sciutti et al. 2012; Le Seac'h & McIntyre 2007) **and/or directional congruence?**

- EARLY KINEMATIC PARAMETERS

- *Do not fit with a simple additive combination of visual and body-related cues*
- *An earlier bottom-up process at work?*

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Barnett-Cowan M, Harris LR (2008) Perceived self-orientation in allocentric and egocentric space: effects of visual and physical tilt on saccadic and tactile measures. Brain Res 1242: 231–243. doi:10.1016/j.brainres.2008.07.075.

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