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EFFECT OF IMPOSED POSTURAL CHANGE ON COGNITIVE LOAD

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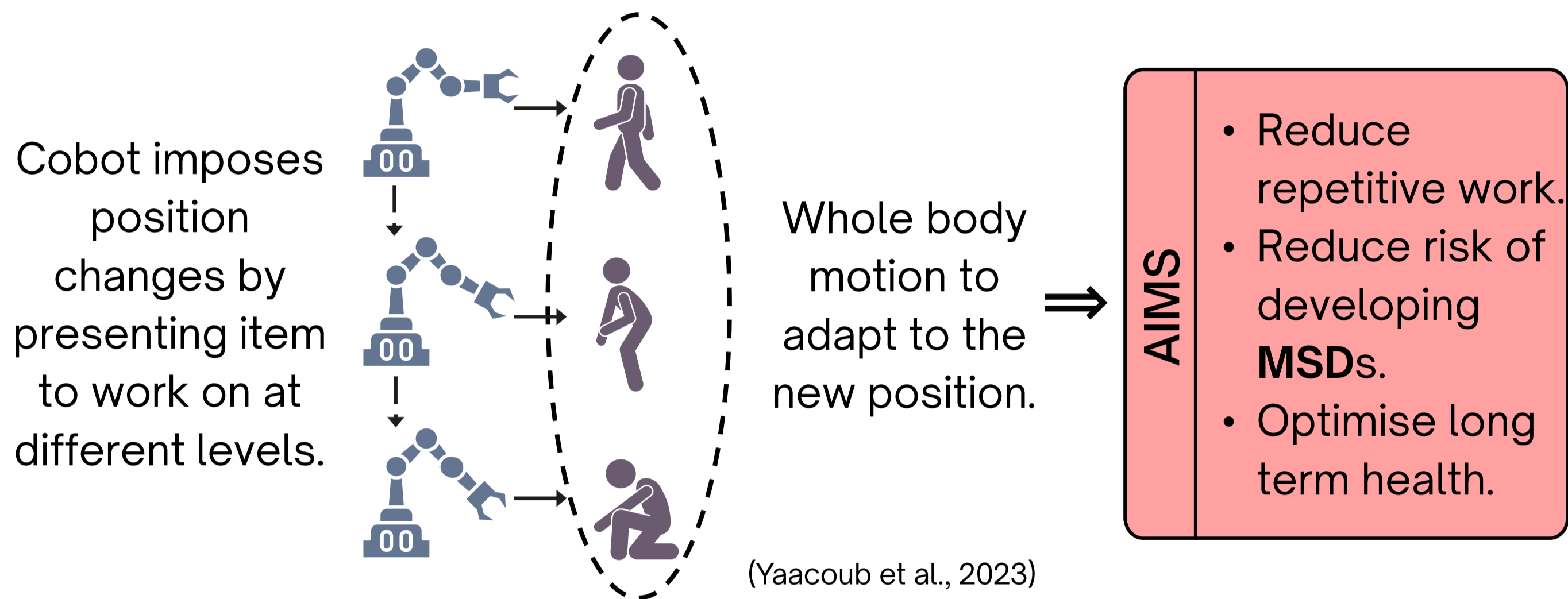
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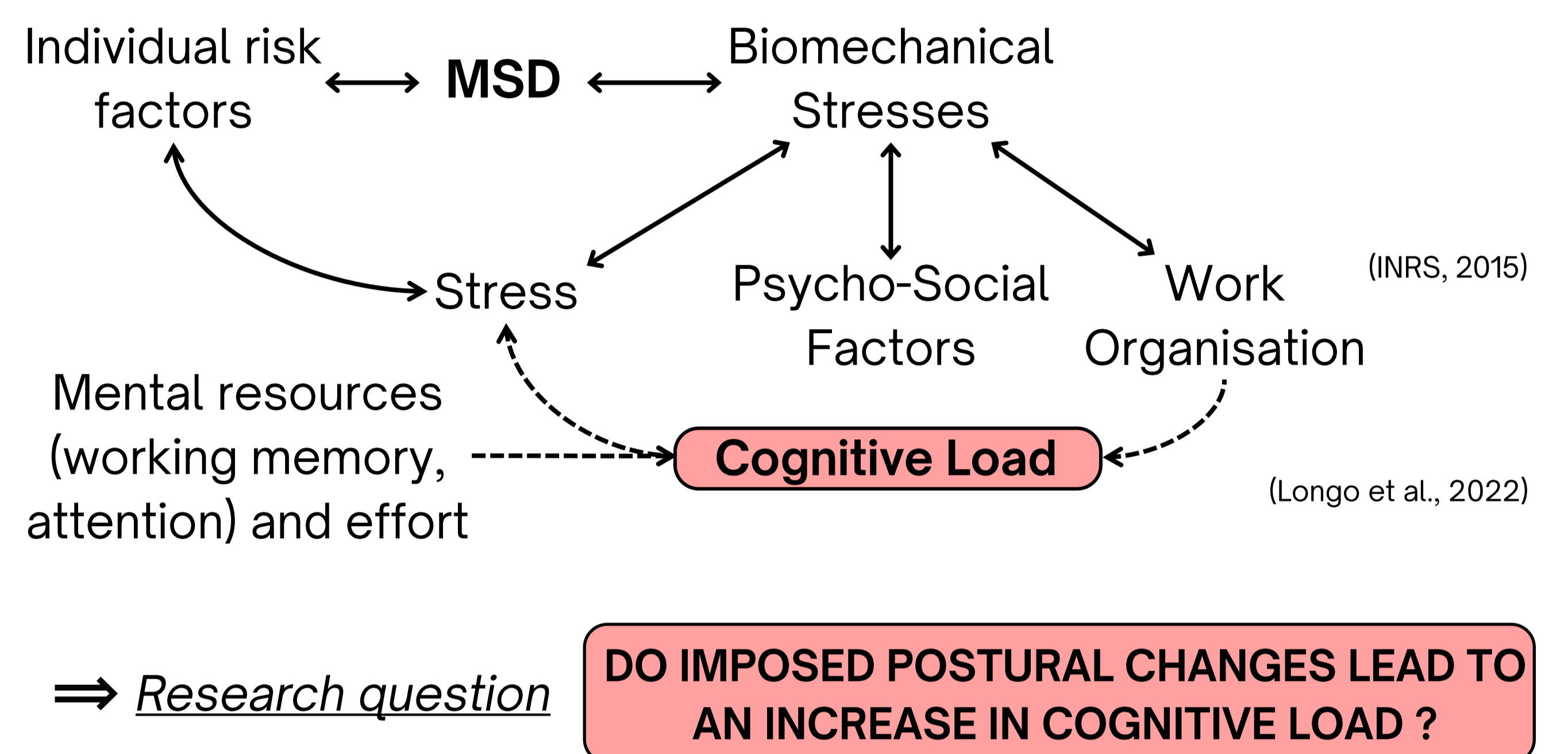
BACKGROUND

