

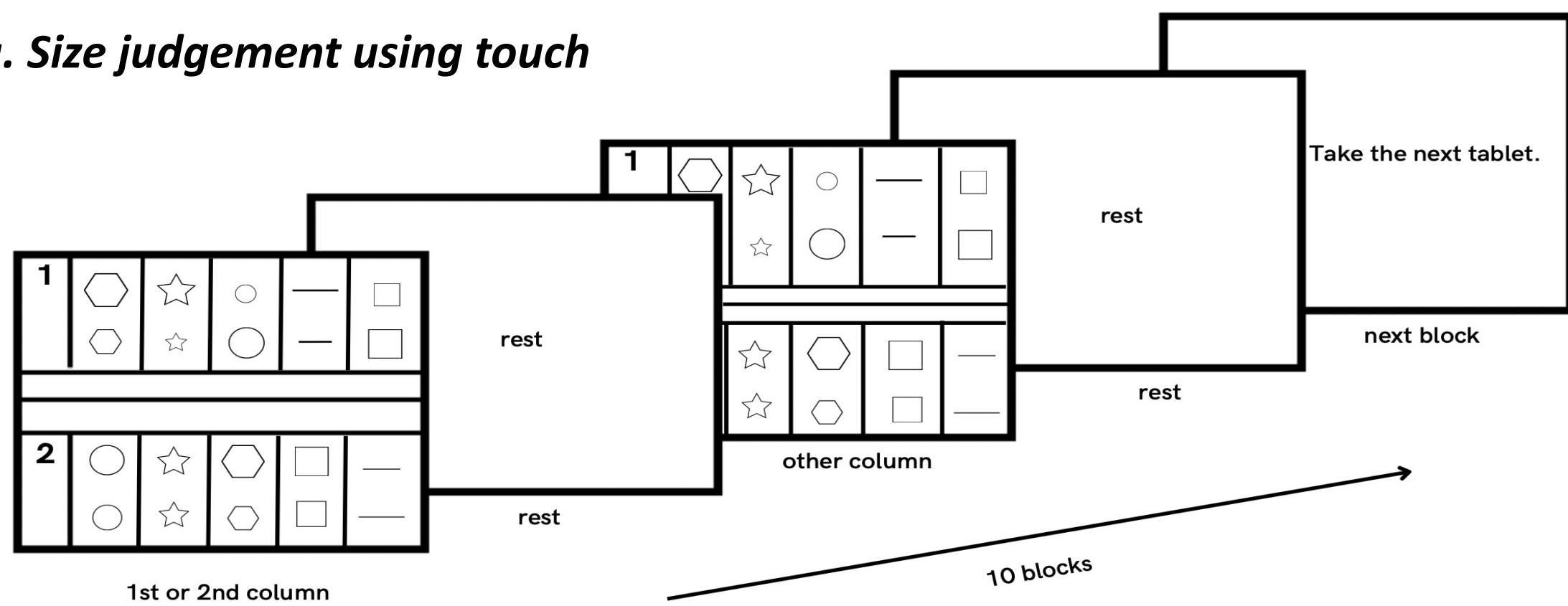
INTRODUCTION

- It is well-known that a common set of frontal and parietal regions activates in response to diverse control demands. This set of regions has been referred to as multiple demands, task-positive, cognitive-control, attentional network (Duncan 2010; Fox et al. 2005).
- Cerebellum, a key hind-brain structure, used to be thought of a motor-related region. Over the past two decades its role in other aspects of cognition has gradually been uncovered.
- Neuroimaging studies frequently find cerebellar activations during diverse cognitive tasks. However, it is unclear if these diverse tasks activate functionally distinct regions within the cerebellum, or activate common loci, just like the case in frontal and parietal regions.
- It is commonly thought that the anterior lobe of cerebellum i.e., **lobule I to V** has motor related functions while the posterior lobe has cognitive functions i.e., **lobules VI and VII including crus 1 and 2** (Stoodley, et al., 2012).

