Reducing Work-Related Rumination Through Personalised Neurostimulation

Delia Ciobotaru[1], Vu Nguyen[2,3], Alejandro Pérez Fernández[1], Zoe E Clothier[1], Ines R Violante[1], Mark Cropley[1], Roi Cohen Kadosh[1]

1. University of Surrey. School of Psychology, Faculty of Health and Medical Sciences; Guildford, UK.
2. Amazon Research. Adelaide, Australia.
3. Cognite Neurotechnology Ltd. Oxford, UK.

INTRODUCTION

- Work-related rumination refers to persistent and repetitive contemplation of work-related issues outside working hours[1].
  - **Affective rumination**: Negative emotional responses when solutions are not found.
- Schoolteachers are prone to high affective work-related rumination due to long working hours and student behaviour[2].
- **Transcranial Alternating Current Stimulation** (tACS) can modulate disturbed neural oscillations in a frequency-specific manner[3].
- Current research often ignoring individual differences, leading to heterogenous findings[4].
- **Personalised Bayesian Optimisation** (pBO) tailors stimulation parameters by accounting for individual differences and accumulating knowledge from previous participants[5].
- **Aim**: Develop a pBO algorithm to personalise neurostimulation for reducing affective work-related rumination in schoolteachers.

METHODS

- Participants: 67 UK schoolteachers, each completing between 5 to 7 sessions for a total of 399 session (see Fig. 1 and 2).
- tACS delivered over the left dorsolateral prefrontal cortex and the midline central region of the head.

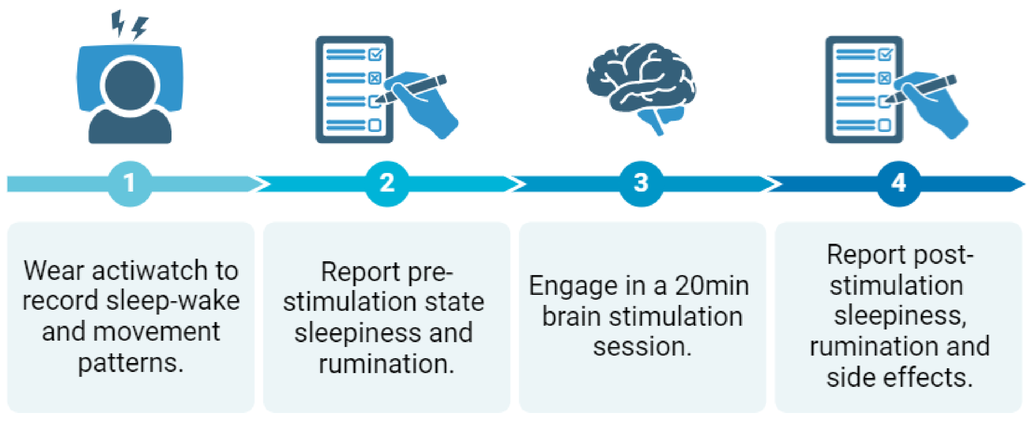


Figure 1. Participant Journey in Experiments 1 and 2. The sequence of events occurred for each session.

