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Measuring Engagement and Fatigue in Hybrid Meetings

Daniela Grassi

Collaborative Research Group
University of Bari

daniela.grassi@uniba.it

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Darja Smite

Blekinge Institute of Technology

Fabio Calefato

University of Bari

Nicole Novielli

University of Bari

Filippo Lanubile

University of Bari

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Hybrid Meetings

Engagement and Fatigue

What can research show?

Value of collaboration

59% of employees say that working together with colleagues (whether on video or in person) energizes them

Differences between generations

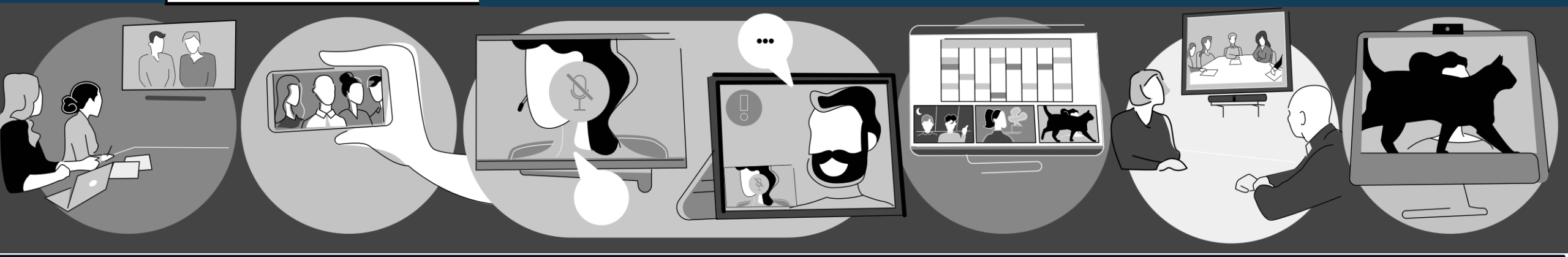
Gen Z and Millennials were **2-3x** as likely as Gen X and Boomers to say they often felt left out in online meetings

Video cameras and engagement

46% employees believe that their colleagues with video on seem more engaged in meetings than those with video off

Video cameras and trust

64% of employees say that being able to see and hear their colleagues makes it easier to trust them



We measure **engagement, emotions and fatigue** among onsite and remote participants **in hybrid meetings** using a light-weight wearable technology

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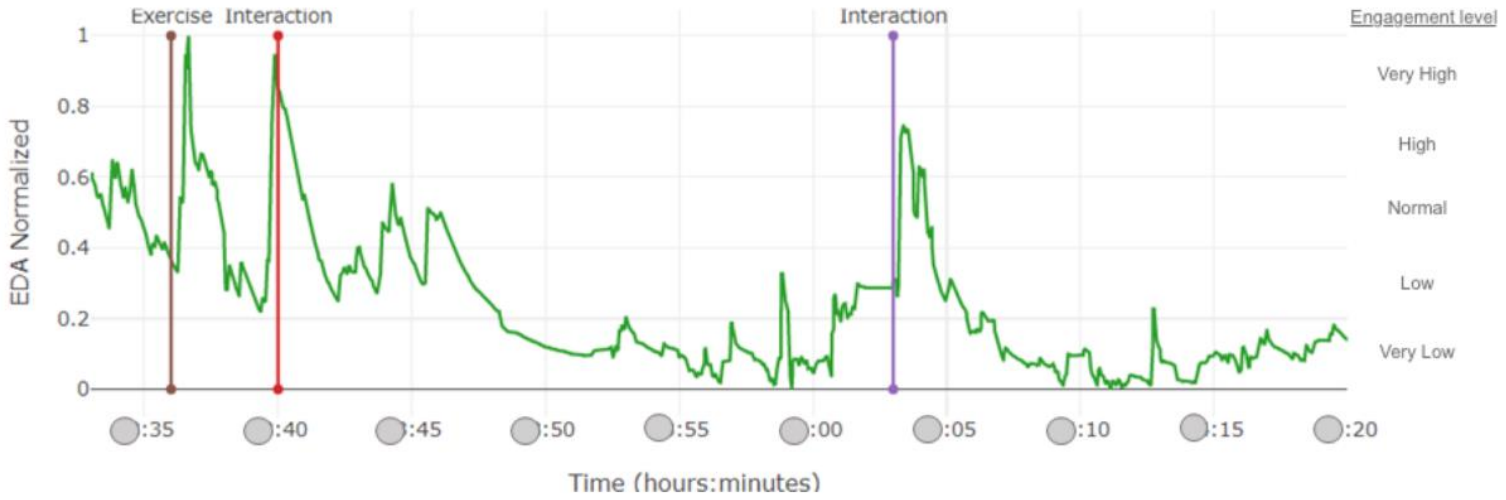
How do we measure *engagement*?

EmbracePlus

Ventral EDA sensor (Electrodermal activity)
Detects subtle changes in electrical conductance at the surface of the skin

EDA-based metrics as a proxy for Engagement

- **Arousing Ratio:** Ratio between arousing and unarousing moments [1]
  - Metrics of **Emotional Engagement:**



[1] Di Lascio et al. Unobtrusive Assessment of Students' Emotional Engagement during Lectures Using Electrodermal Activity Sensors
[2] Salvador, Stan and Philip K. Chan. "FastDTW: Toward Accurate Dynamic Time Warping in Linear Time and Space." (2004).
[3] Ivo Stuldreher «Multimodal Physiological Synchrony as Measure of Attentional Engagement» Doctoral Consortium Paper ICMI '20, October 25–29, 2020
[4] F. Behrens J.A. Snijdewint , R.G. Moulder, E. Prochazkova E. E. Sjak-Shie S. M. Boker & M. E. Kret Physiological synchrony is associated with cooperative success in real-life interactions
[5] Shkurta Gashi, Elena Di Lascio, and Silvia Santini. 2019. Using Unobtrusive Wearable Sensors to Measure the Physiological Synchrony Between Presenters and Audience Members. Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.

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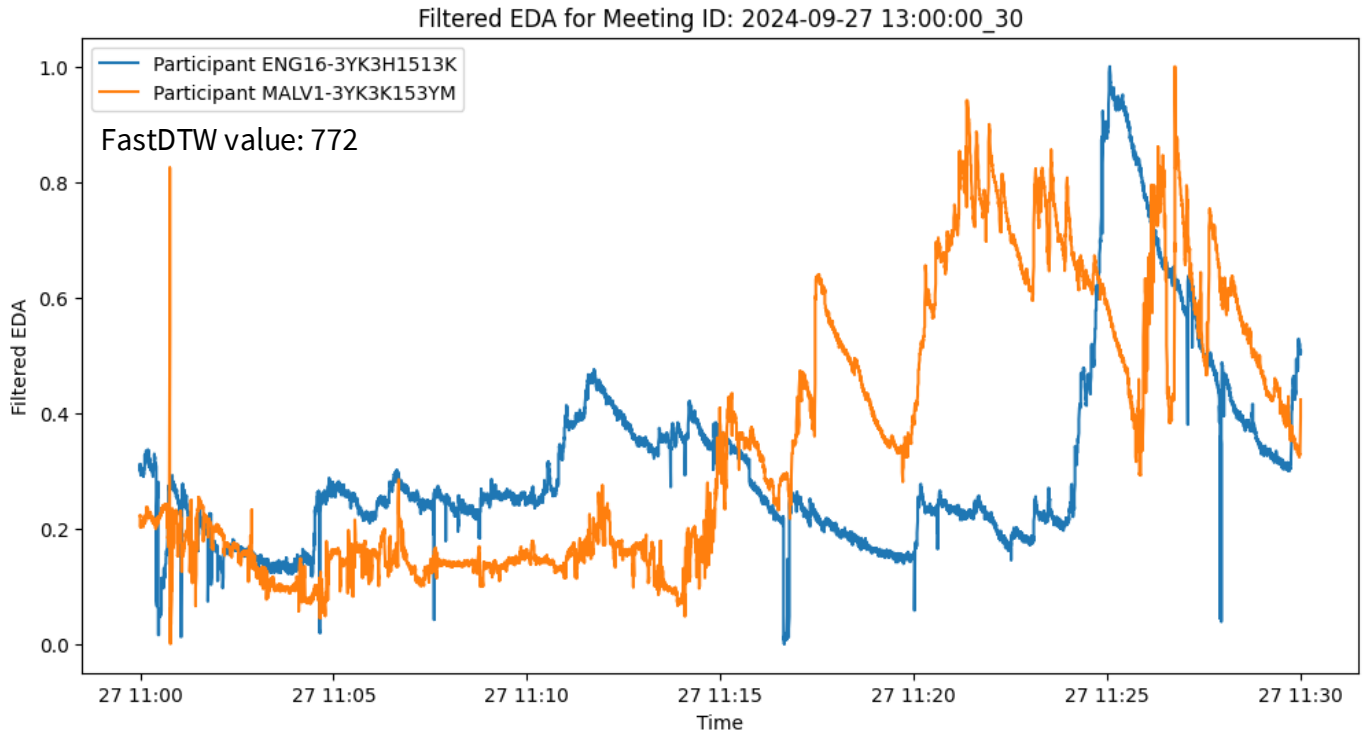
EDA-based metrics as a proxy for Engagement