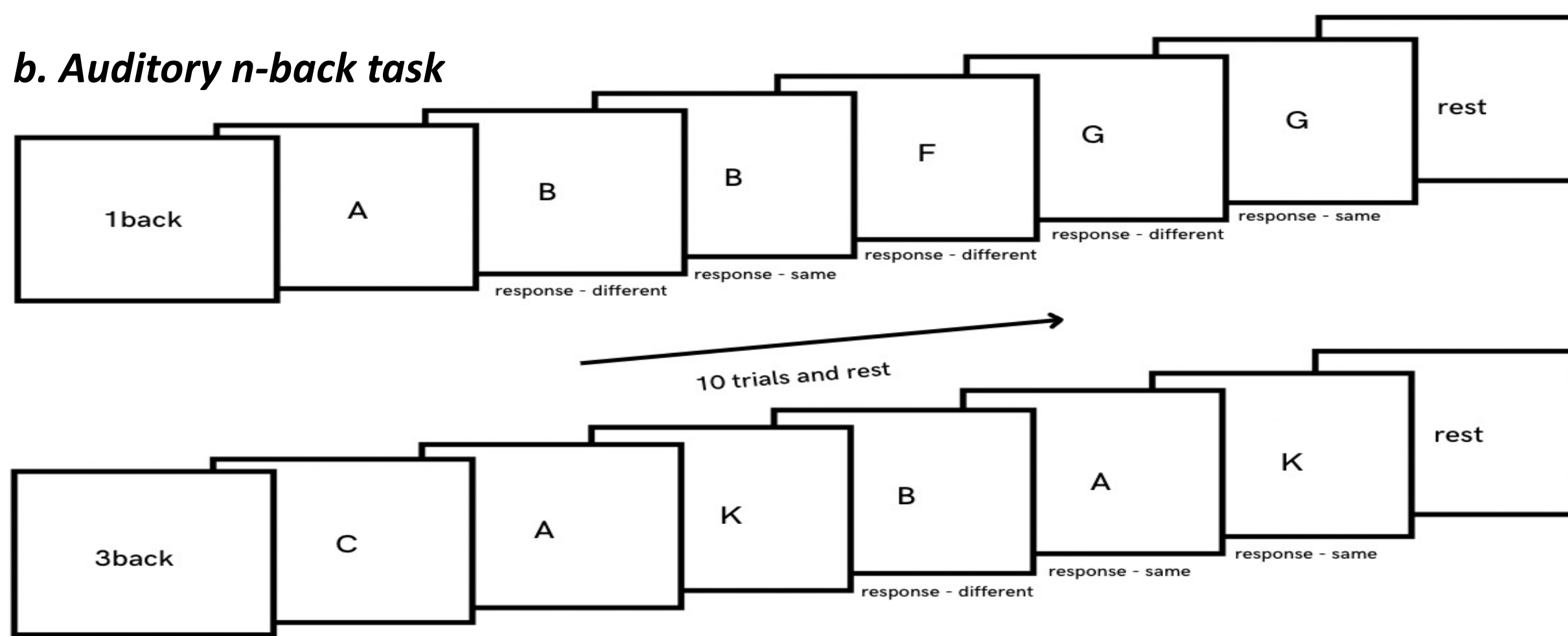
METHOD

- The study comprised a total of 31 participants (15 sighted, and 16 blind). All participants completed **four tasks**, which included **three non-motor tasks** and **one motor task**. Each task had a difficult and an easy condition. The tasks were:

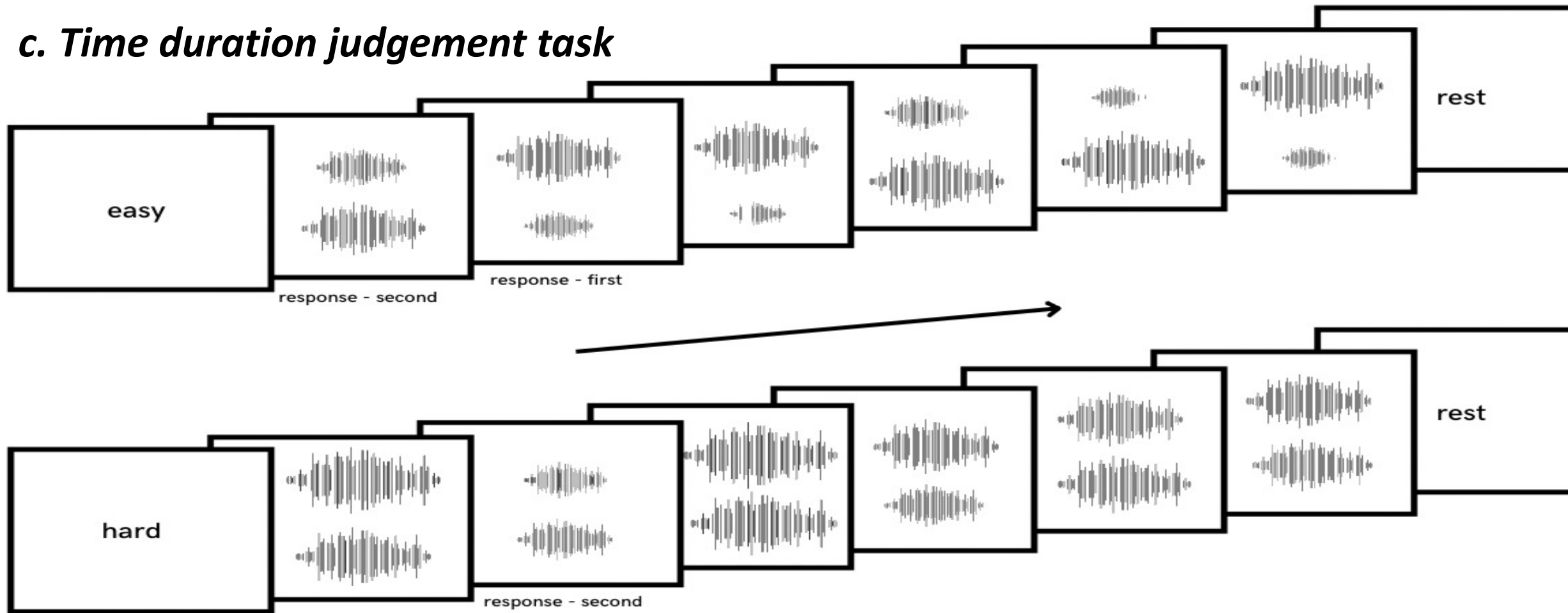
a. Size judgement using touch



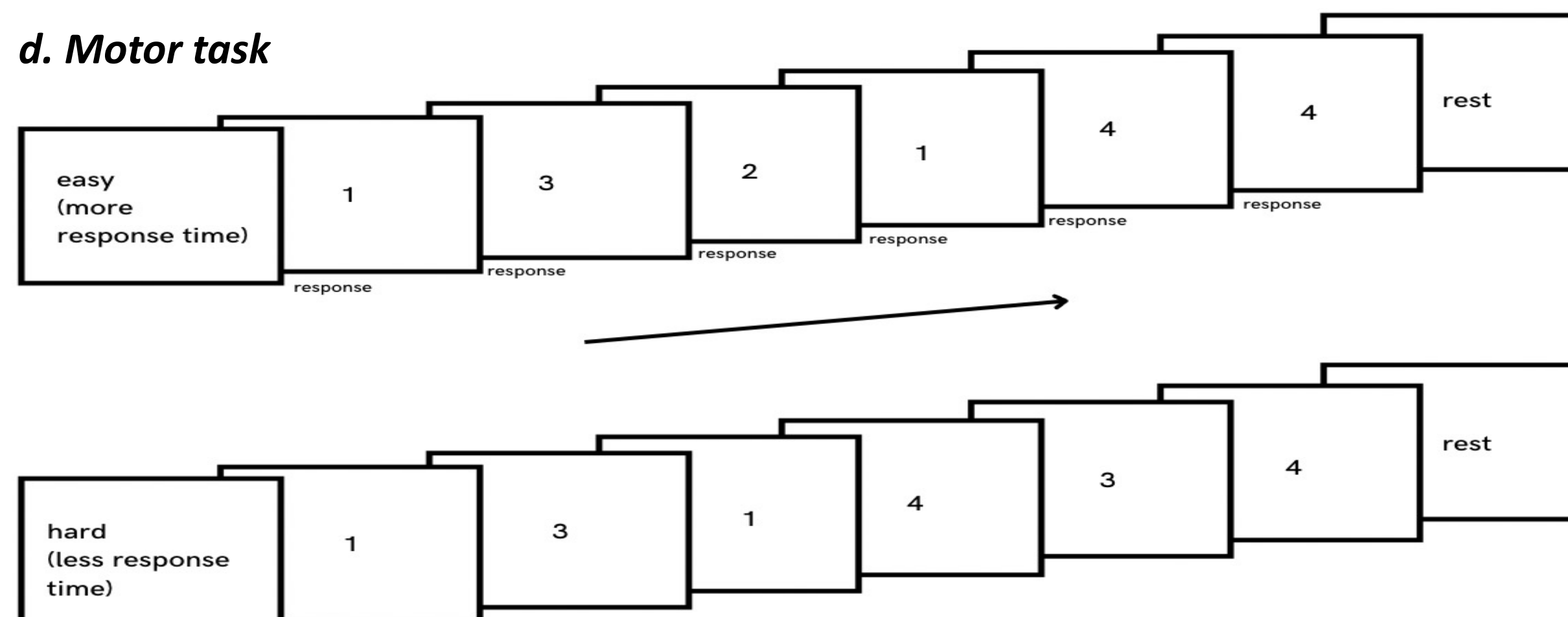
b. Auditory n-back task



