

Using fNIRS to Identify Age-Related Neurocognitive Changes in Working Memory



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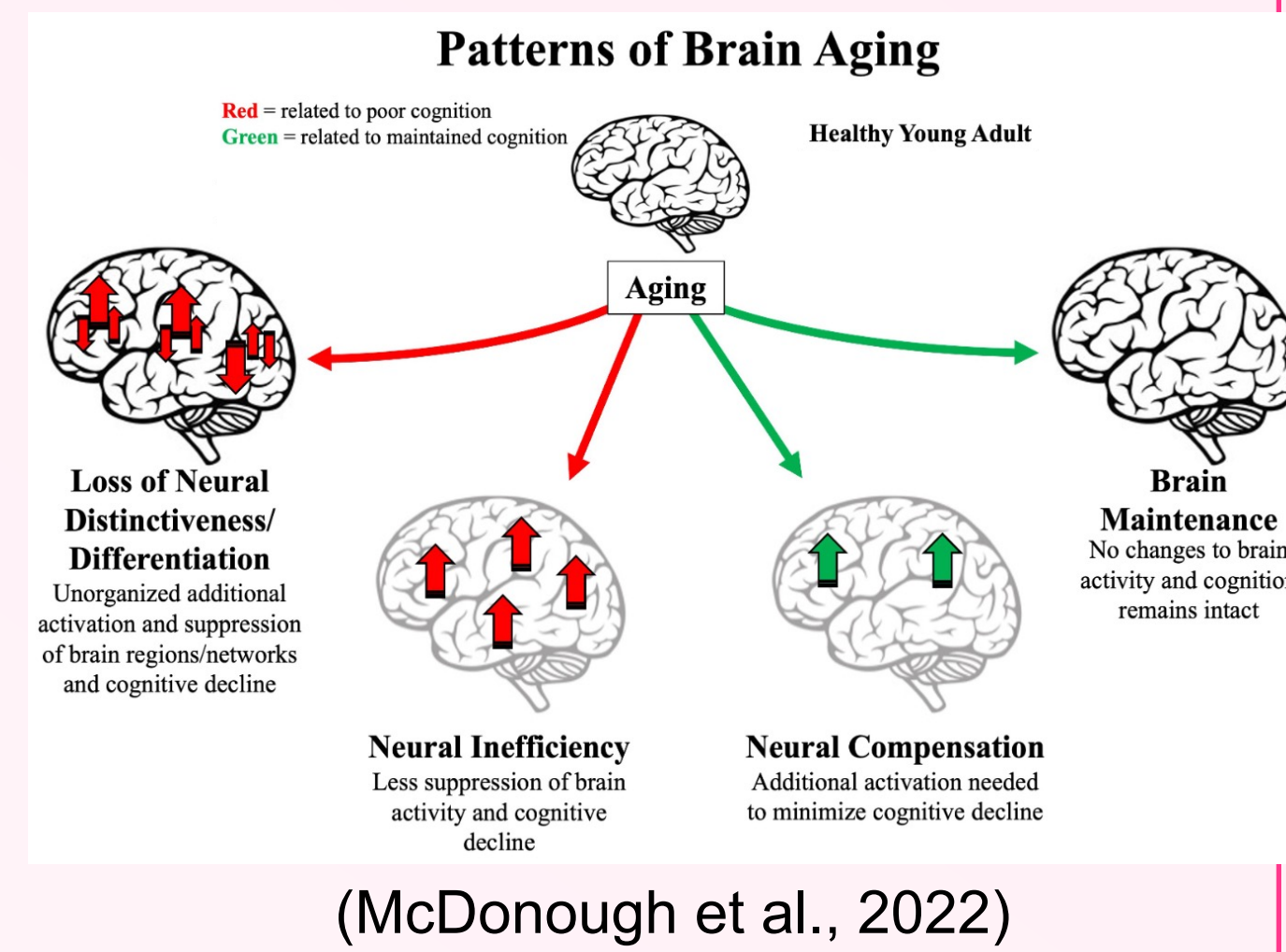
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Background

- Research has found distinct brain activity differences between old (OA) and young (YA) adults
- Multiple neurocognitive theories of brain ageing
 - discrepancies within the literature exist
- OAs show increase in bilateral brain activation
 - Benefit task performance (neural compensation)
- Support for CRUNCH model – compensation limited to lower task loads (decreased activity at high loads)
 - Other studies did not find support for CRUNCH (Ranchod et al., 2023, Blum et al., 2021, Jamadar, 2020)



