Perspective taking in a realistic task in simulated microgravity conditions

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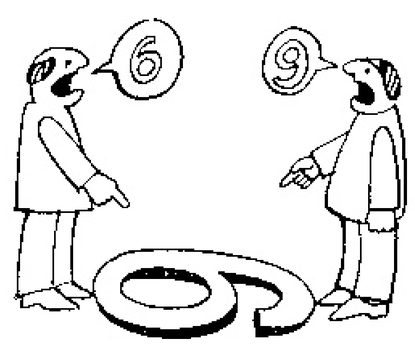
INTRODUCTION



Social interactions and good team collaboration are essential human factors for the success of long duration space flights. They depend on the ability to take another person's viewpoint, **i.e. perspective taking**.

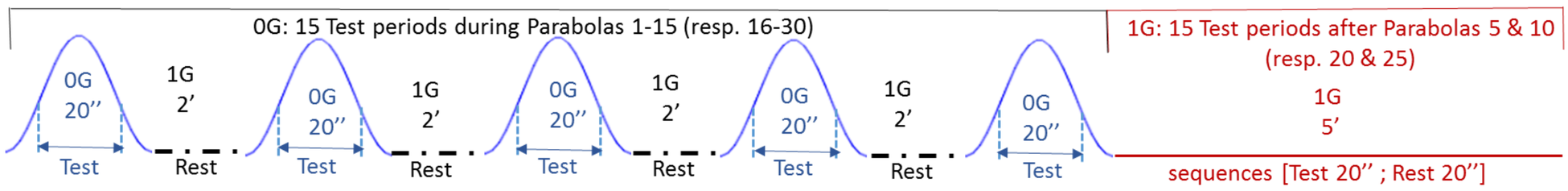
Such mental transformations are enabled by relying :
(1) on an **egocentric reference frame** exploiting a speaker's' own perspective
(2) on **addressee-centered reference frame** requiring a speaker to adopt another speaker's perspective.
(3) on **allocentric reference frame** when an object itself or its features orients a speaker**.**

→ **Depend on retinal, proprioceptive and vestibular inputs**

In microgravity conditions the vestibular system would be disrupted, along with egocentric mental transformations (Grabherr et al., 2007).

RESEARCH QUESTION

The present study tested this hypothesis in a virtual reality perspective-taking task performed in **parabolic flight conditions.**
Performance in 1g and 0g were compared to identify the potential effect of microgravity on perspective-taking abilities (correct answers and reaction times).
The experiment was first performed on ground (baseline performance), then on the airplane during simulated microgravity (0G) and 1G periods.

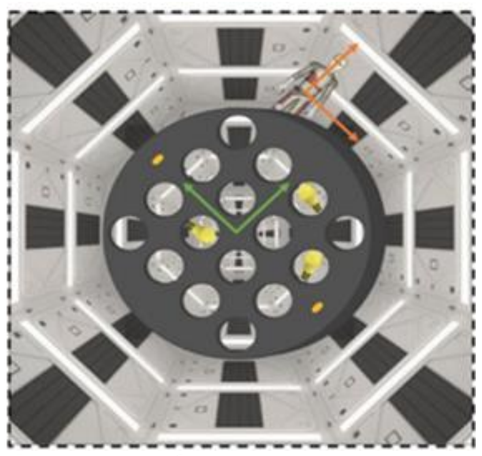


MATERIALS & METHOD

Participants (n=12; mean age 49; all males).

Materials :

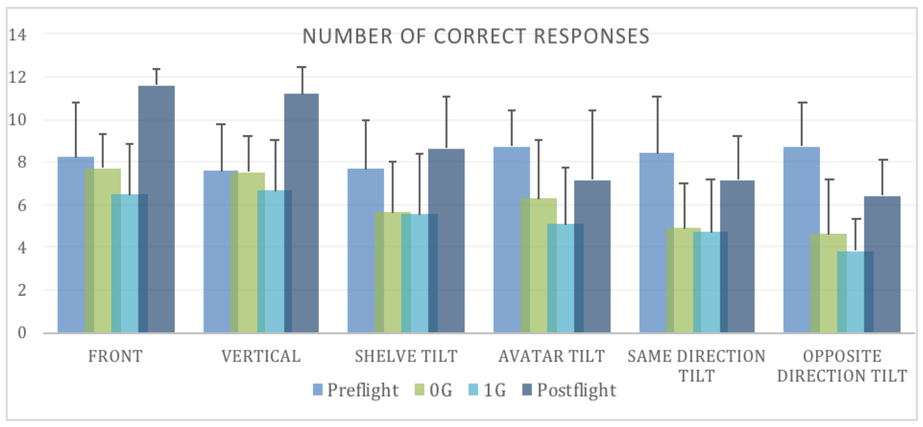
- **Virtual Reality environment** : The participant had to move one of the objects from one compartment of the shelf to another (up/down/left/right) according to the avatar's point of view : **requiring a mental transformation.**