- **FastDTW:** distance between the signals of participation dyads
  - Metrics of **Physiological Synchrony** [5] :



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How do we measure *Fatigue*?

EmbracePlus

Advanced optical PPG (Photoplethysmogram)
Clinically validated PR and PRV measurements through a custom-made sensor

HR-based metrics as a proxy for Fatigue

Passive Fatigue

Measurement

- **Heart Rate Variability (HRV)** analysis using Root Mean Square of Successive Differences (**RMSSD**) between heartbeats

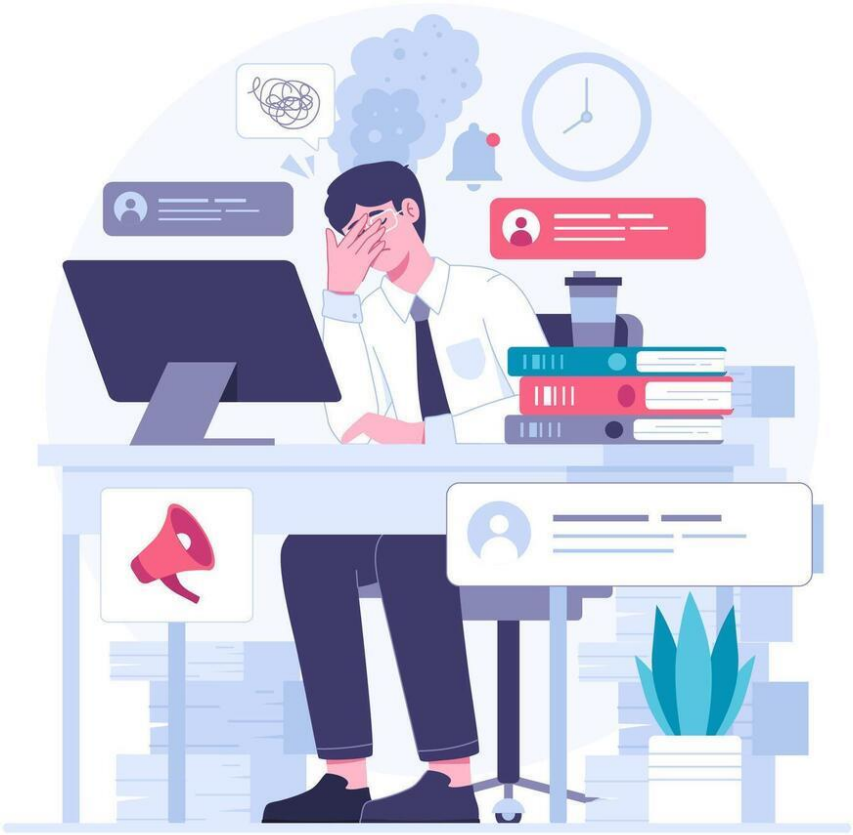
[1] Niina Nurmi, and Satu Pakarinen, Virtual Meeting Fatigue: Exploring the Impact of Virtual Meetings on Cognitive Performance and Active Versus Passive Fatigue

HR-based metrics as a proxy for Fatigue

Active Fatigue

Measurement

- **Heart Rate Variability (HRV)** analysis using frequency bands (**LF/HF Ratio)**



[1] Niina Nurmi and Satu Pakarinen. Virtual Meeting Fatigue: Exploring the Impact of Virtual Meetings on Cognitive Performance and Active Versus Passive Fatigue

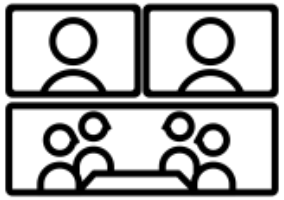
How do we collect data?

Study Protocol

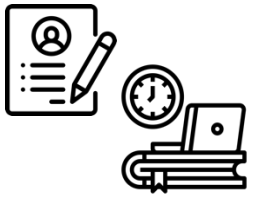
Recruitment → Starting the workday → During the workday → After each meeting

Recruitment of participants
We selected 22 software developers from two companies based in Sweden

Wear the device
Participants wore the device throughout the entire workday



work as usual
Participants engaged in their regular work routines while wearing the device



Fill in a questionnaire
Participants completed a questionnaire after each meeting, self-reporting their **engagement** and **fatigue** levels