Context

ANR Project on user-specific adaptation of collaborative robot behaviour to reduce fatigue and prevent work-related MusculoSkeletal Disorders (MSD).

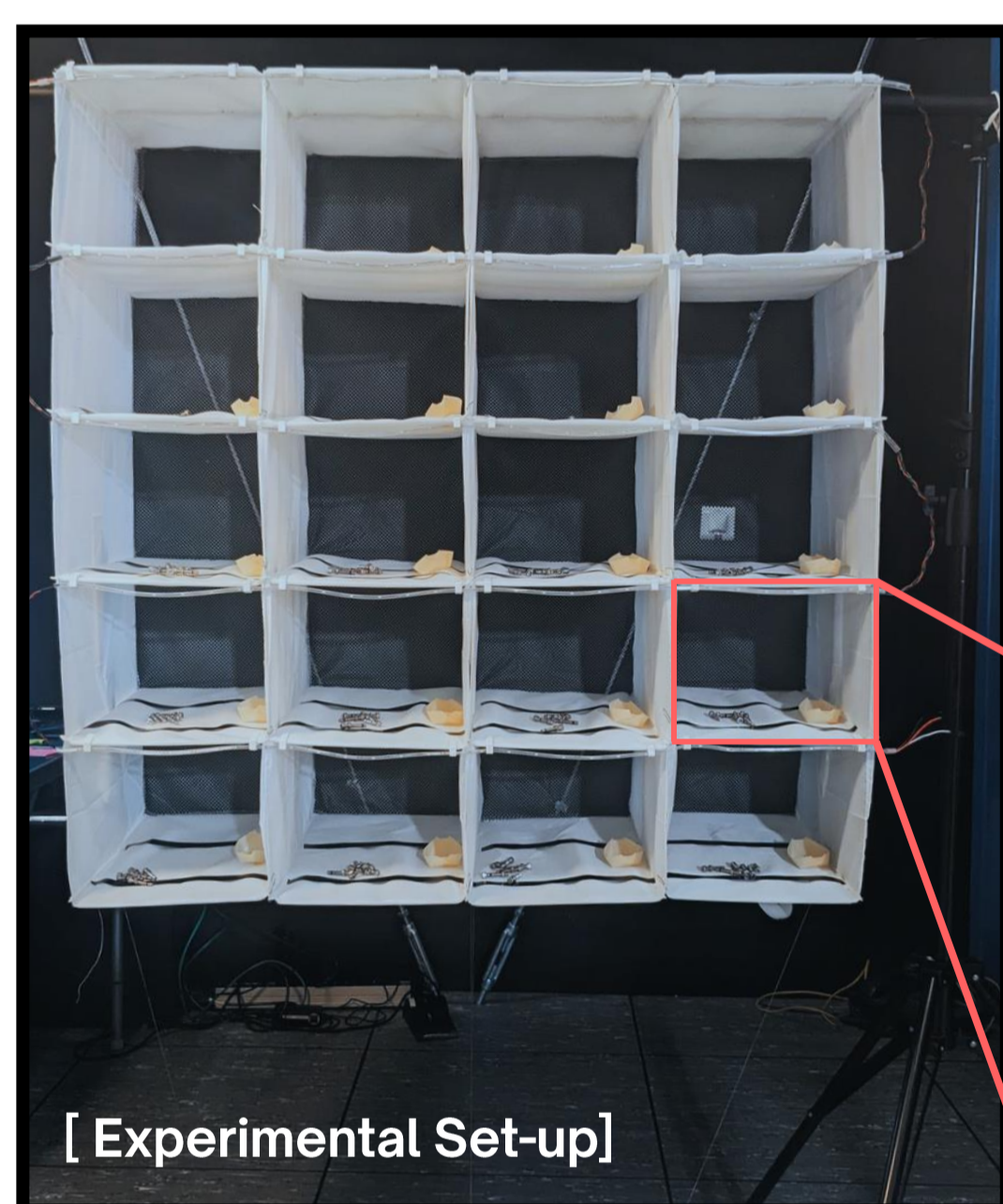


Literature review



METHODS

Experiment : Change of posture while doing a repetitive manual task



- 23 Participants [9 ♀ ; 14 ♂], \bar{x} age = 29.9 years.
- 5 Experimental conditions
 - No postural change ⇒ Baseline : **Fixed** position.
 - Change of posture ⇒ 2 main variables :
 - Level : **Small** vs. **Large**,
 - Type : **Predictable** vs. **Random**.
- ↳ 5 mins/condition.
- ↳ 15 s/box.
- ↳ Change is guided by a light and a sound signal.

	Measures	Performance	Physical Effort	Cognitive Load
Direct	Motion Capture		✓	
	Eye-Tracker			✓
	ECG		✓	✓
Indirect	Task Score	✓		
	NASA-TLX	✓	✓	✓
	Borg's CR-10		✓	

RESULTS & DISCUSSION

Performance : Scores do not show significant difference between any conditions.