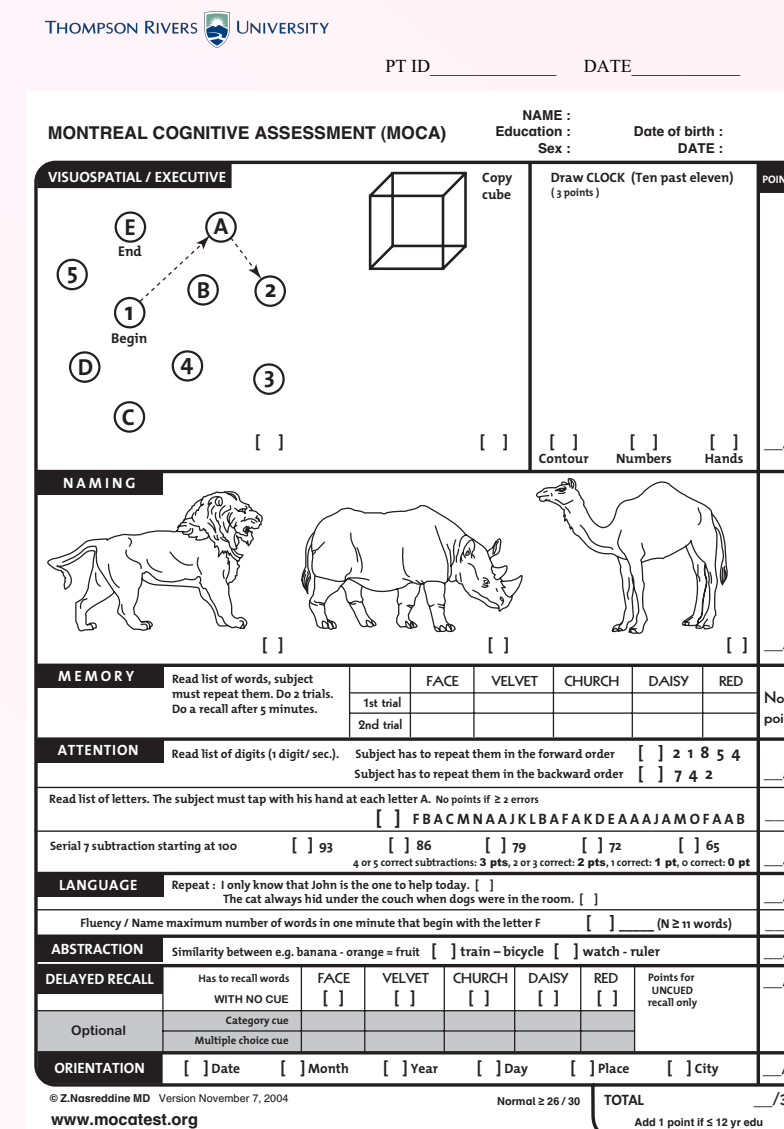
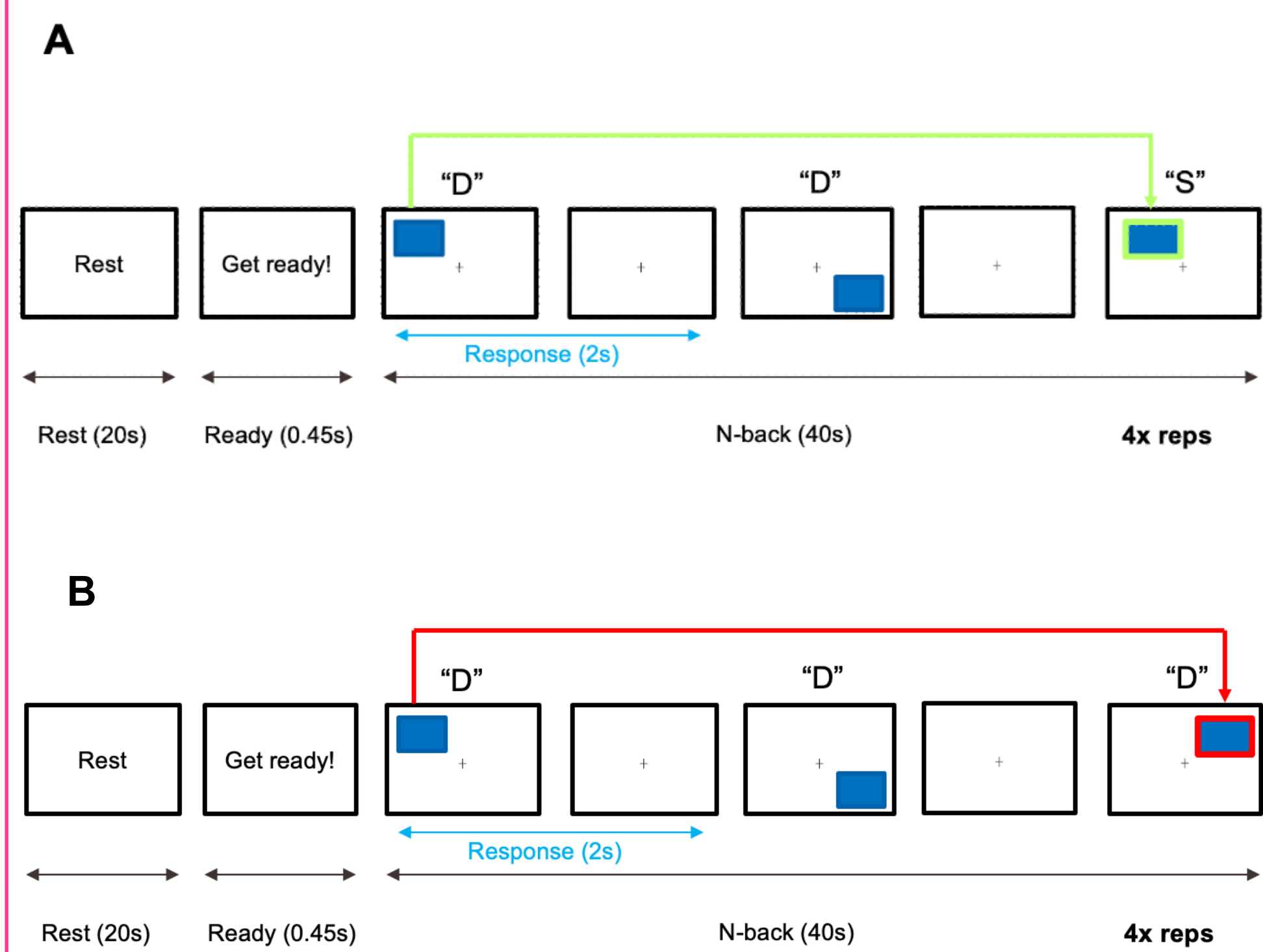
Objective: Use fNIRS to measure brain activity in old and young adults to examine if compensation is occurring & test predictions of CRUNCH model