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Overview of the data

Company A

22 participants
115 meetings per participations
15 days
25 dyads

Company B

50 meetings per participations
6 participants
5 days
19 dyads

Total: 165 individual records, 28 participants

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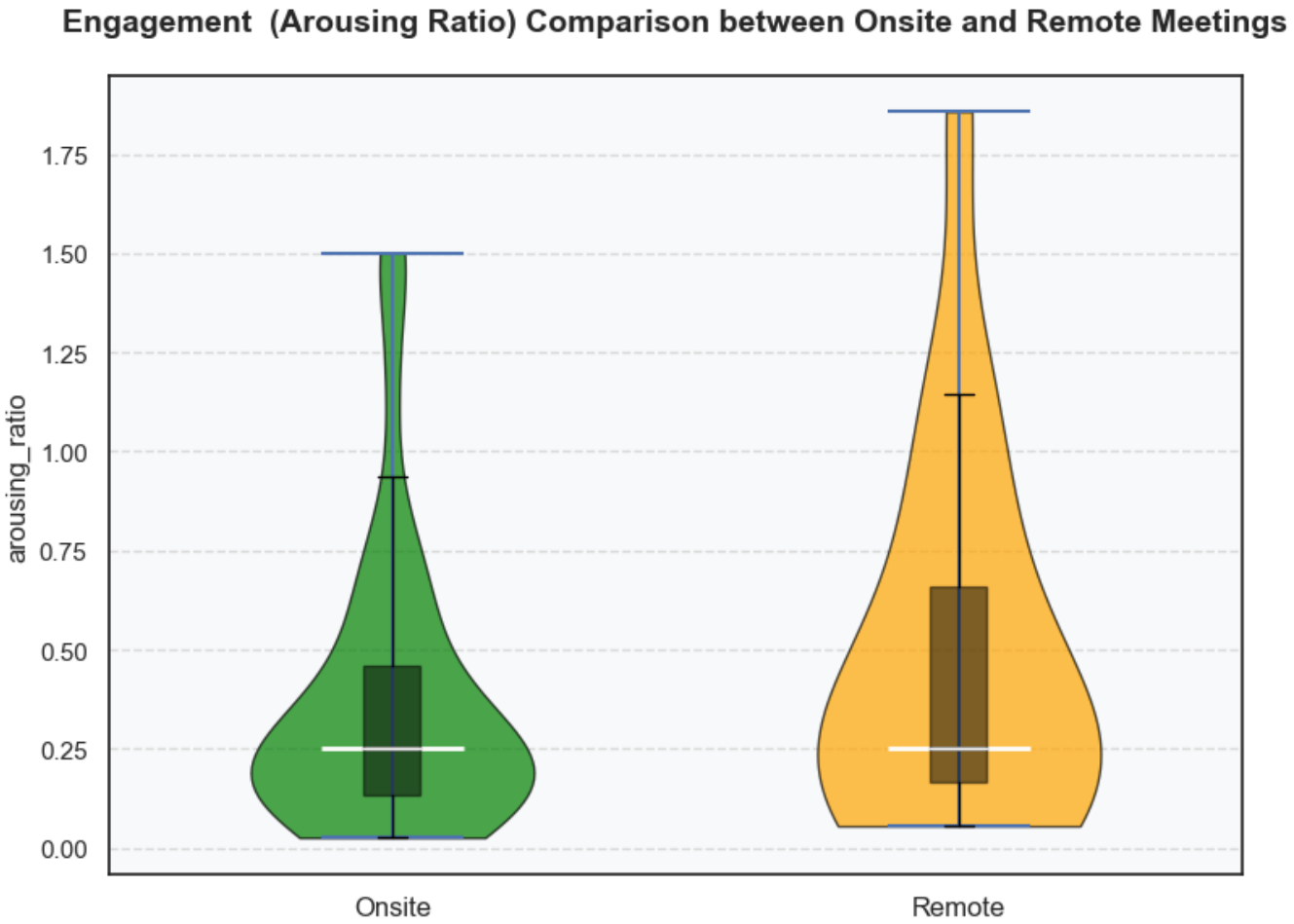
What do our bodies reveal about *Engagement* during meetings?

Does engagement vary with onsite vs. remote participation?



Mann-Whitney U test p-value (Bonferroni corrected): 0.356
There is no statistically significant difference in arousing ratio between the onsite vs remote participation

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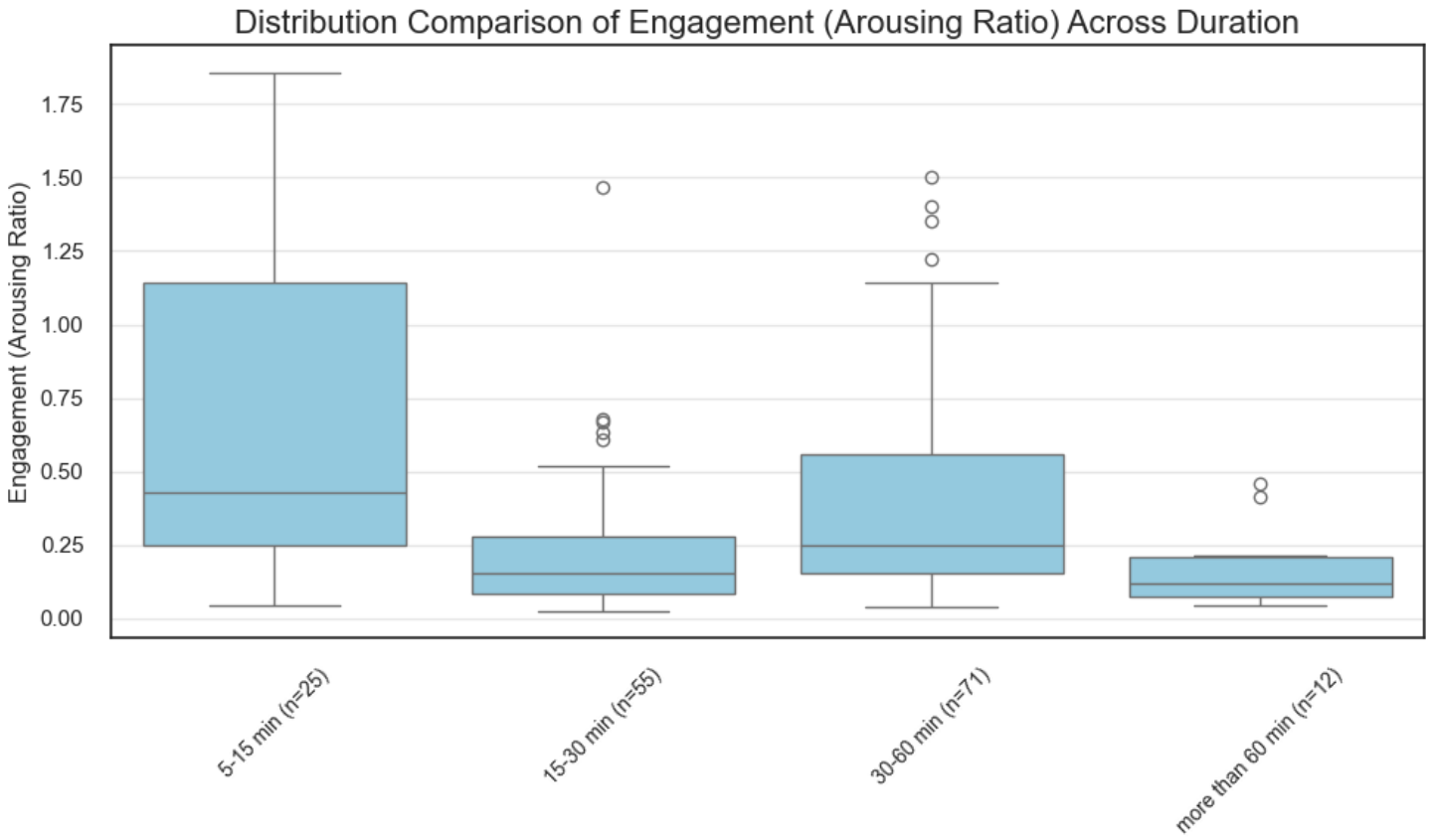
Does engagement change with onsite vs. remote participation?



Kruskal-Wallis H test p-value (Bonferroni-corrected): 0.000
The analysis revealed statistically significant differences in arousing ratio across meetings of varying durations.

Significant differences were found in the Dunn Test:

- 5-15 min vs 30-60 min (p = 0.000)
- 5-15 min vs more than 60 min (p = 0.001)

Engagement significantly decreases for meeting longer than 30 minutes when participating in onsite and remote meetings

