

## Feedback-driven adaptation of gravity-related sensorimotor control to an upside-down posture

### to editor:

- **Title and abstract**
  - Does the title clearly reflect the content of the article? [] Yes, [] No (please explain), [] I don't know
  - Does the abstract present the main findings of the study? [] Yes, [] No (please explain), [] I don't know
- **Introduction**
  - Are the research questions/hypotheses/predictions clearly presented? [] Yes, [] No (please explain), [] I don't know
  - Does the introduction build on relevant research in the field? [] Yes, [] No (please explain), [] I don't know
- **Materials and methods**
  - Are the methods and analyses sufficiently detailed to allow replication by other researchers? [] Yes, [] No (please explain), [] I don't know
  - Are the methods and statistical analyses appropriate and well described? [] Yes, [] No (please explain), [] I don't know
- **Results**
  - In the case of negative results, is there a statistical power analysis (or an adequate Bayesian analysis or equivalence testing)? [] Yes, [] No (please explain), [] I don't know
  - Are the results described and interpreted correctly? [] Yes, [] No (please explain), [] I don't know
- **Discussion**
  - Have the authors appropriately emphasized the strengths and limitations of their study/theory/methods/argument? [] mostly-need a little more] Yes, [] No (please explain), [] I don't know
  - Are the conclusions adequately supported by the results (without overstating the implications of the findings)? [] should be limited to their task] Yes, [] No (please explain), [] I don't know

### To authors:

#### Summary:

Authors conducted an experiment in which they assessed repetitive discrete upward and downward movements of the arm at the shoulder joint in 35 s bouts. They alternated upright and inverted positions which required about +/- 18 degree range of motion about a horizontally oriented arm and asked participants to complete as many movements as possible. Results revealed an initial difference in the first block for each body position such that relative time to peak velocity and deceleration differed for inverted condition yet people adapted to achieve similar values by the third block to suggest evidence for use of feedback and not feedforward control mechanisms.

I applaud the authors for their efforts in the research. I found the study interesting and believe it will be of interest to researchers who explore gravitational influences on movement control and beyond. I do believe that authors could clarify several items for potential future readers and expand discussion on the applications of their work.

#### General comments:

It would be great to see raw data of the movements, get insight into how many movements each person achieved in each 35 s bouts? Did the number of movements stay the same across bouts? Did it differ for upright vs inverted?

Lines 136-7: I have questions about movement accuracy. What does accuracy mean here? Having people perform movements about the horizontal places torques at the shoulder throughout the 35 s trial which I agree will be same if people above and below the horizontal equally (line 141). However, when performing goal-directed movements with the use of vision, people have a tendency to align the position of their finger along the line of sight or gaze direction. This would result in people making greater movement excursions during movements toward the head/eyes and smaller excursions toward the feet. Authors should address the movement excursions/amplitude relative to horizontal, rather than just full amplitude, and provide insight into the implications of gaze direction and the outcomes of their study. If the people did perform equal movements above and below the horizontal, does this suggest that people ignored the allocentric visual cues for endpoint accuracy when performing the task? If they ignored the visual cues what application does this have for upright and inverted RtPA, rtPV, rtPD? What implications do either of these have on motor control?

In lines 252-256, the results seem to work for repetitive up and down discrete vertical movements. Does this mean that the gravitational pull effects on vertical movements decay with use? Do they apply multiple goal-directed 3D movements throughout space?

In lines 267-272, what are authors using as evidence for use of feedback information? I cannot see in the data where the cutoff for feedforward vs feedback is provided the supplementary data are relative times for direct comparisons. I assume the use of 80 ms but am unsure. Did you have people achieve PA before 80 ms?

#### Minor comments/concerns:

I believe the word “gravity” is a noun and not an adjective, yet authors use it as the latter. Example on line 23 of abstract, “...face of various gravity level modifications...” should be, “...face of various gravitational level modifications...”

This is an editorial preference, but I do not care for the use inanimate objects doing things. Example, “...most studies varied gravity...” on line 25 of abstract and other places. I prefer people doing the task, such as “...most researchers varied gravity...” But of course this is up to the editor.

Line 254, I think “procee” should be “process”.

Limitations: Did any of your participants reveal obvious negative effects of inversion that you eliminated all or some of their data from analyses? It would be nice to have what your people experienced.