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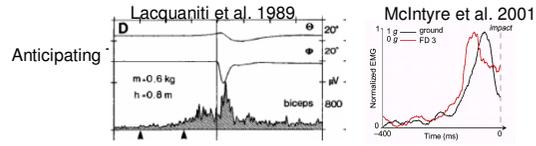
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Poster Session 81, Voluntary Movements I

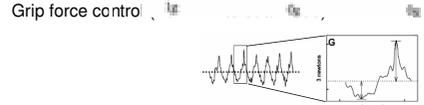
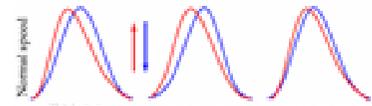
Introduction

Anticipation of gravity's effects

Certain tasks show asymmetries depending on the direction of movement. This specialization may indicate an anticipation of the effects of gravity.

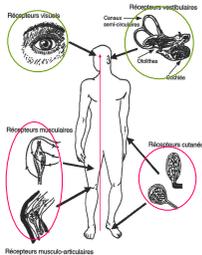


Movement kinematics (from Papaxanthis et al 2005)



What defines "up" and "down" ?

Two type of referential can be used to define up and down :



- ⊙ A reference frame based on **allocentric** cues
- ⊙ A reference frame based on **egocentric** cues
- ⊙ A combination of the two

General methods : Separating allocentric and egocentric frames of reference



Acknowledgements

This work was supported by french space agency (CNES), Prodex/SSTC/FNRS (Belgium) and European Space Agency (ESA)

Experiment 1

What cues contribute to the sense of "Up" and "Down" when estimating TTC for interception ?



From Senot et al 2005

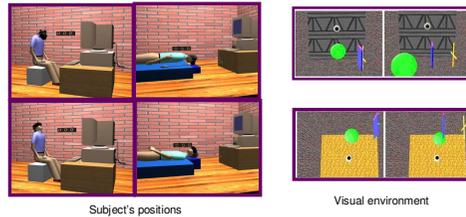
- When vision is congruent with body axis and gravity, Ss anticipate the effects of gravity on the ball
- If vision is **not** congruent with body axis and gravity, Ss **don't** anticipate the effects of gravity on the ball based on visual cues alone.

What is the direction that matters ?

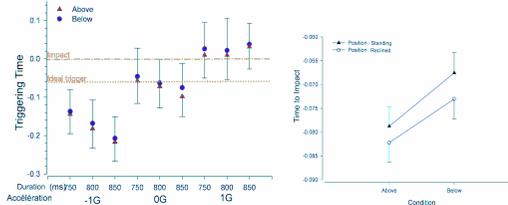
Direction with respect to the body axis, based on neck posture (egocentric) or direction with respect to gravity based on vestibular and other cues (allocentric)

Methods

25 subjects, 2 ball direction (upward and downward), 2 positions (sat and reclined), 9 type of balls : 3 accelerations (1g, 0g, -1g) and 3 falling time (750ms, 800ms, 850ms)



Results



- Whatever the duration or acceleration of the ball, Ss trigger the racket movement earlier when it comes from above
- The effect of ball's direction is the same for both body postures

Conclusion

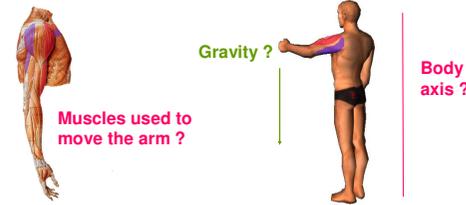
Asymetry seems to reflect an allocentric effect that is linked to gravity.

Question

But then why did astronauts appear to anticipate gravity's effects when there is none ?

Experiment 2

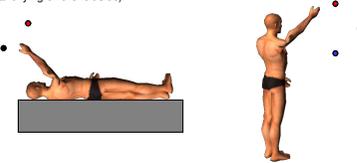
Is the difference in kinematics linked to the direction of movement respective to the body axis or to gravity ?



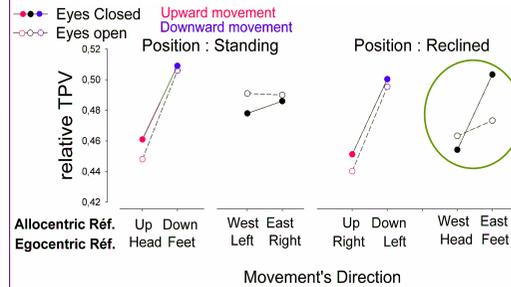
Muscles used to move the arm ?

Methods

11 subjects, 4 movement directions (upward, downward, eastward, westward), 2 positions (standing and lying on the left side).



Results



Allocentric Réf. Egocentric Réf. Movement's Direction

When Ss close their eyes, the same effect is observed for horizontal movements : TPV is smaller for headward movements than for feetward ones.

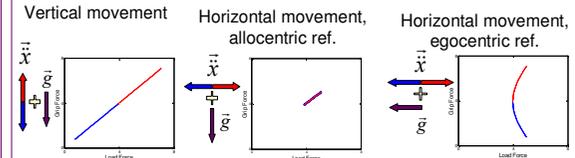
Conclusions

Both allocentric and egocentric cues can elicit the asymetry of pointing movements.

Weighting of the sensory inputs depends on the number of cues availables.

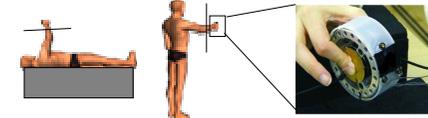
Experiment 3

How does one anticipate the direction of gravity for the control of grip force ?



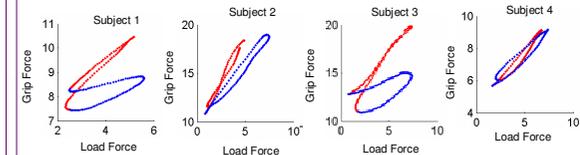
Methods

15 Subjects performed cyclic movements during 1min, in 2 positions upright or reclined.



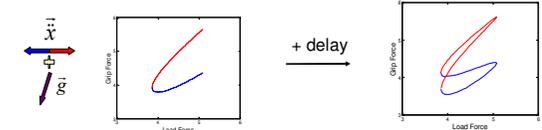
Results

For the majority of subjects, grip force was not simply proportional to load force



Can this be due to a misperception of vertical direction ?

Simulation results



Conclusion

Grip force appears to depend on the precision of the estimate of gravity's direction.

Question :

What cues contribute to the estimate of gravity's direction ?