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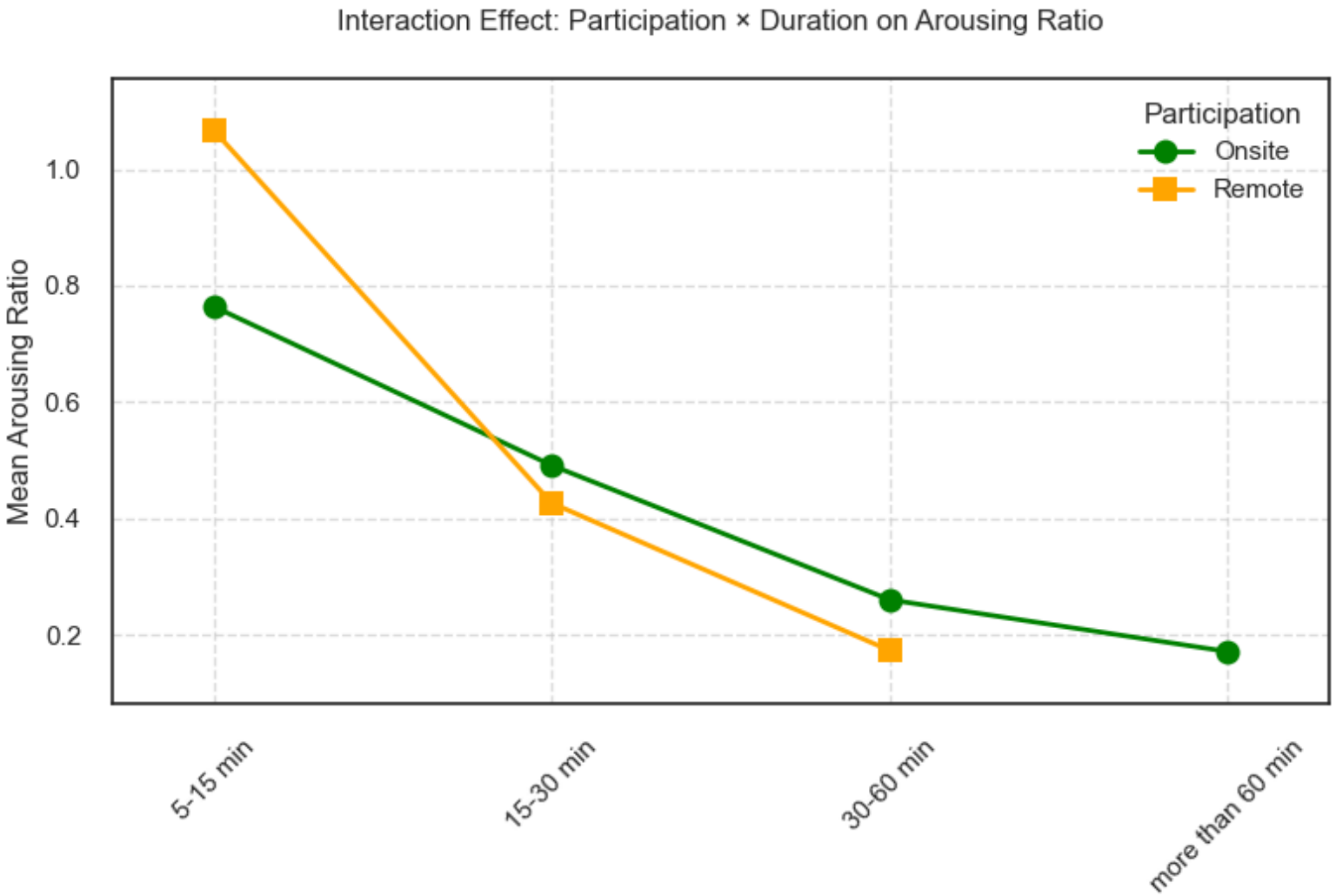
Does engagement change with Duration? (onsite vs. remote)



Interaction plot shows that in shorter meeting (up to 30 minutes) the relationship between **engagement** and **duration depends on participation**

For meeting longer than 30 minutes, participation doesn't interact with the engagement

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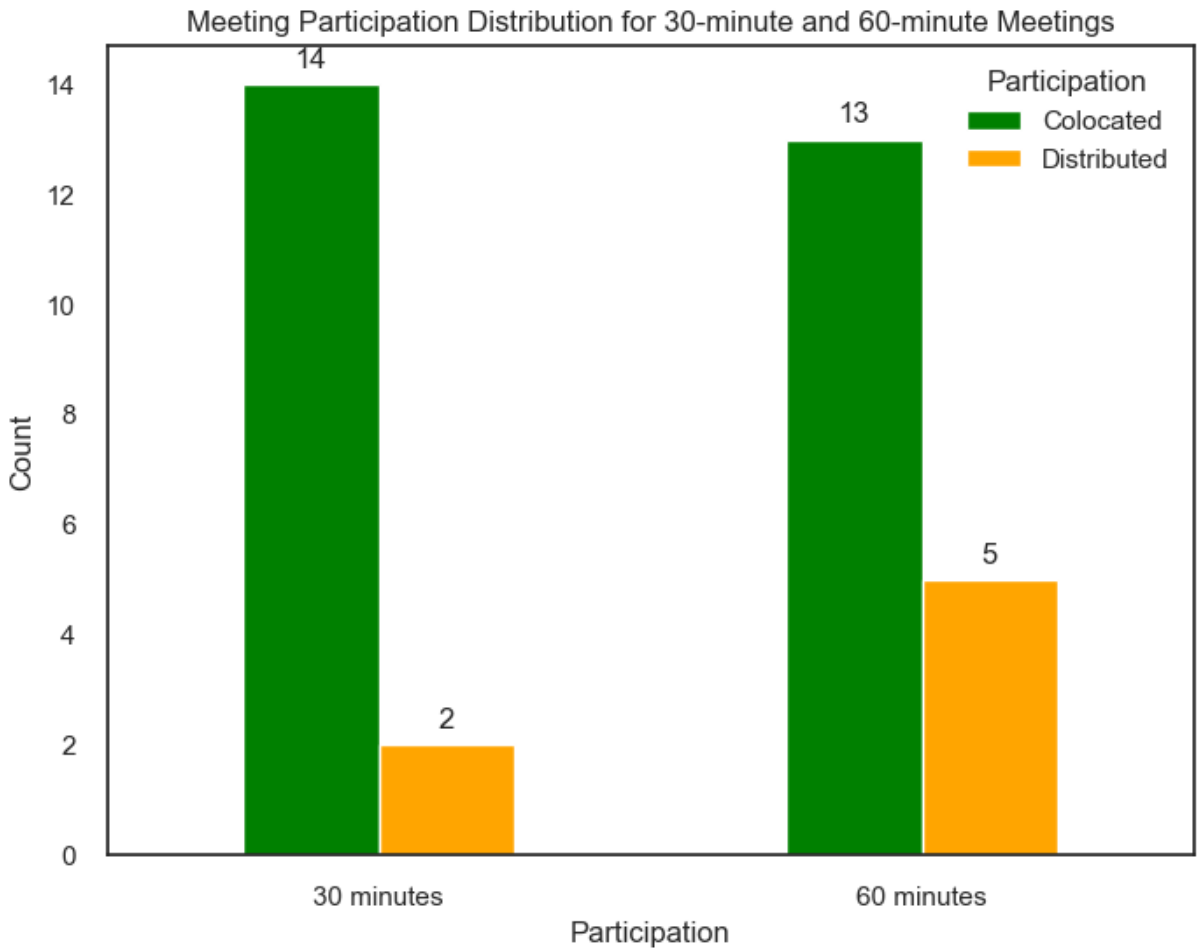
Possible dyads based on participation: co-located vs. distributed

- Co-located dyads: both participants are onsite
- Distributed dyads: at least one participant is remote

43 Dyads

Co-located	36 (83,7%)
Distributed	7 (16,3%)