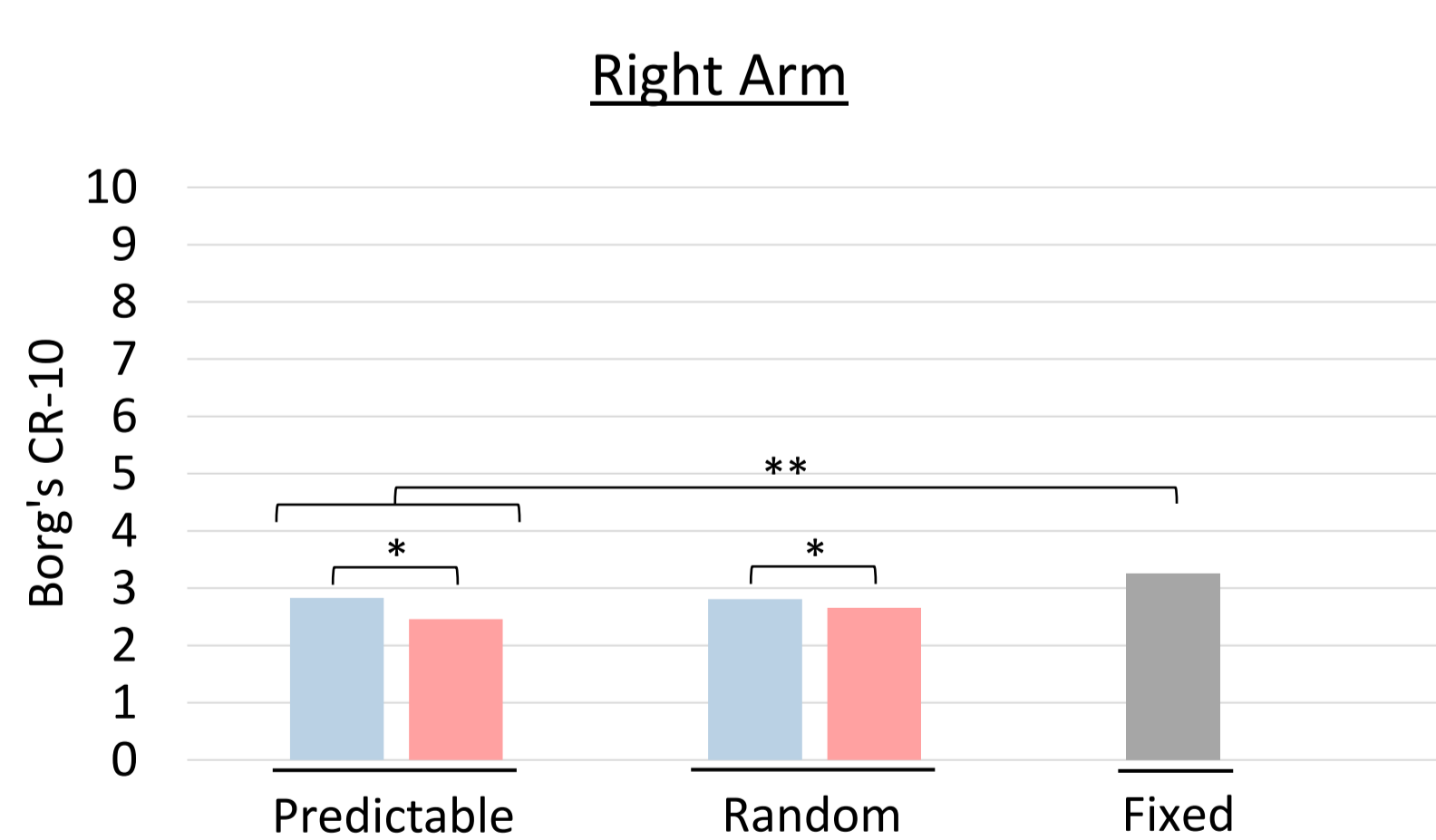
Nasa-TLX score shows that better performance is perceived for the fixed condition than for the rest.

Level of postural change :
■ Small ■ Large

Physical Effort :

Borg's CR-10 : [Arms and Legs]

- Fixed position > Postural change,
- Large change < Small change.