c. Time duration judgement task



d. Motor task



RESULTS

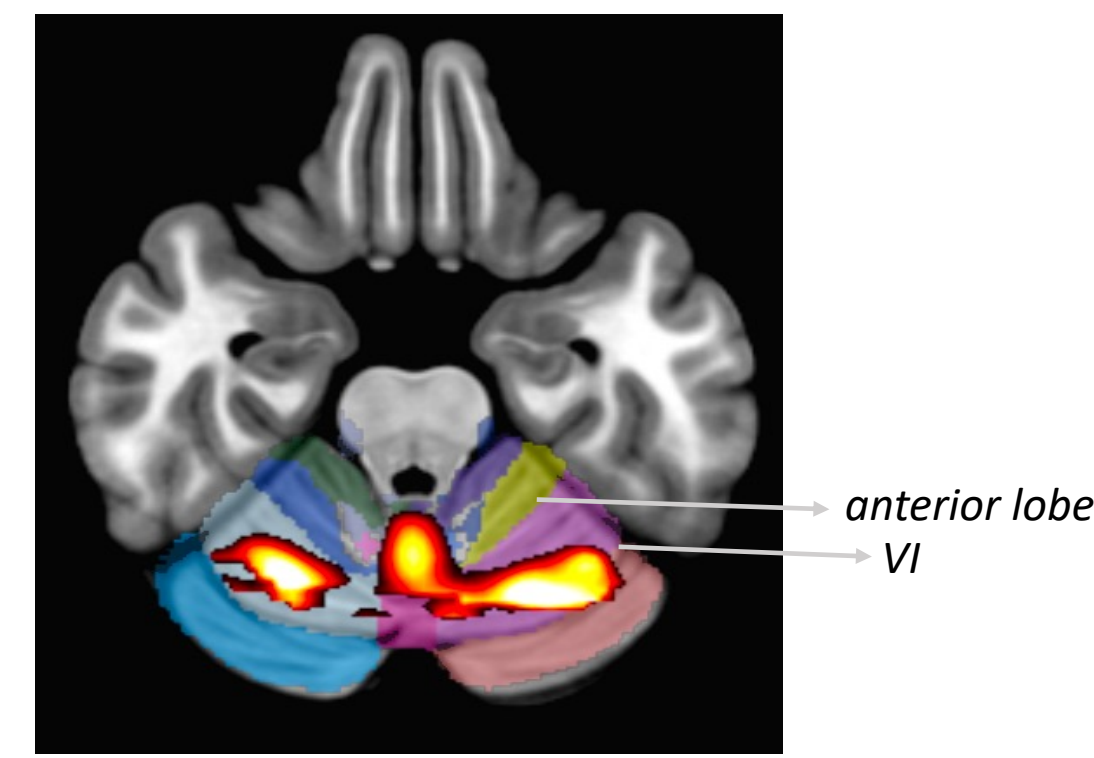
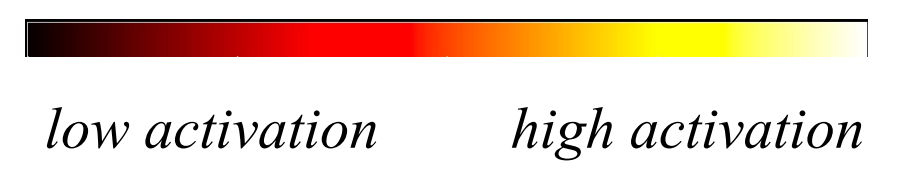