Methodology

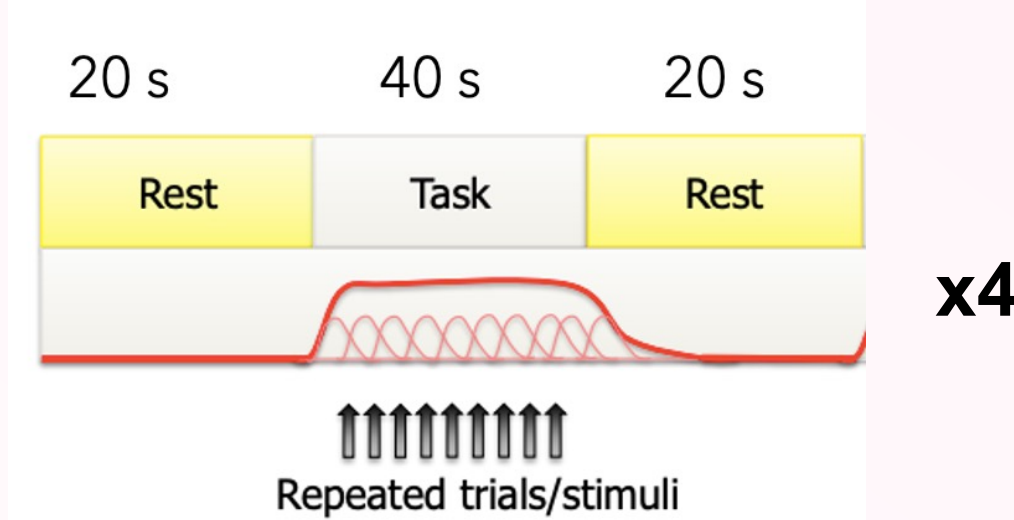
Participants: 24 YA (18-25 yrs, M = 22.17, SD = 1.2 yrs) and 35 OA (65-91 yrs, M = 74.92, SD = 7.0 yrs)