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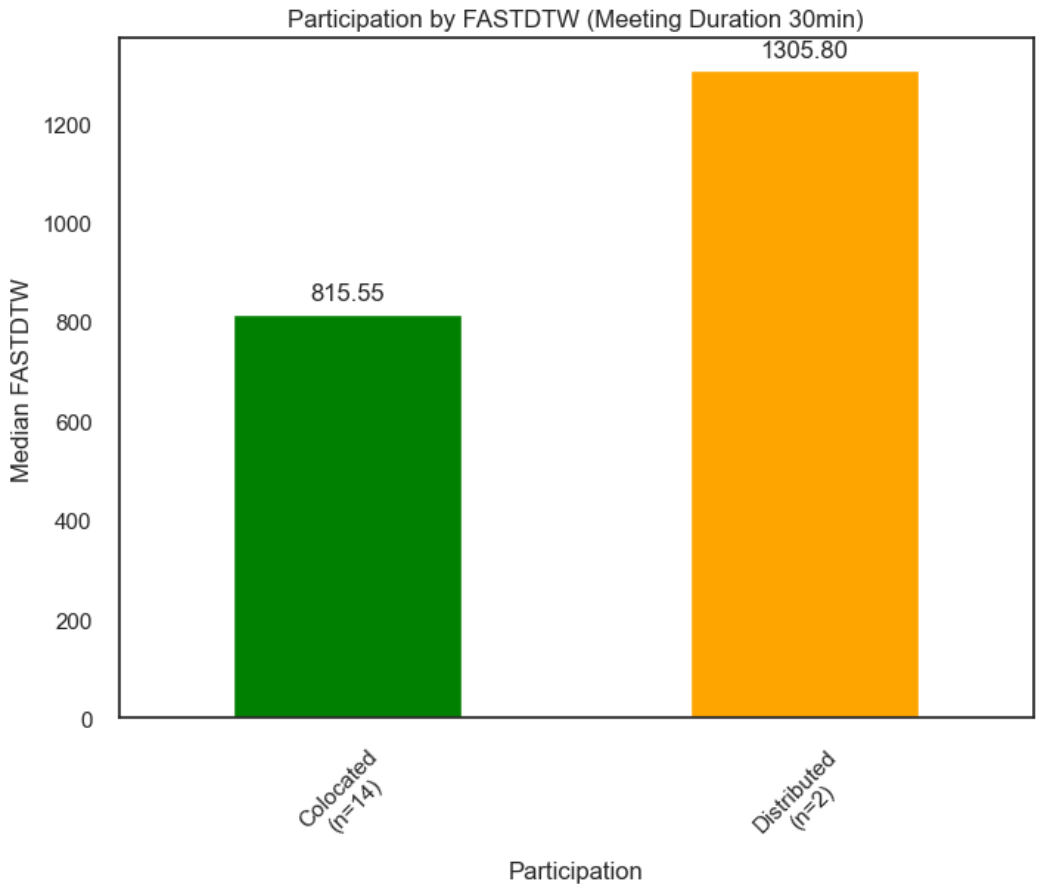
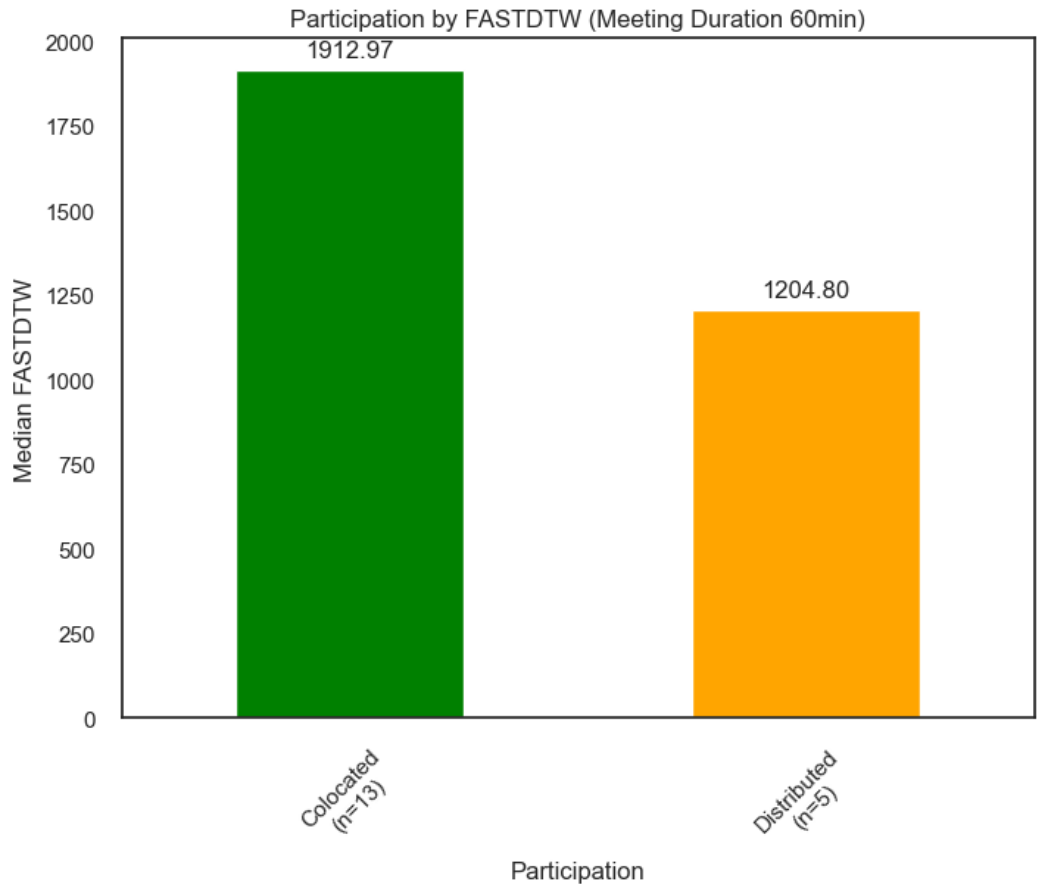
Does Engagement alignment change in co-located vs. distributed dyads?





T-test analyses reveal *no statistically significant difference* in engagement alignment for co-located and distributed participation regardless of meeting duration

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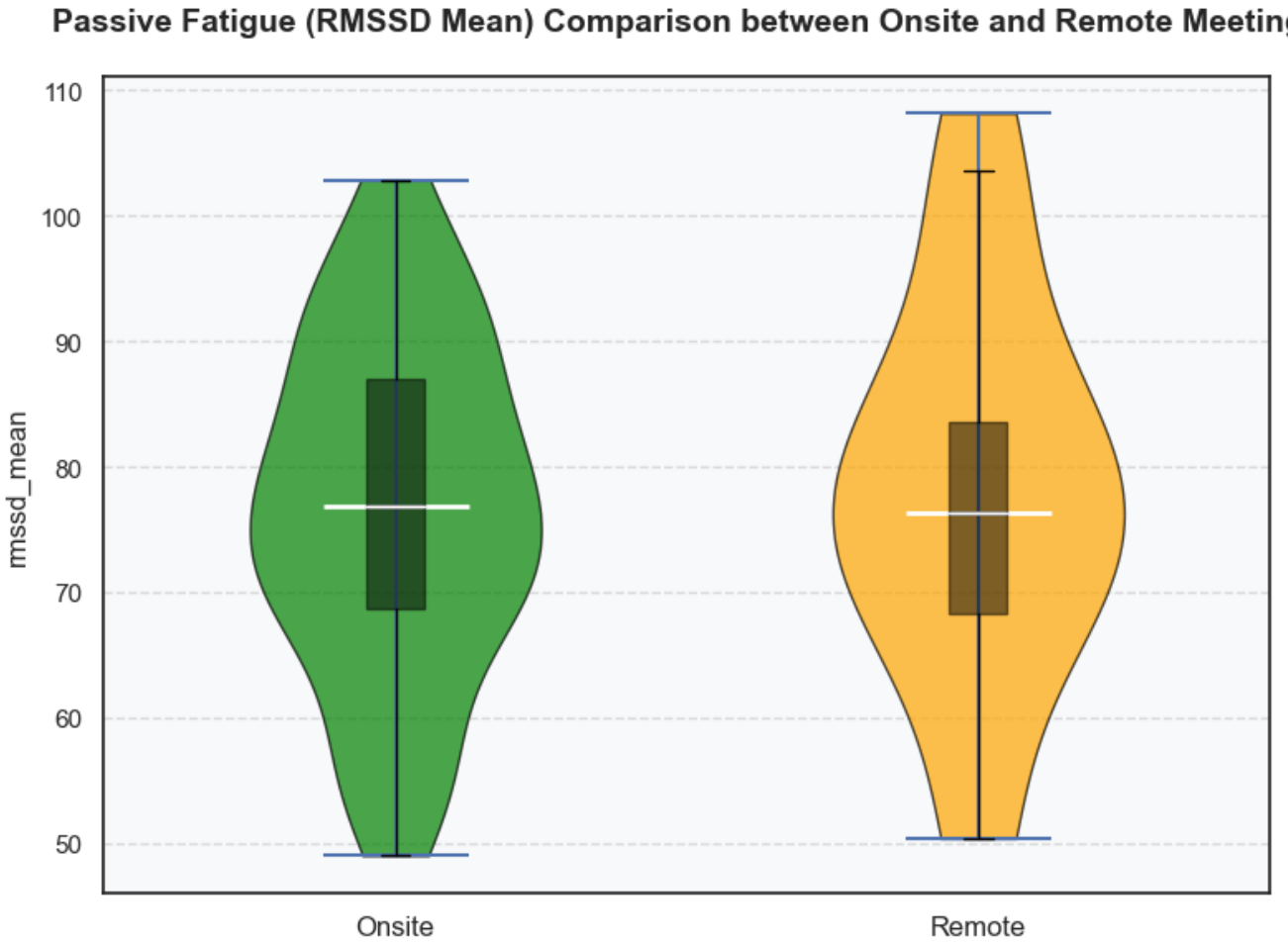
What do our bodies reveal about *Fatigue* during meetings?

