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Human behaviors and Human-Robot Interaction with a cobot in a collaborative task

K. Bouillet^{1,2}, S. Lemonnier², F. Clanche¹, G. Gauchard¹

Cobots: robots intended to interact physically with humans, in a shared workplace, with a common goal. (Terveen, 1995)

Musculoskeletal disorders: main issue for industries: more than 80% of professional diseases in 2017. (L'Assurance Maladie, 2017)



Changes in the relationship between operator and task with the cobot



Which repercussions on the employees health?



Analyze the features of the human performance (motor and attentional behaviours)



34 participants
22,1±2,0 years old
13♀ & 21♂

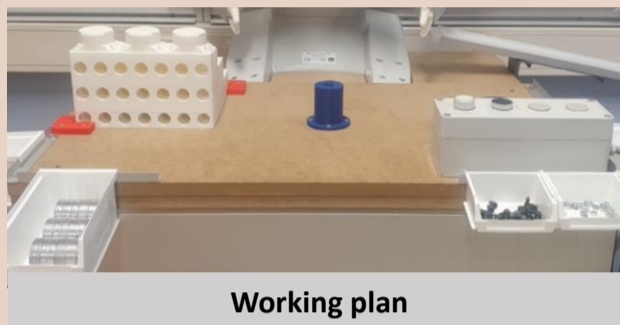
Not familiar with robots

Collaborative task:

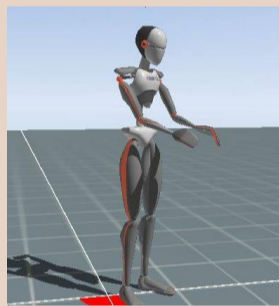
Manufacture maximum of products in four minutes in collaboration either...

...with a cobot (COB)
YuMi cobot

...with a human (HUM)
Always the same human



Working plan



Motion capture



Eye-tracking



Videos & coding

Measures:

Biomechanical:

- Stance: RULA, trunk flexion, ...
- Gesture: hand speed, fluidity, ...

Attentional:

- Fixations: number, time
- Saccades: length
- Pupillary diameter

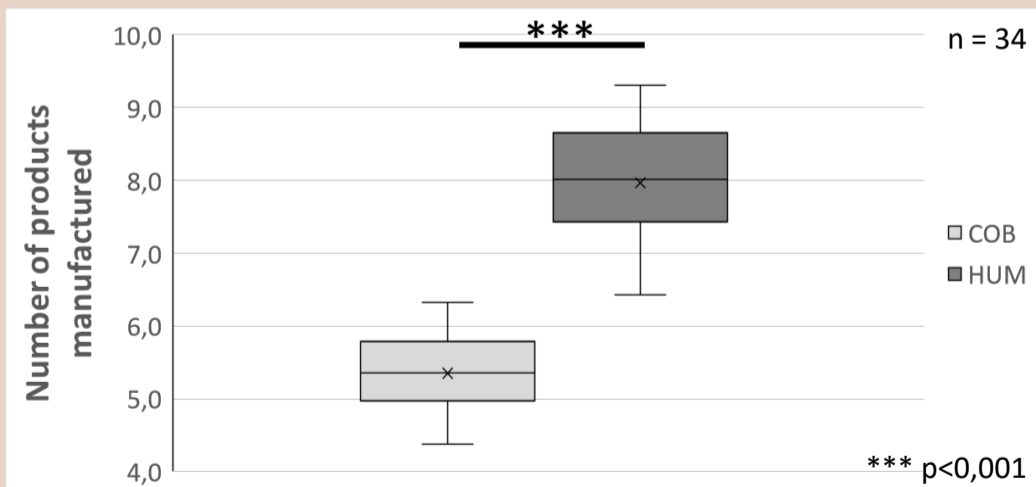
Collaborative task performance:

- Number of products manufactured
- Fluidity interaction:
 - Cobot/human actions: inactivity, activity
 - Participant actions: inactivity, activity
 - Concurrent actions: collaboration

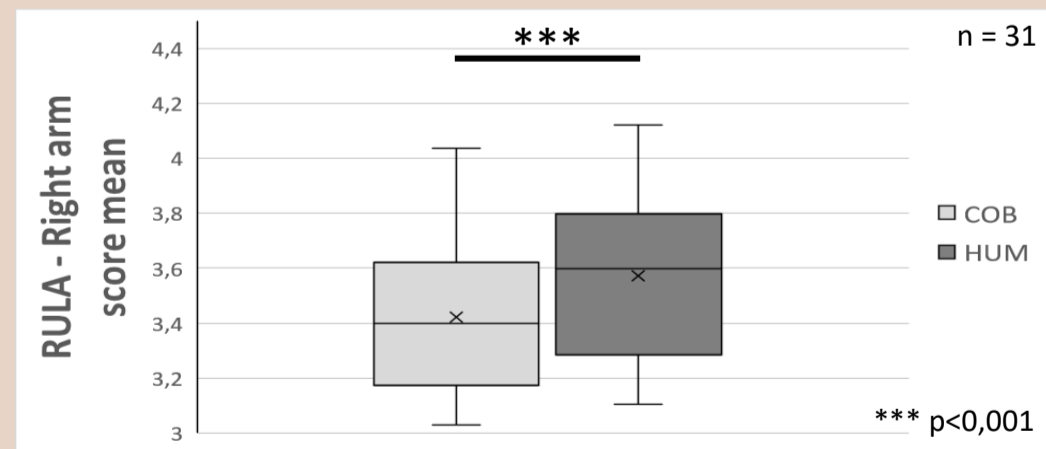
Collaborative task performance:

First results:

Biomechanical (RULA score):



Production: collaboration with human > cobot.



Mean RULA score: collaboration with human > cobot.
Time spent in risk 2: collaboration with cobot > human.
Time spent in risk 3: collaboration with human > cobot.

Discussion / Conclusion:

Future experiment:

- Better production when the collaboration is with a human than the cobot but more risk of developing MSDs.
- Other results (attentional behaviours, fluidity of interaction) are incoming.

- Evaluate the impact of the autonomy of the cobot on the motor behaviour of operators and fluidity interaction:
 - Manual release: participants lead the cadence of production.
 - Automatic: the cadence is led by the cobot at three different speed: low, medium and high.

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• Terveen, L.G. (1995). Overview of human computer collaboration. Knowledge-Based Systems 8:67-81.

• L'Assurance Maladie. (2017). Risques professionnels (p. 1-160).