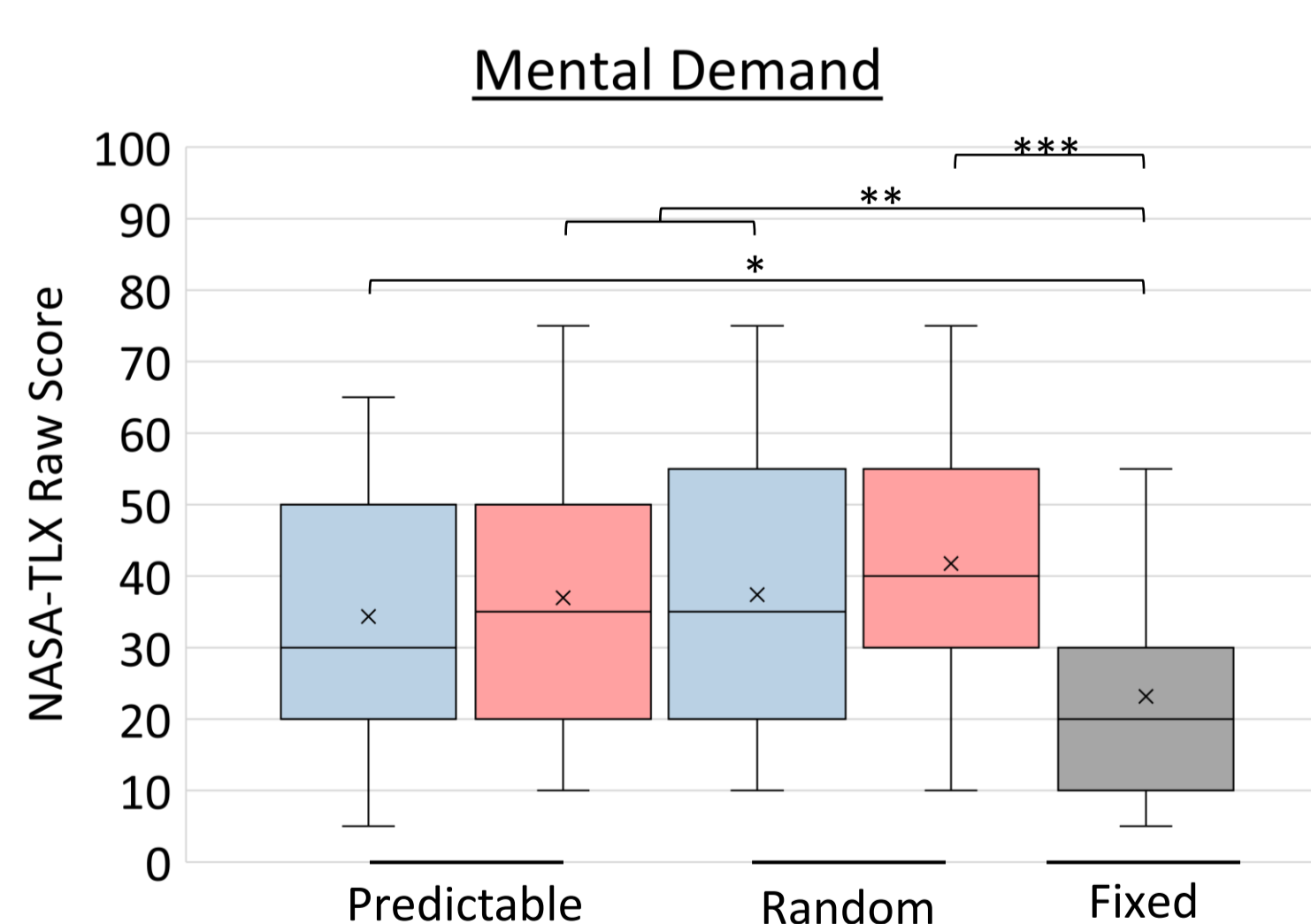


⇒ Postural change seems to be beneficial in reducing physical effort especially with large change as the whole body is engaged in the postural adaptation.

Cognitive Load :

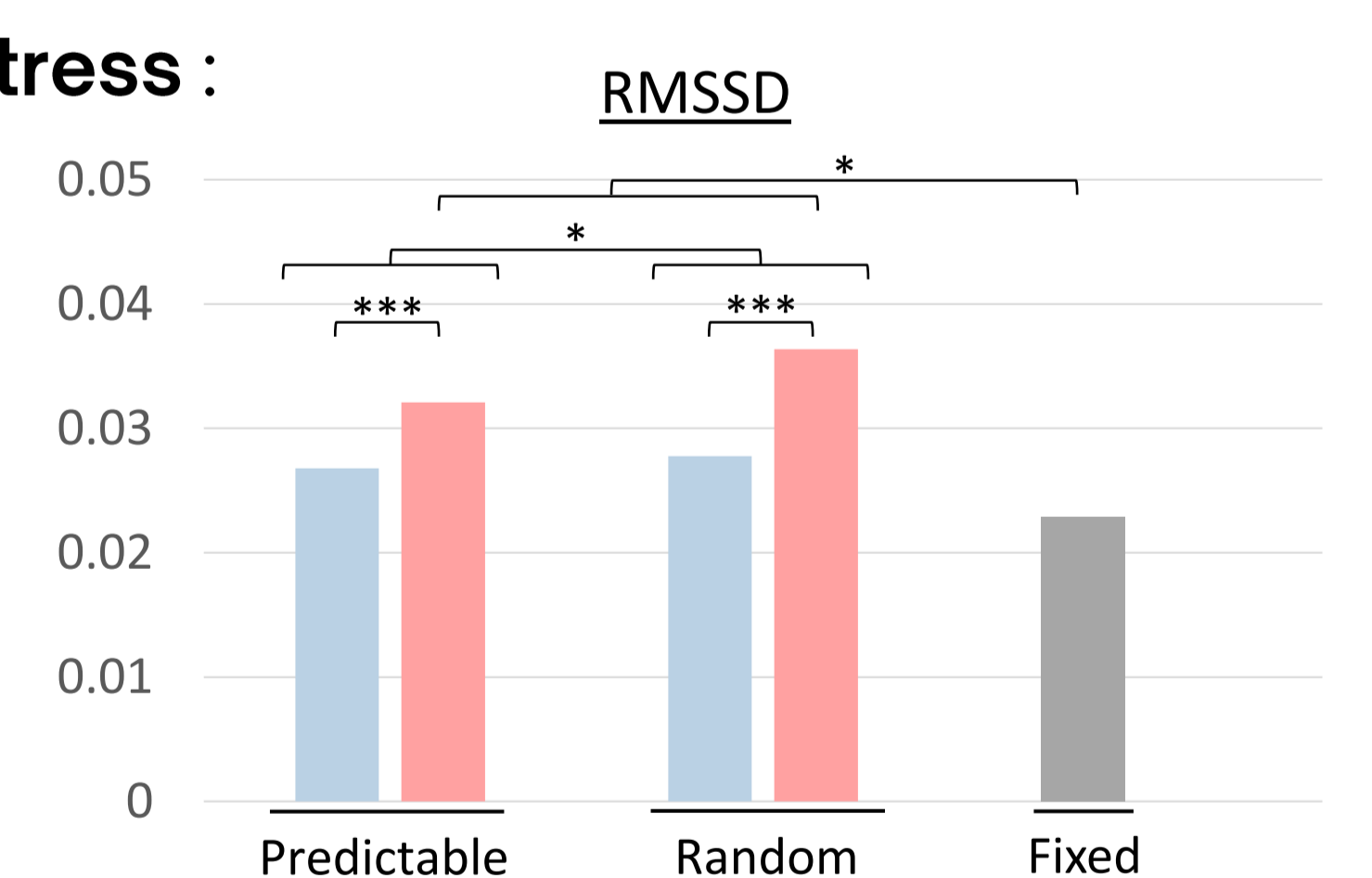
NASA-TLX : [Task Load, Mental Demand and Temporal Demand]

- Postural change > Fixed position.



⇒ Postural change seems to have a cognitive cost that was felt irrespective of the type or level of change.

Stress :



⇒ Better adaptation to stress with postural changes and for large changes compared to small changes.

Strategies :

Posture adaptation ⇒ varying strategies depending on the level and the predictability of the change.
 (based on interviews and observations)

CONCLUSION & PERSPECTIVES

- Postural variation seems to mitigate physical fatigue but might impose additional cognitive load.
- This trade-off between physical and mental demands needs to be considered in task design as increased cognitive load could affect performance and overall well-being.
- It is important to replicate the experiment with robot, as the general context of the study is collaborative work with cobots, and human behaviour is highly influenced by its presence.

REFERENCES

- INRS. (2015). Troubles musculosquelettiques (TMS)
- Longo L, Wickens CD, Hancock G and Hancock PA (2022) Human Mental Workload: A Survey and a Novel Inclusive Definition. Front. Psychol. 13:883321. doi: 10.3389/fpsyg.2022.883321
- Yaacoub, A., Thomas, V., Colas, F., & Maurice, P. (2023). A Probabilistic Model for Cobot Decision Making to Mitigate Human Fatigue in Repetitive Co-Manipulation Tasks. IEEE Robotics and Automation Letters, 8(11), 7352-7359. https://doi.org/10.1109/LRA.2023.3315583