Figure a: Three non-motor tasks activation among all participants

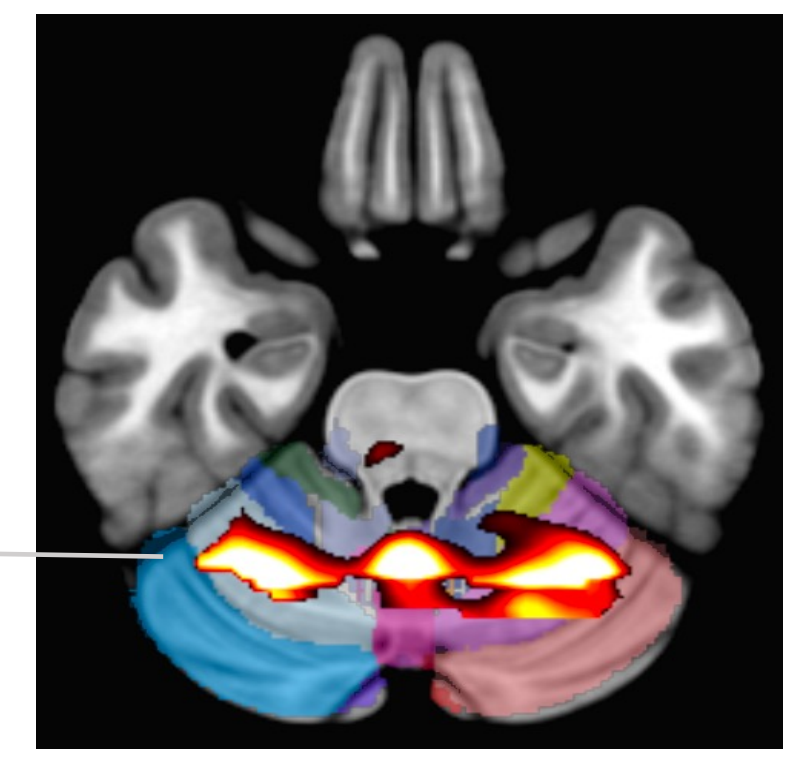


Figure b: All four tasks activation among all participants

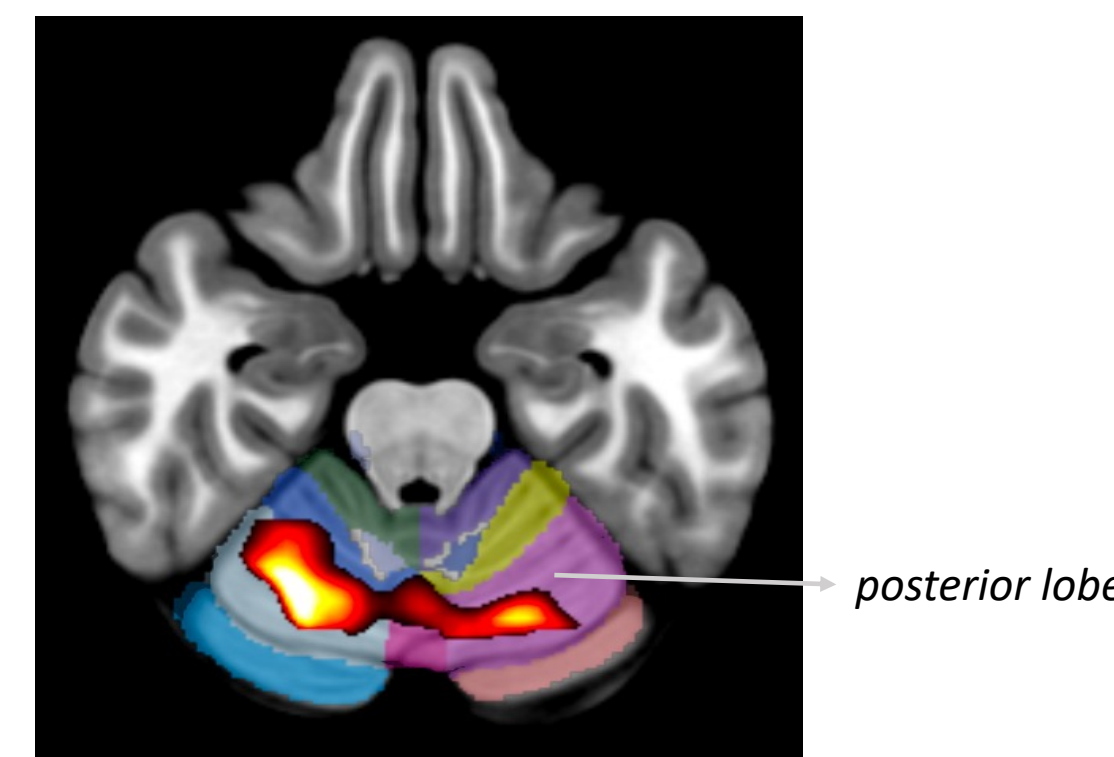


Figure c: Tactile task activation among all participants

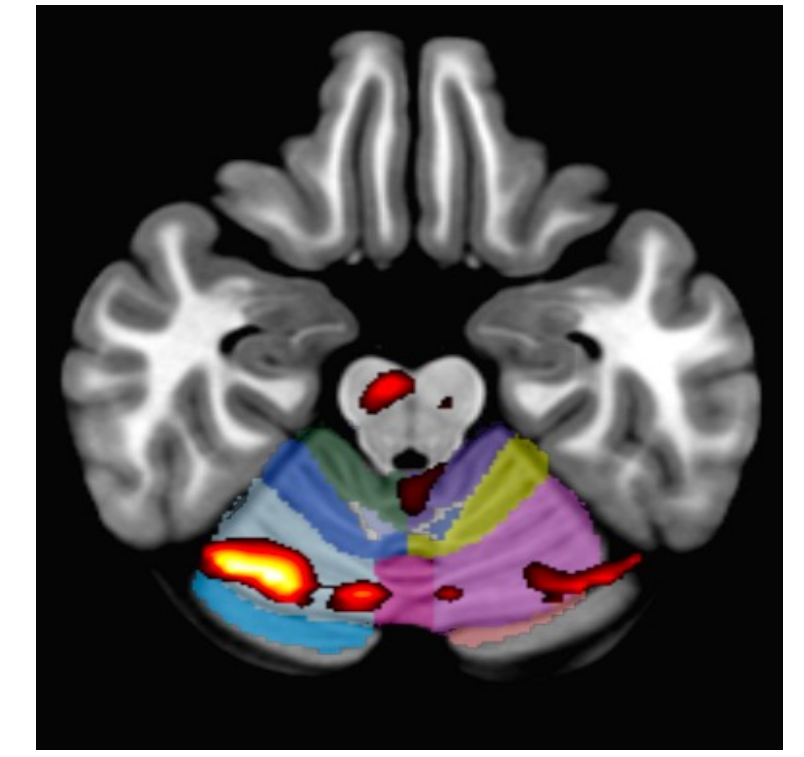


Figure d: n-back task activation among all participants

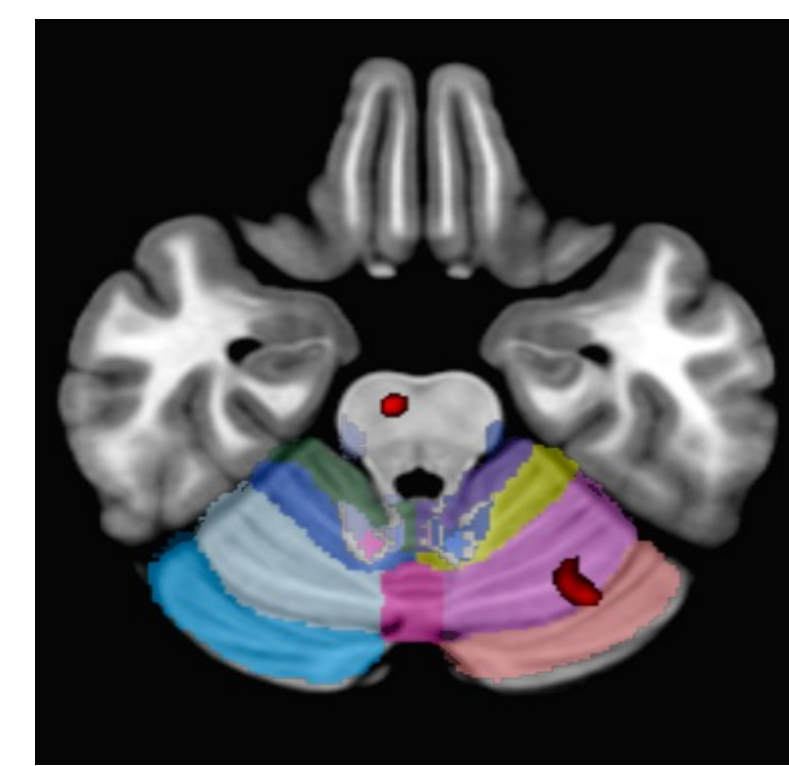


Figure e: Temporal duration judgement task activation among all participants

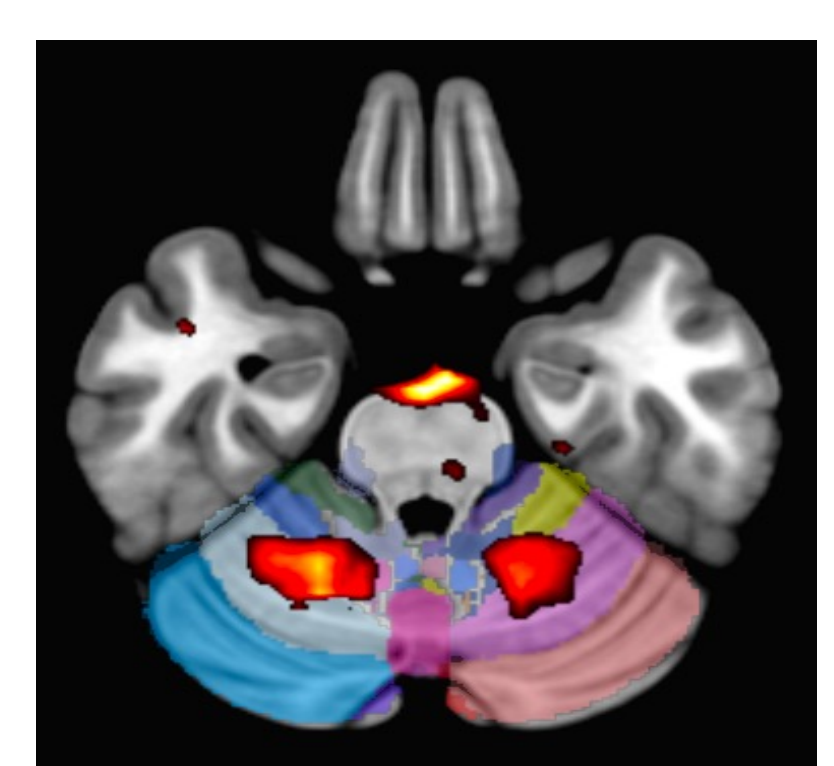


Figure f: Motor task activation among all participants

- **Motor-complexity demands** increased activation in both anterior as well as posterior lobes.
- **The three non-motor cognitive demands** (working memory, tactile decision, and time-duration judgement) **activated** a region in **lobule VI of posterior lobe that was also activated by motor-complexity**
- Crucially, these **three non-motor cognitive demands** also activated a locus in the vermis of anterior lobe that spanned lobules II-V

DISCUSSION

- Specific regions of cerebellum activate in response to diverse set of control demands. These parts include what are accepted as cognitive parts (e.g., lobule VI) .
- Crucially, these also include parts that are still thought of as purely motor (e.g., vermis of lobules II – V) .

References

- Duncan, J. (2010). The multiple-demand (MD) system of the primate brain: mental programs for intelligent behaviour. *Trends Cogn Sci*, 14(4), 172-9. doi: 10.1016/j.tics.2010.01.004
- Fox, M.D., Snyder, A.Z., Vincent, J.L., Corbetta, M., Van Essen, D.C., & Raichle, M.E. (2005). The human brain is intrinsically organized into dynamic, anticorrelated functional networks. *Proc Natl Acad Sci USA*, 102(27), doi: 10.1073/pnas.0504136102
- Stoodley, C.J., Valera E.M., & Schmahmann J.D.(2012). Functional topography of the cerebellum for motor and cognitive tasks: an fMRI study. *Neuroimage*, 59(2), 1560-70. doi: 10.1016/j.neuroimage.2011.08.065