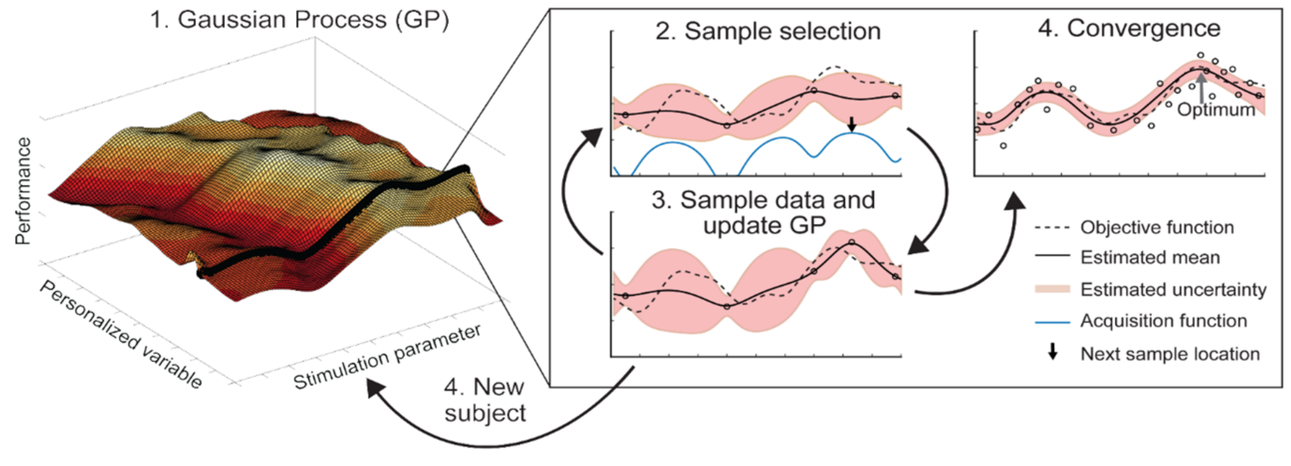


Figure 2. Personalised Bayesian Optimisation (pBO) of tACS Parameters . After a burn-in phase with 80 random tACS parameters, the pBO algorithm iteratively refined its predictions of optimal parametrs to reduce affective rumination based on head circumference and baseline rumination levels. Adapted from [5].

RESULTS

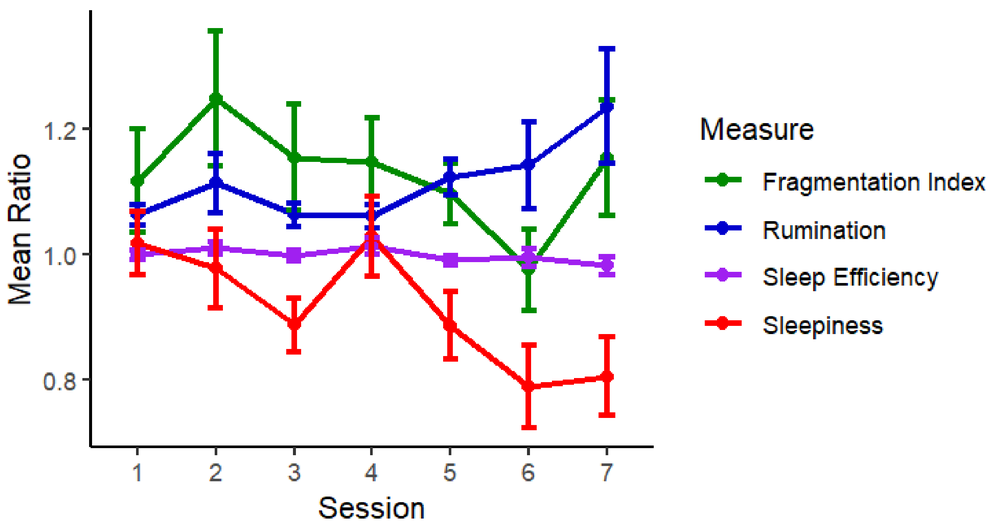


Figure 3. Changes in State Measure Ratios Across Sessions. Greater ratios indicate higher reductions in scores following stimulation compared to pre-stimulation levels. Error bars show standard error.

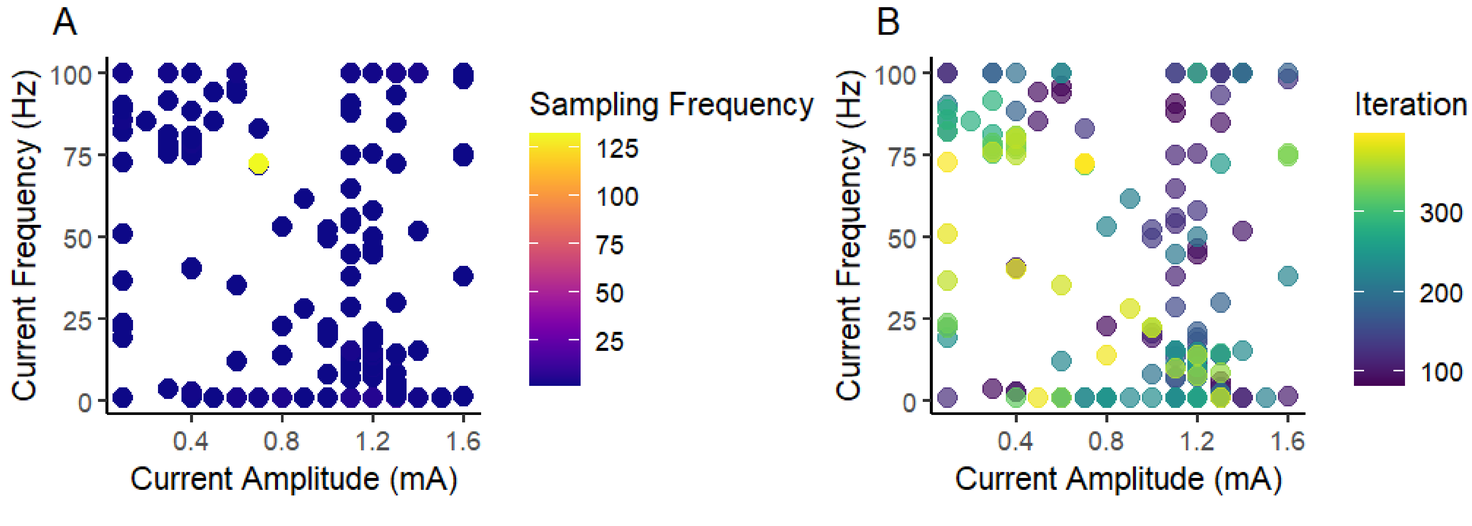
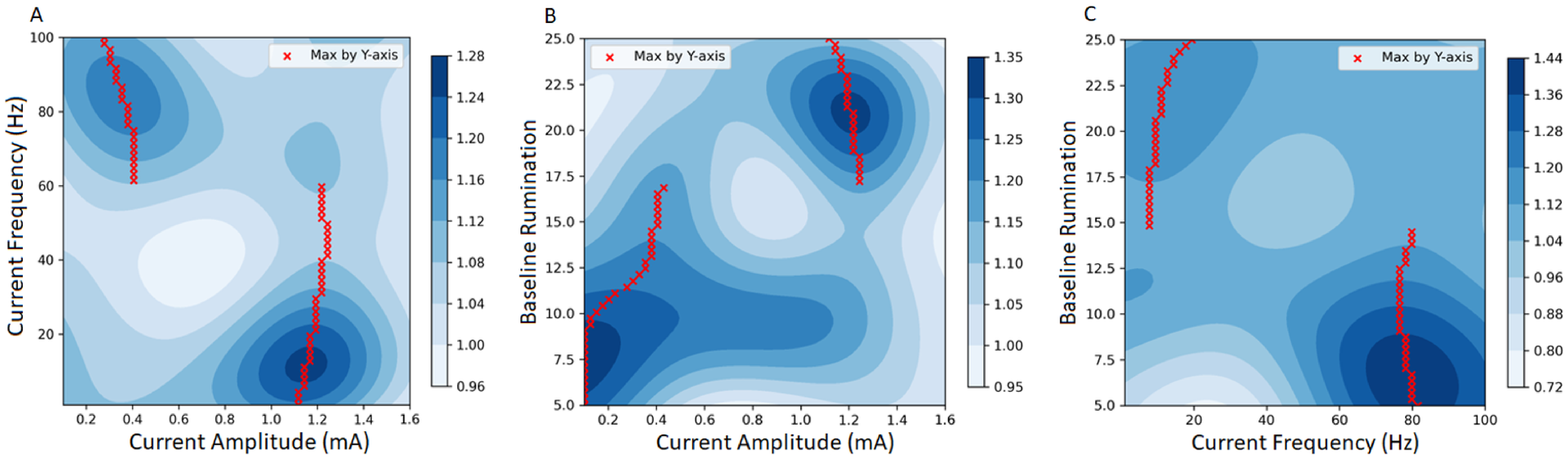


Figure 4. Frequency and Evolution of Parameter Sampling Across Sessions. Figure A illustrates how often different combinations of amplitude and frequency were sampled. Figure B indicates the session in which each combination was last explored, providing insight into the evolution of the sampling algorithm.

Figure 5. Estimated Rumination Reduction Across Different Parameter Combinations. Figure A: Across head circumferences and baseline rumination, higher amplitudes paired with lower frequencies generate the greatest reductions in rumination. Figures B&C: At higher rumination levels, the greatest reductions are achieved at higher amplitudes across head circumferences and frequencies, and lower frequencies across head circumferences and amplitudes, respectively. Higher ratios indicate greater rumination reductions.



CONCLUSION

Our pBO-based approach offers a promising, evidence-based method for optimising tACS parameters to optimise reductions in affective work-related rumination based on head circumference and baseline rumination. These findings should be considered a preliminary step that warrants further validation through comparison with sham stimulation in a double-blinded study, as well as direct measurement of neurocognitive outcomes.

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