

Using break choice options to regulate cognitive fatigue induction? A preliminary study

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Introduction

Cognitive Fatigue (CF) increases effort discounting, further reducing the willingness to engage into mental activities¹.

Recent work suggested CF **fluctuates** on a momentary basis under two components: long- and a short-term increases². Importantly, periods of **rest** seem to promote recovery², at least on the short timescale³.

→ Designing tasks offering break-options may be promising to capture CF dynamic and regulation.

Hypothesis 1: Participants will take more (and earlier) breaks in the hard/fatiguing condition.

Hypothesis 2: Subjective fatigue will predict the probability to take break during the task.

Methods

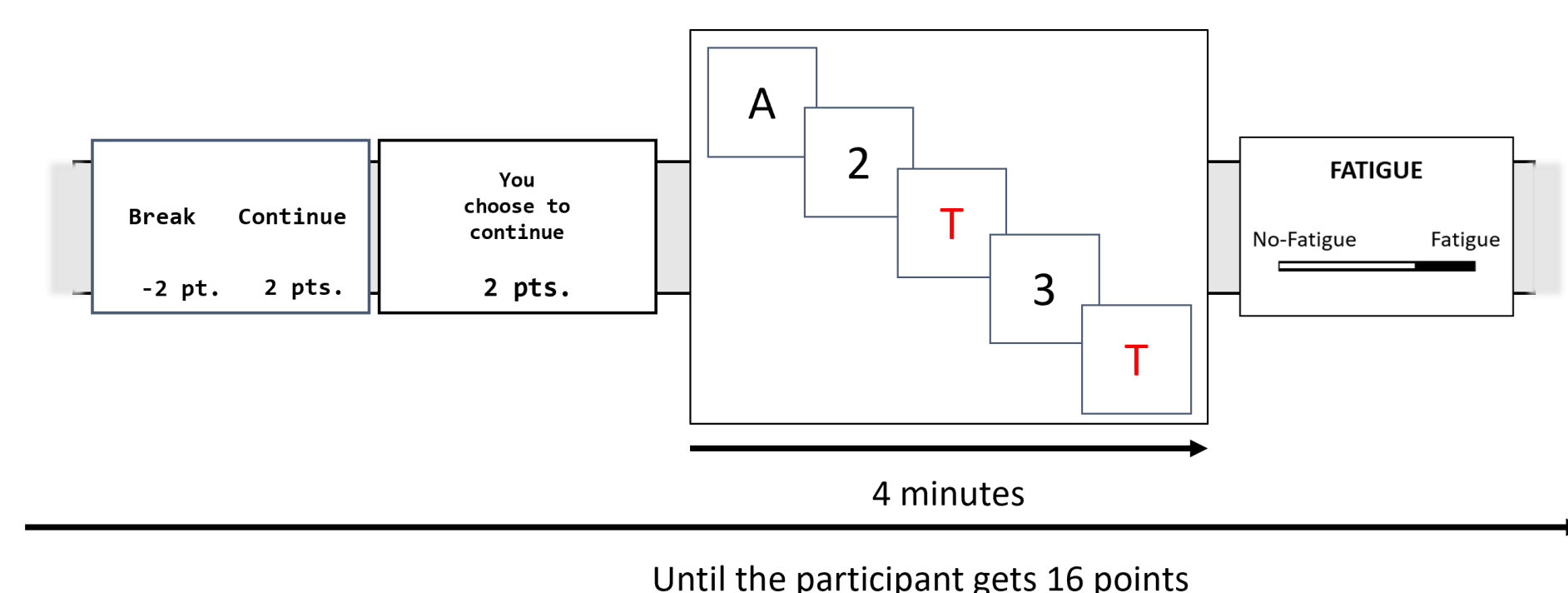
83 young adults (20.71 ± 2.94 y.o.; 74% women)

Time Load Dual Back task with break-options.

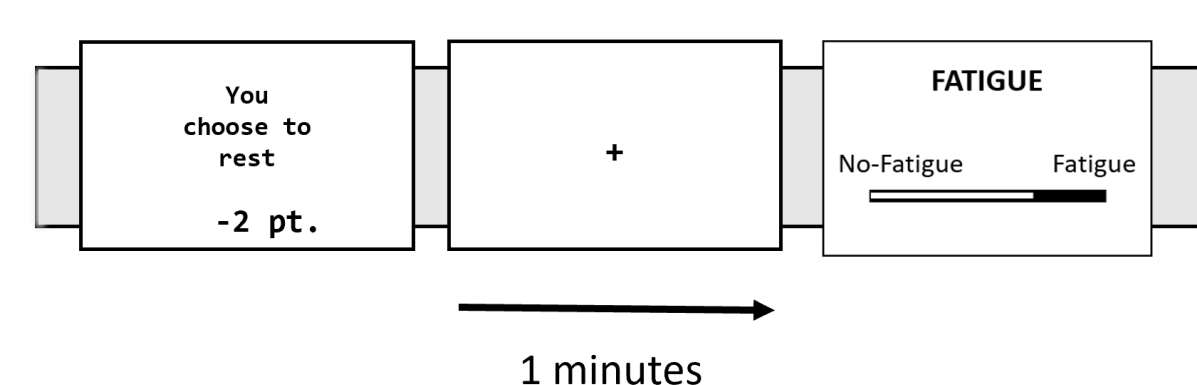
Easy (1500ms/trial; N1 = 41)

Hard (1000ms/trial; N2 = 42)

A



B



Extracted measures

Continuous

- > Choice Made
- > Decision Latency (DL)
- > Subjective Fatigue (SF)

Global

- > Number of Breaks (NB)
- > First Break Onset (FBO)

Statistical analyses