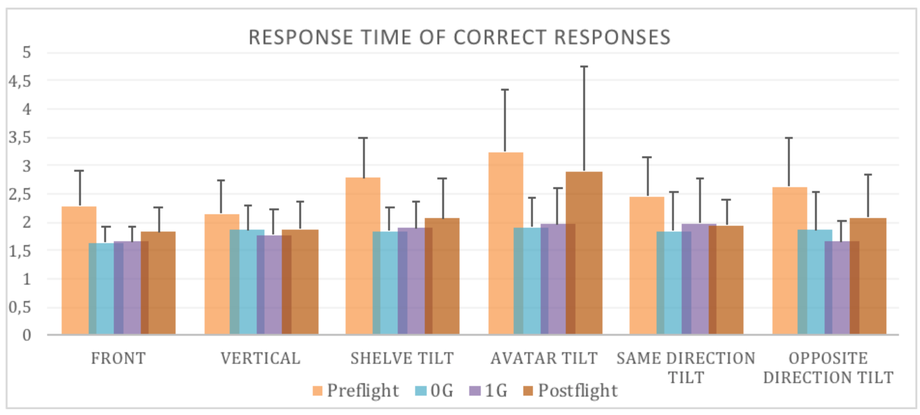


We tested the involvement of :
(1) visual information, i.e. the avatar in vertical position and shelf was tilted (-45 / +45°)
(2) vestibular information, i.e. only the avatar was tilted (-45 / +45°) requiring the participant to adjust to the avatar's perspective.
Against two control conditions :
- All elements were vertical (Vertical)
- The avatar was in front of the shelf (e.g. direct perception)

At the end of the test, participants indicated the mental task load they had perceived (**NASA-TLX**). On the pre-flight session, they also performed **the rod-and-frame test** to control for spontaneous visual dependency.

PRELIMINARY RESULTS





N = 11	On Ground	On flight 0G	On flight 1G
SHELVE TILT	RT>Vertical[1] RT>Front[3]	Nb<Vertical[2] Nb<Front[3]	NS NS
AVATAR TILT	RT>Vertical[1] RT>Front[2]	NS Nb<Front[3]	NS Nb<Front[2]
SAME DIRECTION TILT	NS NS	Nb<Vertical[1] Nb<Front[1]	Nb<Vertical[2] Nb<Front[2]
OPPOSITE DIRECTION TILT	RT>Vertical[1] NS	Nb<Vertical[2] Nb<Front[1]	Nb<Vertical[1] Nb<Front[1]

[1] P < .01 ; [2] P < .05 ; [3] p < .07 ; *NS:* non significant
RT = reaction time ; Nb = number of correct answers

DISCUSSION / CONCLUSION

⇛ **On-flight :** performances differences in the critical test conditions manipulating egocentric reference frame alone (avatar tilt) or allocentric + egocentric reference frame (shelf tilt).

⇛ Lower number of correct answers in 0G and 1G conditions compared to tests on ground condition and lower performances on allocentric condition in 0G : **disrupt of own body perception in space ?** (Friederici & Levelt, 1990).

Variation between first-person perspective and third-person perspective (Vogeley & Fink, 2003). An imagined body transformation is likely to use some gravitational reference information regarding the actual body position (Grabherr et al., 2007).

We propose either a disrupting effect of microgravity in perspective taking or a facilitating effect of microgravity in control conditions.

On future experiment, we need introduice more participants and rely others factors : working memory measures, pure mental rotation tasks and basic measure of speed information processing.

References: Vogeley & Fink, 2003, Trends Cogn. Sci. (Regul. Ed.), 7(1), 38-42. Grabherr et al., 2007, Journal of Vestibular Research: Equilibrium & Orientation, 279-287. Friederici & Levelt, 1990*; Perception & Psychophysics, 47(3) 253-266.*