Does passive fatigue vary with onsite vs. remote meeting participation?



T- Test p-value (Bonferroni corrected): 0.503

There is no statistically significant difference in RMSSD between the onsite vs remote participation

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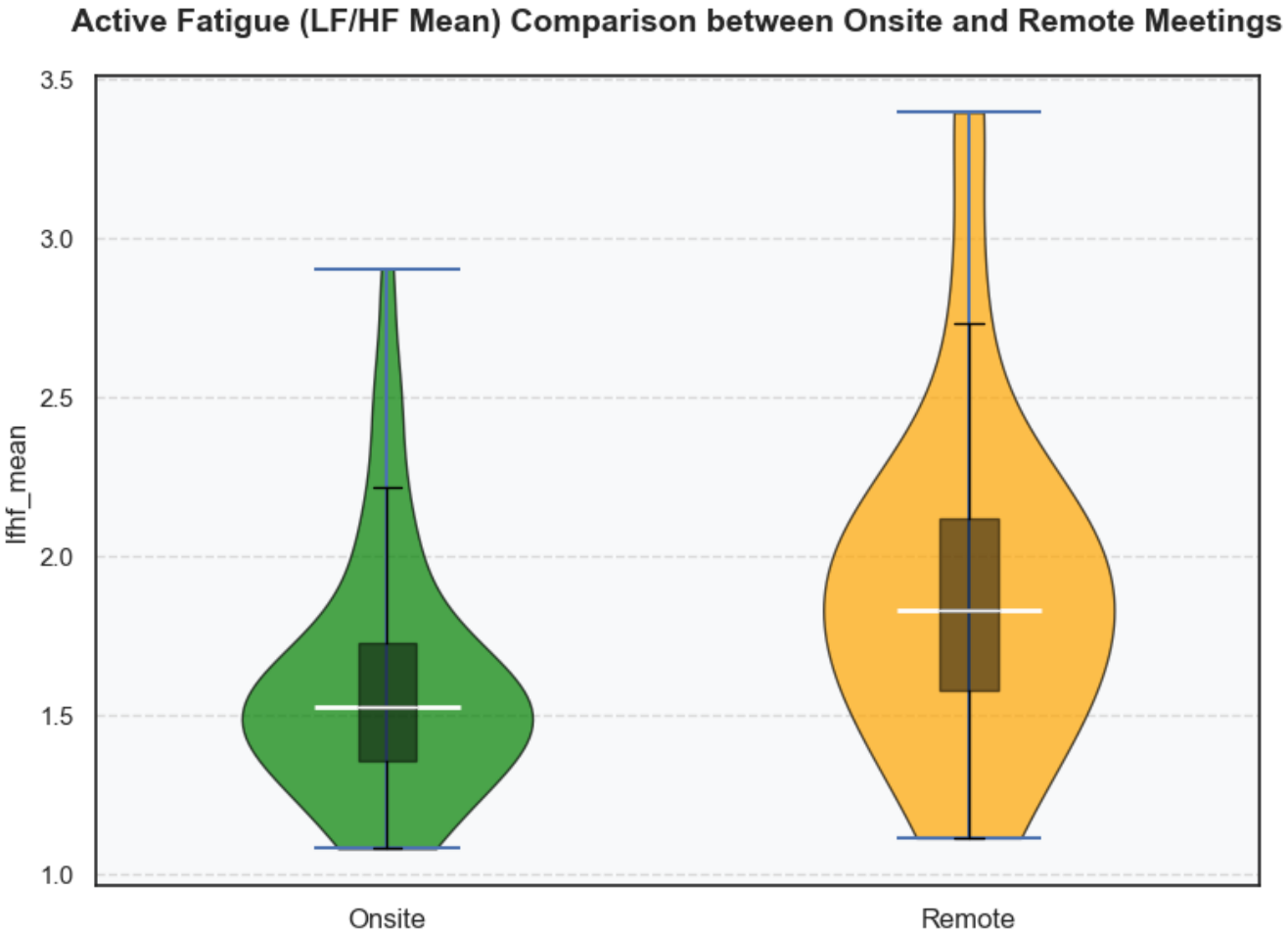
Does active fatigue vary with onsite vs. remote participation?



Mann-Whitney U test p-value (Bonferroni-corrected): 0.0581

There is no a statistically significant difference LF/HF between the onsite vs remote participation

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Does Passive Fatigue and Active Fatigue change with other meeting characteristics? (Onsite vs remote participation)

Stratified analysis for other meeting characteristics show **no statistically significant** differences in terms of **RMSSD** and **HF/LF**

- Location
- Duration
- Type of meeting
- Day of Week
- Time of Day
- Meeting Timing
- Body Language
- Facial Expression
- Familiarity
- Predominant Role
- Cumulative Meeting sum per Day
- Number of participants