Tasks: three visuospatial N-back tasks, increasing in complexity (1-back < 2-back < 3-back), designed in Eprime (PST, USA)

N-back Task



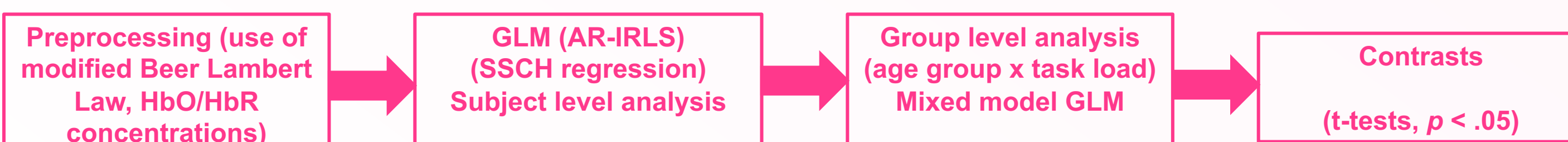
OA participants showed normal cognitive scores on MoCA & RBANS



Adapted from Ranchod et al. 2023

Fig 4. 2-back task response, where: A) the “target” is in the same location, indicated by pressing the “S” key for “same”, B) the “target” is in a different location, indicated by pressing the “D” key for “different”

Analysis



Behavioural data: Accuracy measured as error rates (%) and Pr (hits – misses) and reaction times (RT) compared between age groups and task load conditions through repeated-measures ANOVA.