H0 – Linear mixed-effects model predicting fatigue from task-difficulty, block, and their interaction:

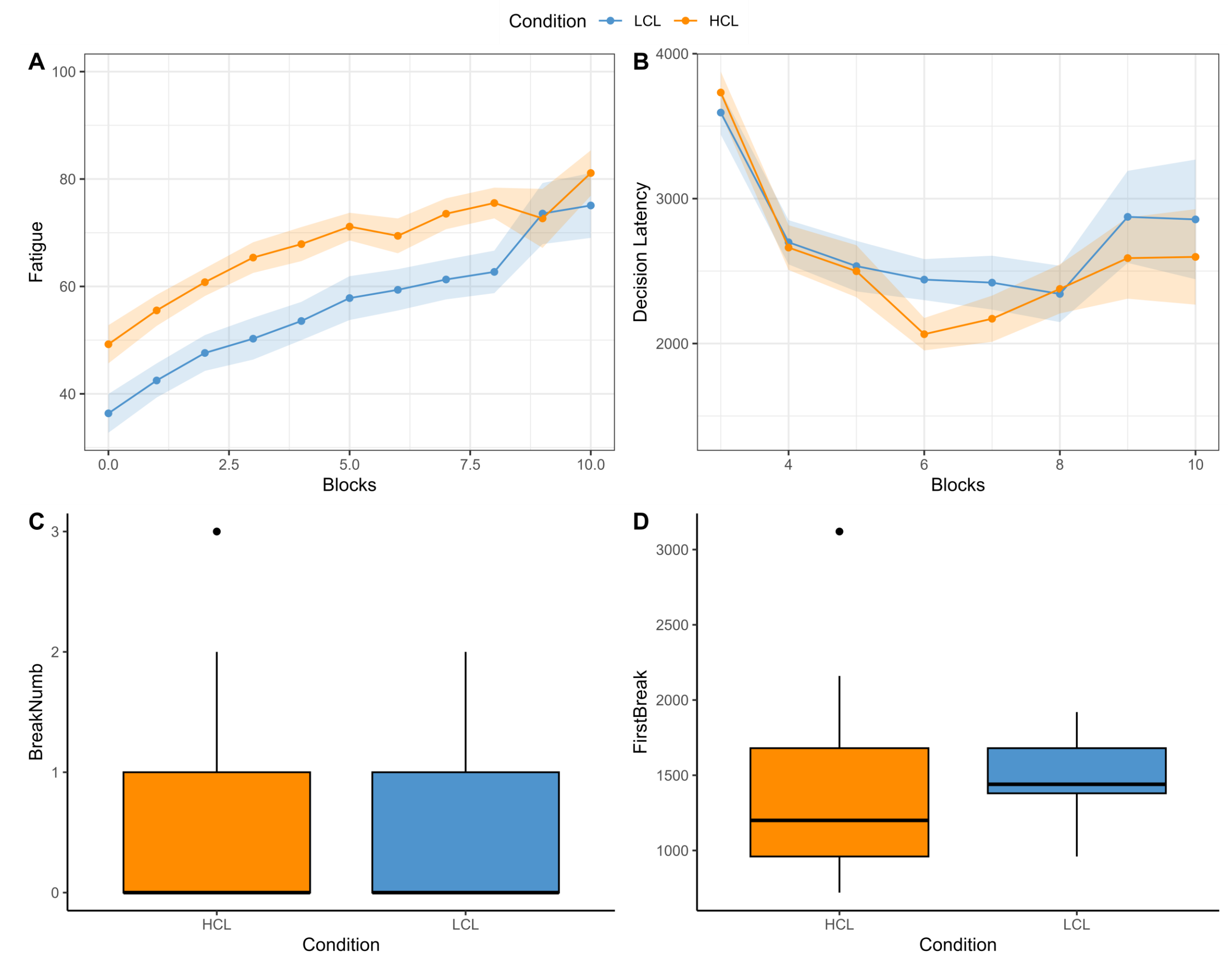
$$SF = \beta_0 + \beta_1 \cdot \text{Block} + \beta_2 \cdot \text{Group} + \beta_3 \cdot (\text{Block} \times \text{Group}) + u_{0(\text{Subject})} + u_{1(\text{Subject})} \cdot \text{Block} + \varepsilon$$

H1 – Mann-Whitney U tests comparing NB and FBO between task-difficulties (easy vs. hard).

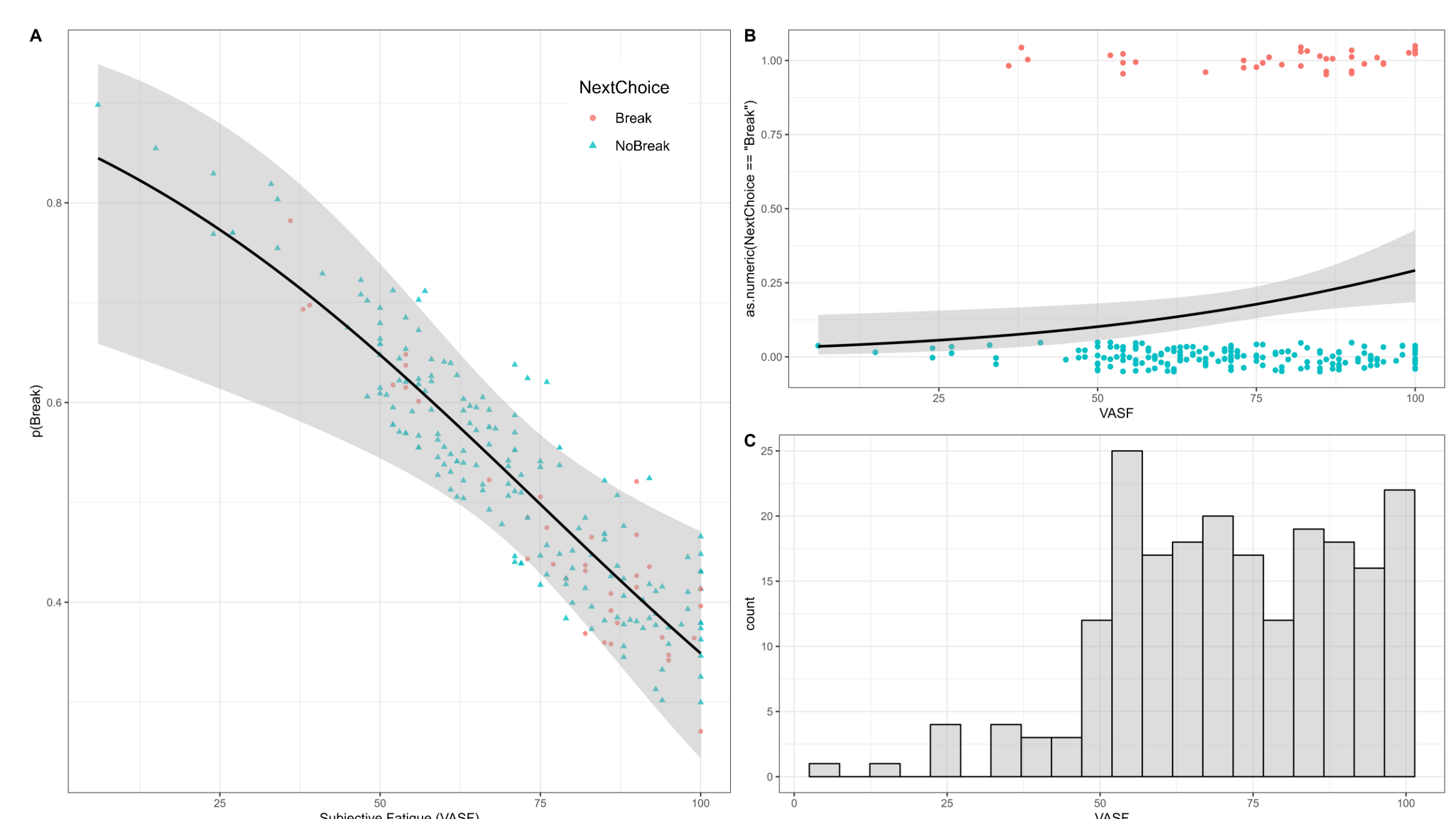
H2 – Weighted GLMM (binomial, logit link) predicting choices from fatigue, controlling for task-difficulty and block:

$$\text{Choices} = \beta_0 + \beta_1 \cdot \text{SF} + \beta_2 \cdot \text{Block} + \beta_3 \cdot \text{Group} + u_{0(\text{Subject})} + \varepsilon$$

Results



Main results show (A) a significant SF increase with time ($t_{(81.25)} = 10.94$, $p < .001$), with higher fatigue in the hard task ($t_{(82)} = 3.34$, $p < .01$); (B) a quadratic effect of time on DL ($t_{(61.57)} = -4.91$, $p < .001$); (C) no group-difference for total NB ($W = 852$, $p = 0.747$); (D) no group-difference for FBO ($t_{(22)} = -1.04$, $p = 0.311$).



Model ($N_{\text{break} \geq 1} = 25$) reveals that (A) fatigue significantly reduces the probability to rest when analyzed continuously ($\beta = -0.029$, $SE = 0.007$, $p < .001$). In addition, when categorizing fatigue to mitigate ceiling effects observed in data (B-C), results suggest that only high fatigue scores influence choices (high vs low: $\beta = -1.41$, $SE = 0.46$, $p < .01$). We also note a significant increase in break-choices with time ($\beta = 0.10$, $SE = 0.05$, $p < .05$).

Discussion

We could not validate our paradigm as only few participants took at least one break during the task ($N_{\text{sub}} = 30\%$; $N_{\text{obs}} = 7\%$).

→ Imbalance between rewards needs to be addressed in future studies.

Still, our results showed that high levels of fatigue solely are linked to a reduction in the probability to rest while overall, this latter probability increases with time-on-task. This could reflect participants' willingness to quickly end the task despite fatigue.

→ Related to increased frustration⁴ triggered by our manipulation?

References

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4. Matthews, J. et al. Computational mechanisms underlying the dynamics of physical and cognitive fatigue. *Cognition* **240**, 105603 (2023).