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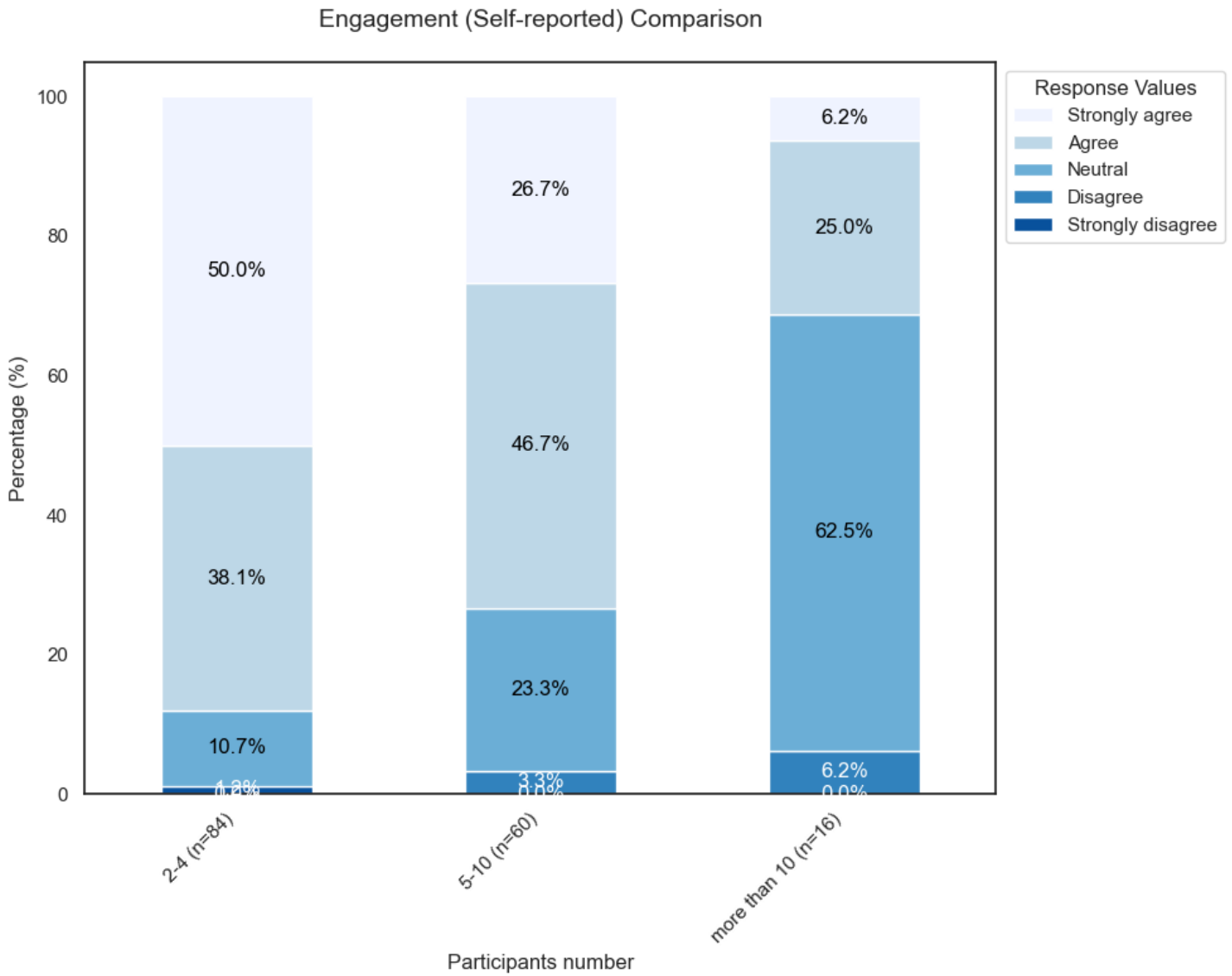
What did developers disclose about *Engagement* and *Fatigue* during meetings?

Does engagement change with number of participant? (onsite + remote)



Kruskal-Wallis H test Bonferroni-corrected p-value: 0.005
The analysis revealed statistically significant differences in self-reported engagement across meetings of varying of number of participant

Significant differences were found in the Dunn Test:

- 2-4 vs more than 10: p = 0.001

Engagement decrease for larger groups (>10 participants), with the majority (62.5%) reporting moderate engagement (3.0)

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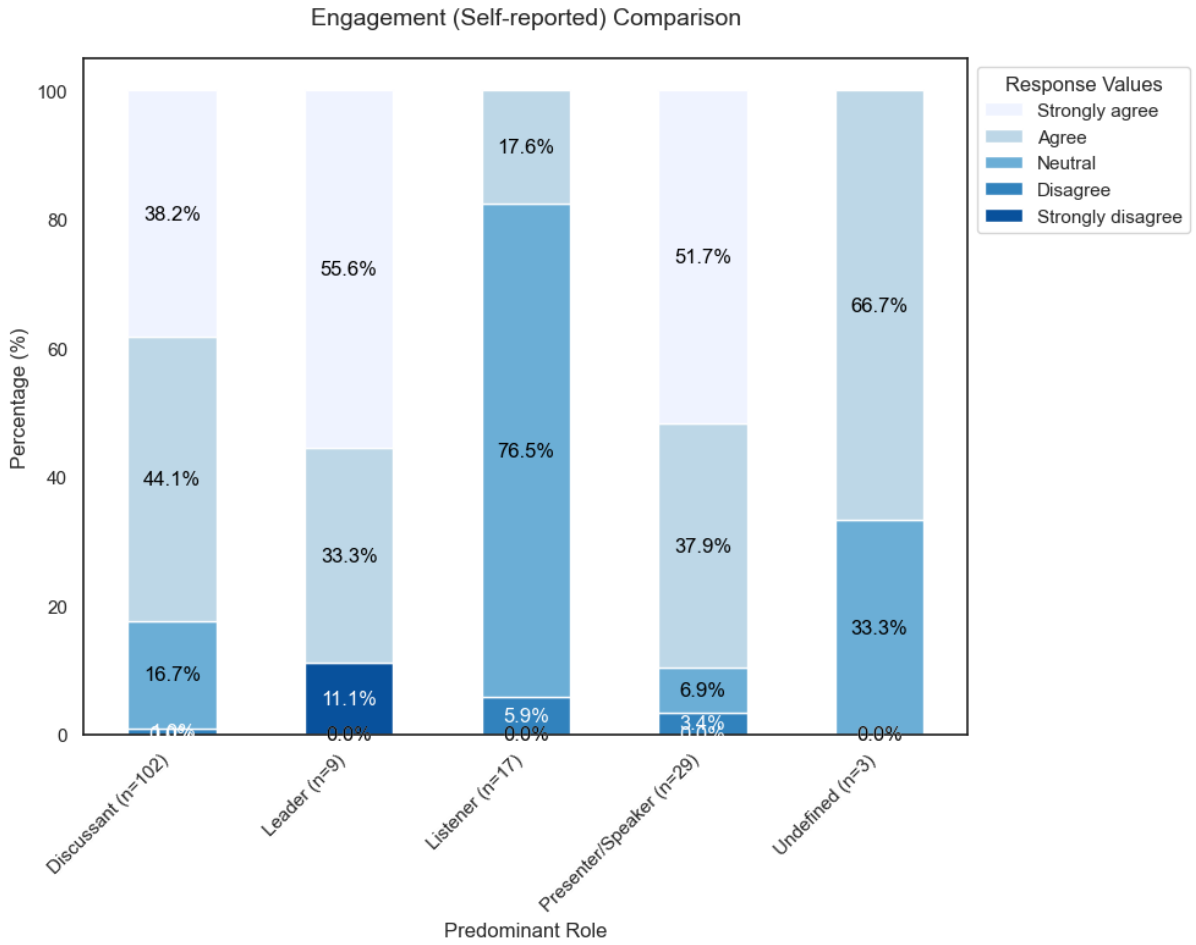
Does engagement change with role? (onsite + remote)



The same analysis revealed statistically significant differences in self-reported engagement across meetings of varying role

Significant differences were found in the Dunn Test:

- Presenter/Speaker vs Listener: p = 0.000
- Discussant vs Listener: p = 0.000
- Leader vs Listener: p = 0.002

Engagement significantly decreases for participants with a listener role compared to other roles (presenter/speaker, discussant, and leader)

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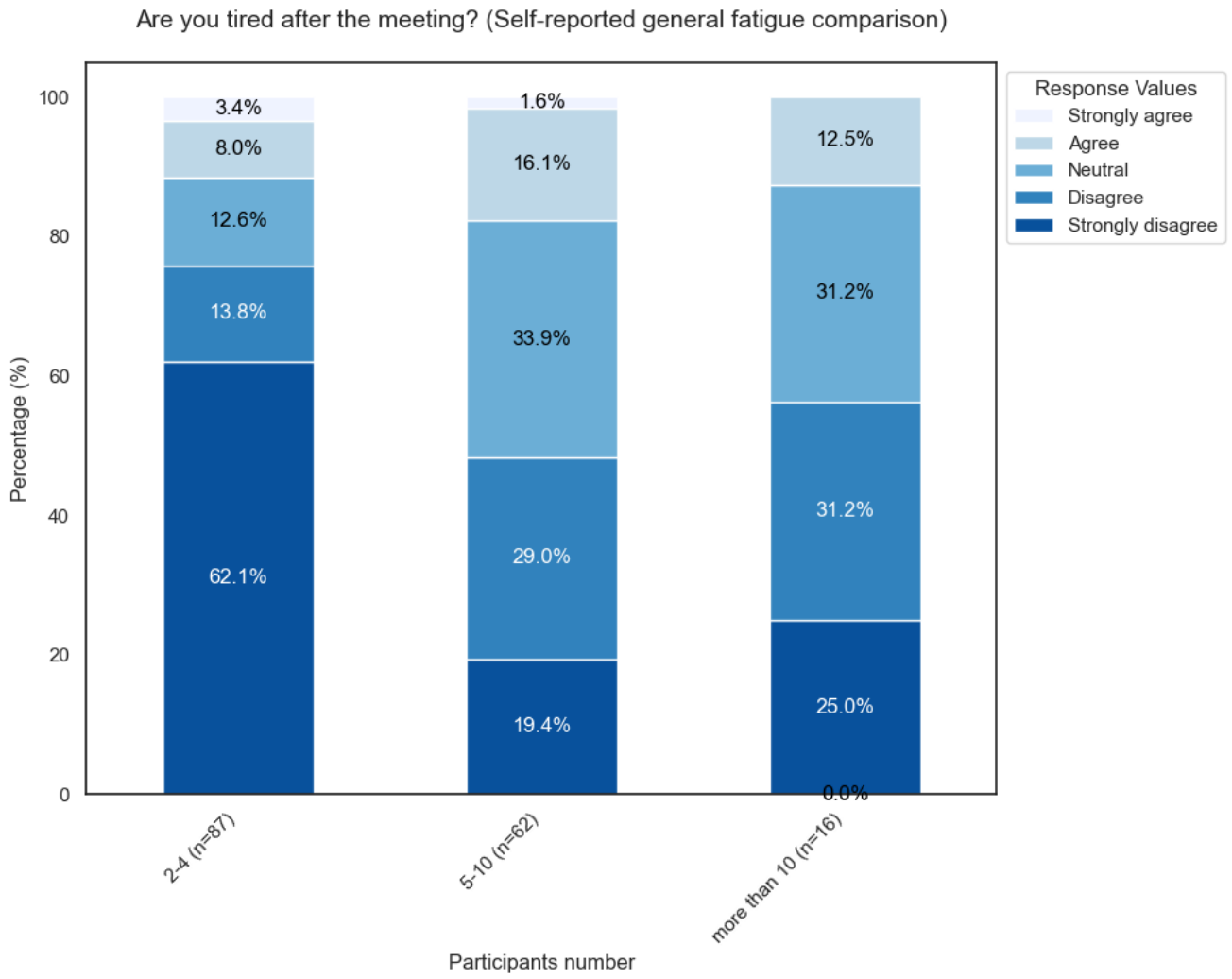
Does fatigue change with number of participants?
(onsite + remote)



Kruskal-Wallis H test p-value (Bonferroni corrected): 0.005
The analysis revealed statistically significant differences in self-reported general fatigue across meetings of varying of participant's number

Significant differences were found in the Dunn Test:

- 5-10 vs 2-4: ($p = 0.000$)

  Fatigue significantly increase for meeting with more 5 participants

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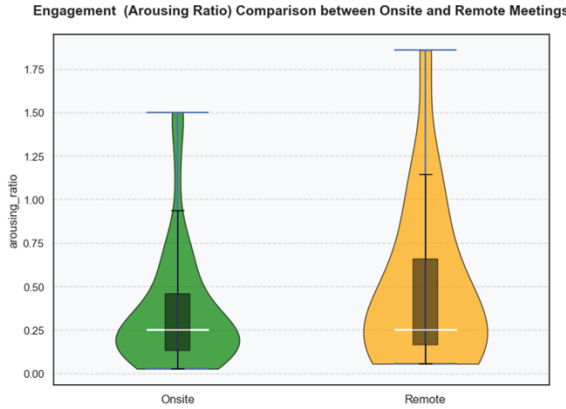
What are the main findings?

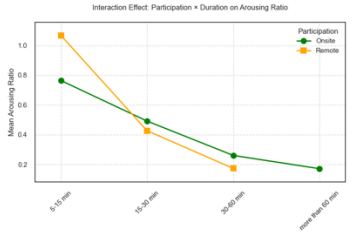
Participation mode

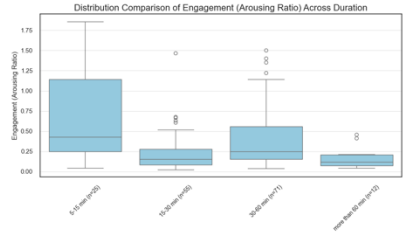


Arousing ratio do not vary with participation mode

Arousing Ratio

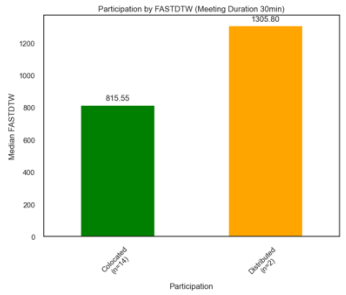
Significantly decreases for meeting longer than 30 minutes for onsite participation

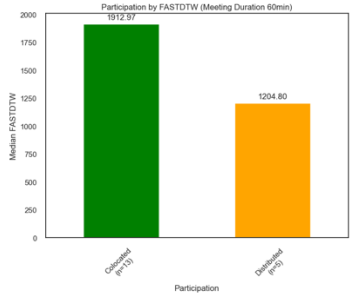




Physiological Synchrony (FastDTW)

No differences observed

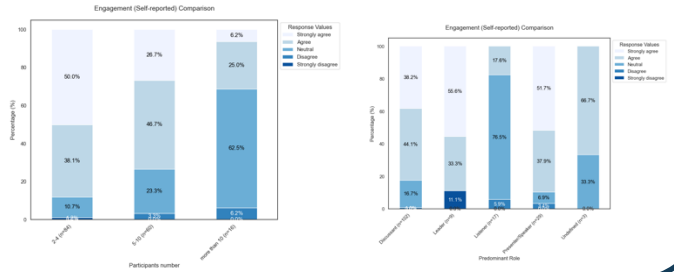




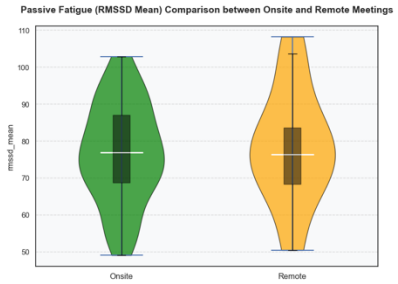
Self-reported Engagement

Significantly decreases for listener role in the meeting

Significantly decreases for meeting bigger than 10 people

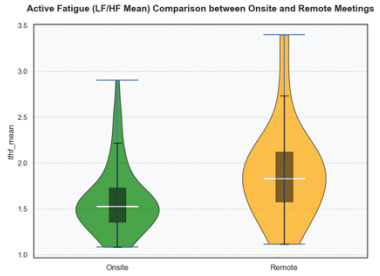


Passive Fatigue



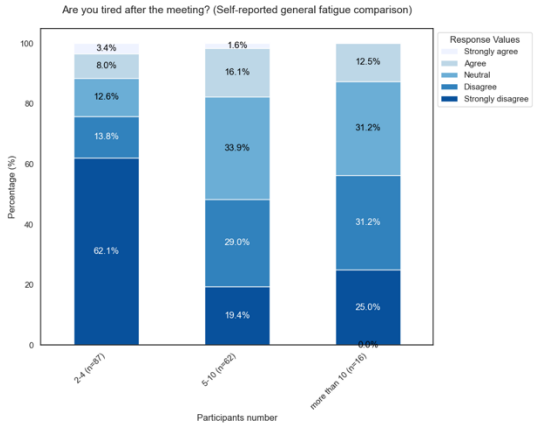
RMSSD do not vary with participation mode

Active Fatigue



LF/HF do not vary with participation mode

Self-reported Fatigue



Fatigue significantly increase for meeting with more 5 participants

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Questions?

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University of Bari

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