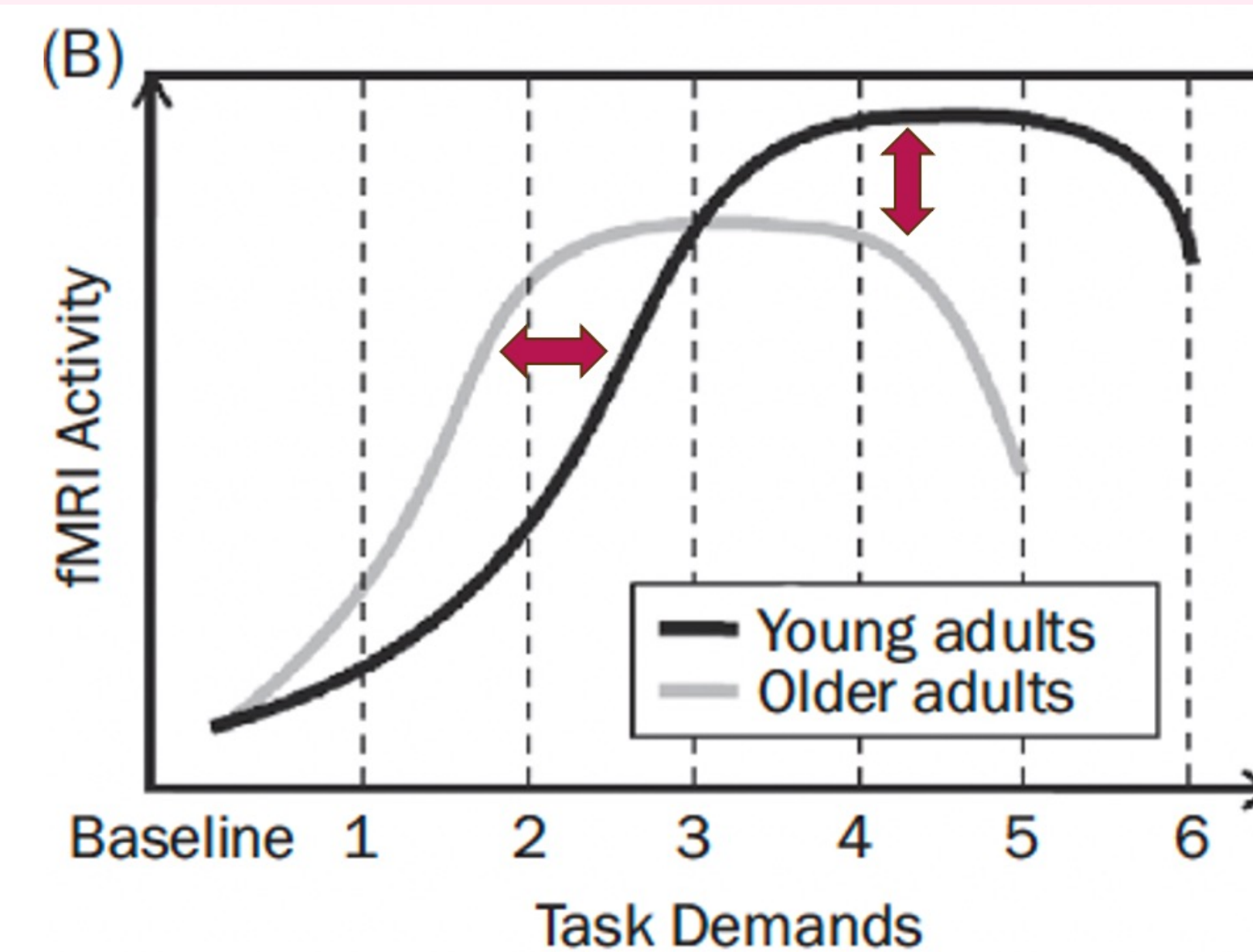


Fig.1. Compensation-Related Utilization of Neural Circuits Hypothesis (CRUNCH)



Fig.2. The fNIRS Brite system (Artinis Medical Systems, Netherlands)

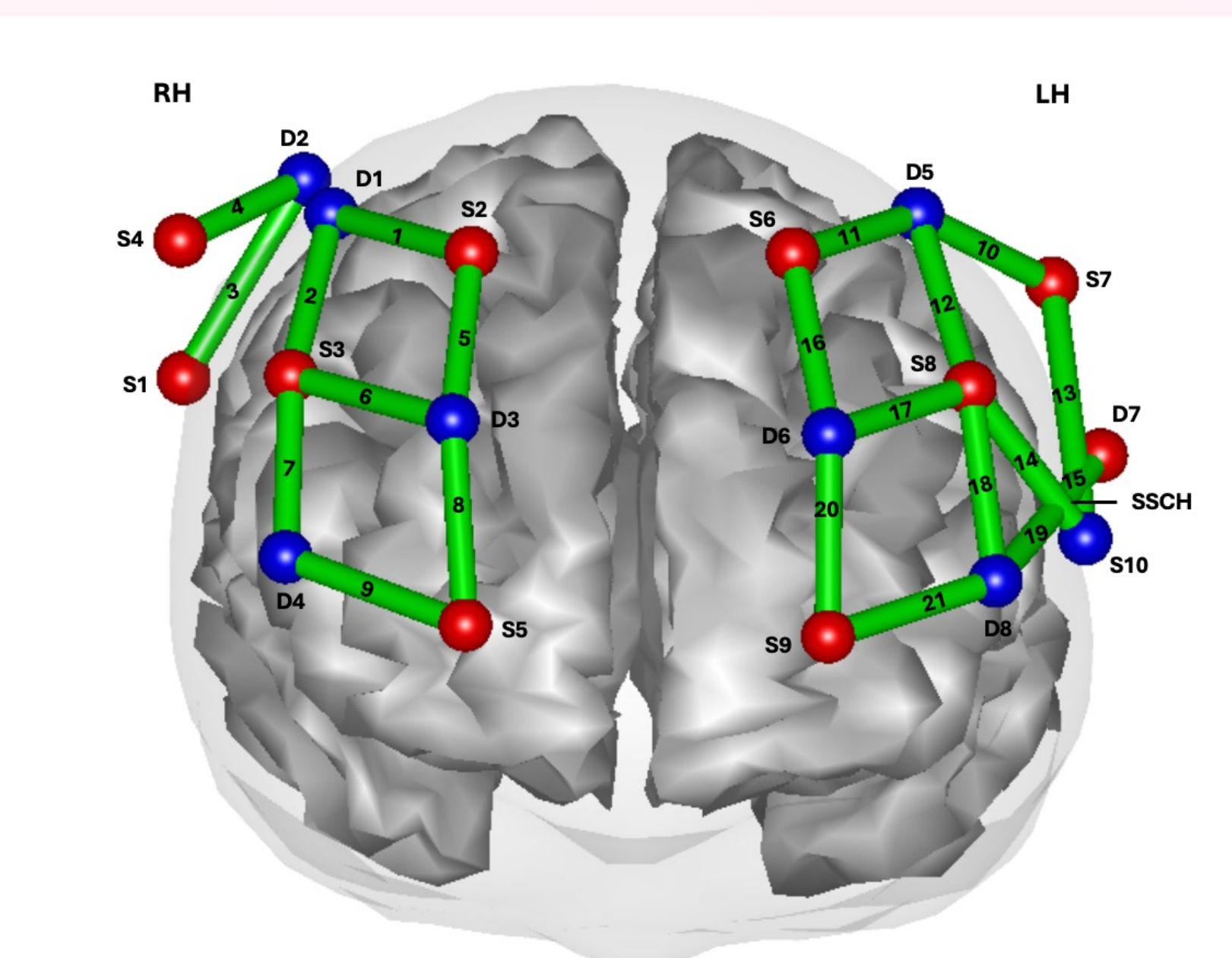
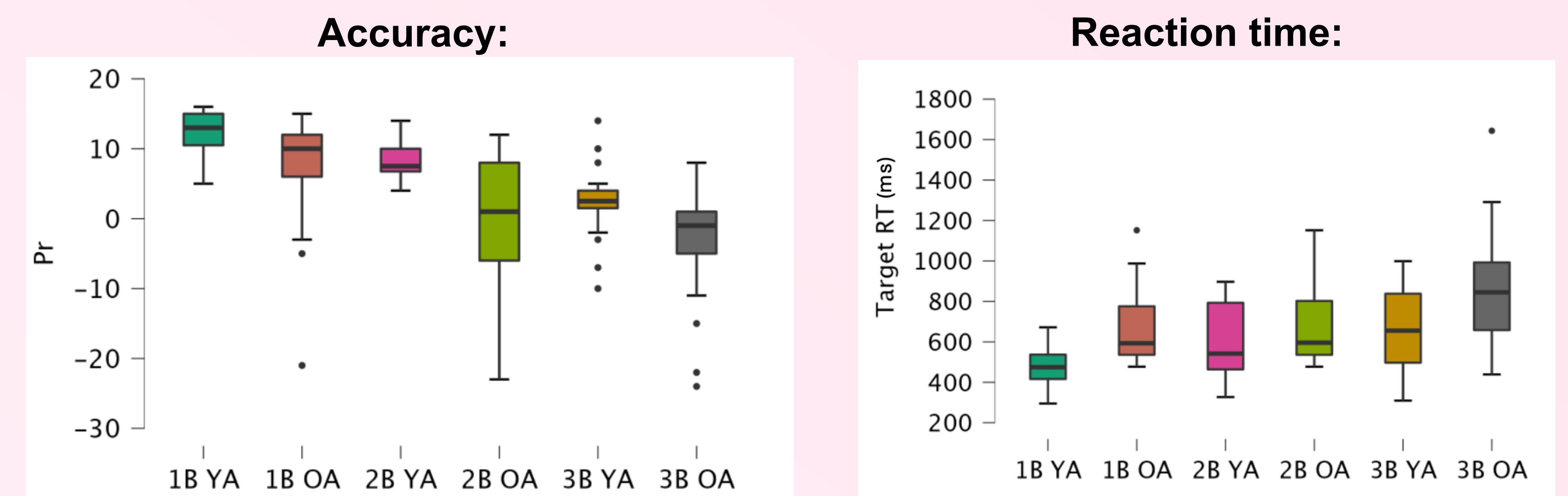
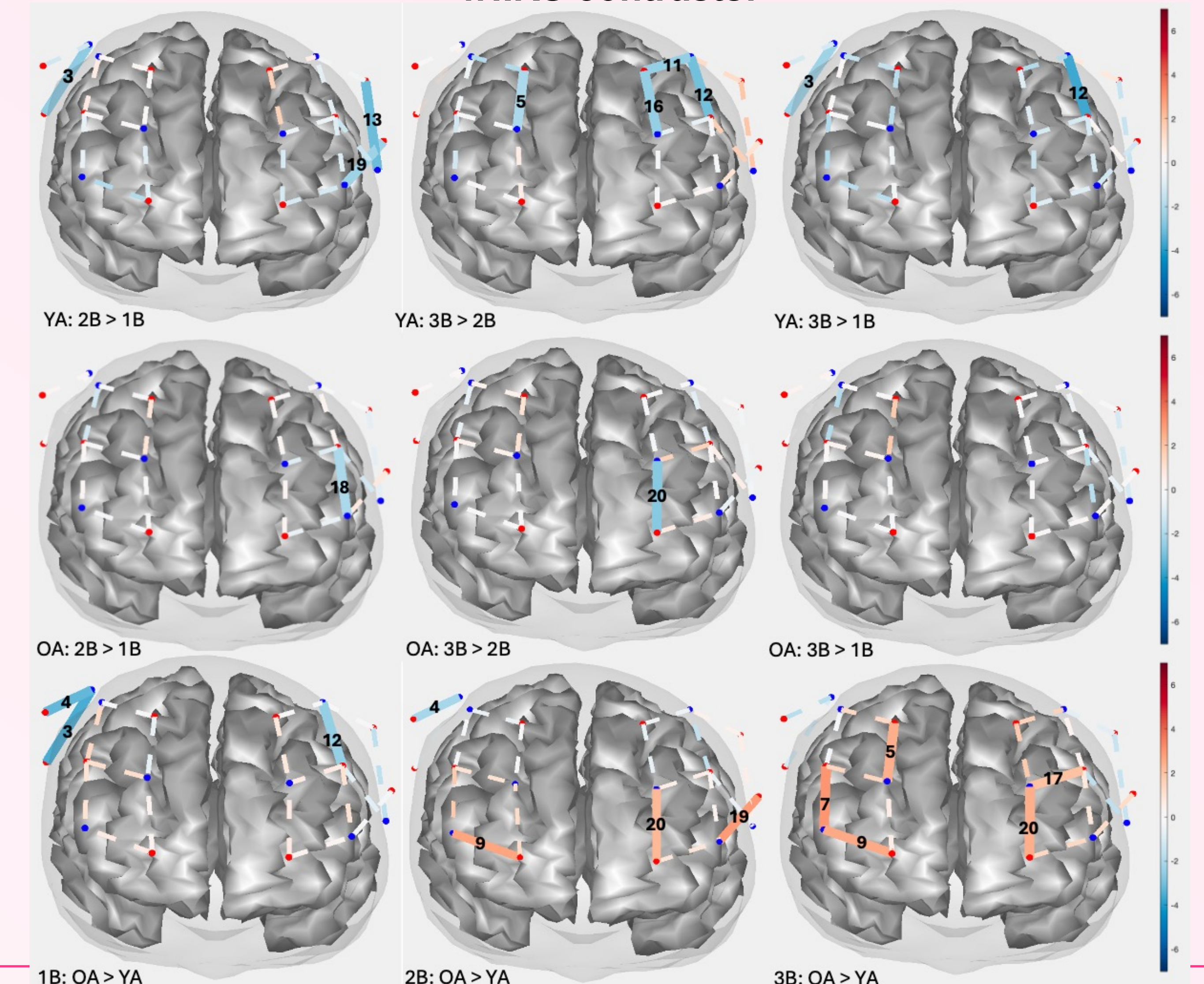


Fig.3. The 21-channel fNIRS optode array over the bilateral prefrontal cortex (PFC) and right parietal lobe (1SSHC). RH = right hemisphere, LH = left hemisphere.

Results



fNIRS contrasts:



Conclusion

- Lower accuracy and longer RTs indicated increased cognitive load (1B < 2B < 3B)
- YAs had significantly faster target RTs in the 1B and 3B compared to OAs ($p < .05$)
- YA had higher accuracy (Pr) than OAs in the 2B and 3B tasks ($p < .05$), but not in the 1B
- OAs showed increased bilateral PFC compared to young adults
 - while there was no difference in accuracy between OA and YA in the 1B, the additional recruitment of brain areas did not seem to benefit OAs task performance in the 2B or 3B tasks
- Our results did not show support for the CRUNCH model nor the compensation view
 - Rather, showed support for neural inefficiency model

Acknowledgements

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Refs:

