

Introduction

Imagine an immersive world where one could learn the skill to voluntarily self-regulate one's brain activity.

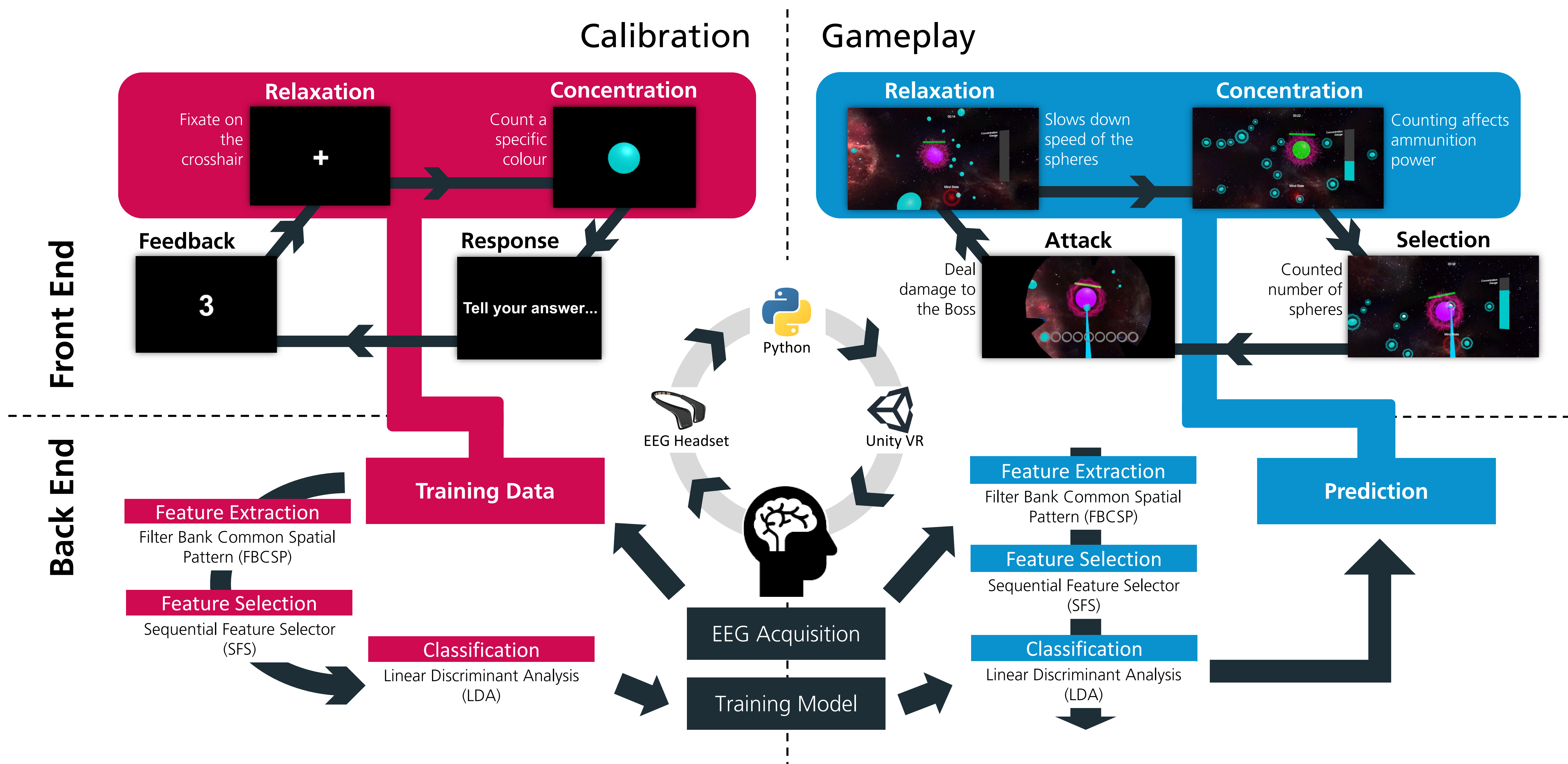
Using apps such as Headspace [1] for practicing meditation techniques are slowly gaining prominence.

Virtual Reality headsets can create enriched and interactive worlds.

Mobile EEG-wearables provide correlates of mental states [2,3].

What if one could combine these to learn the ability to concentrate in a busy environment or fully relax between meetings.

We explore how MindTrain - an immersive, gamified environment combining VR and EEG-based neurofeedback- enables users to learn to self-regulate their mental states of concentration and relaxation.



Results

Calibration Results

Participant	ACC	PPV	NPV
1	0.78	0.87	0.72
2	0.79	0.78	0.8
3	0.72	0.69	0.68
4	0.69	0.69	0.68
Mean	0.75	0.77	0.73

		Actual	
		Relax	Conc.
Predicted	Relax	TP = 26	FP = 4
	Conc.	FN = 14	TN = 36

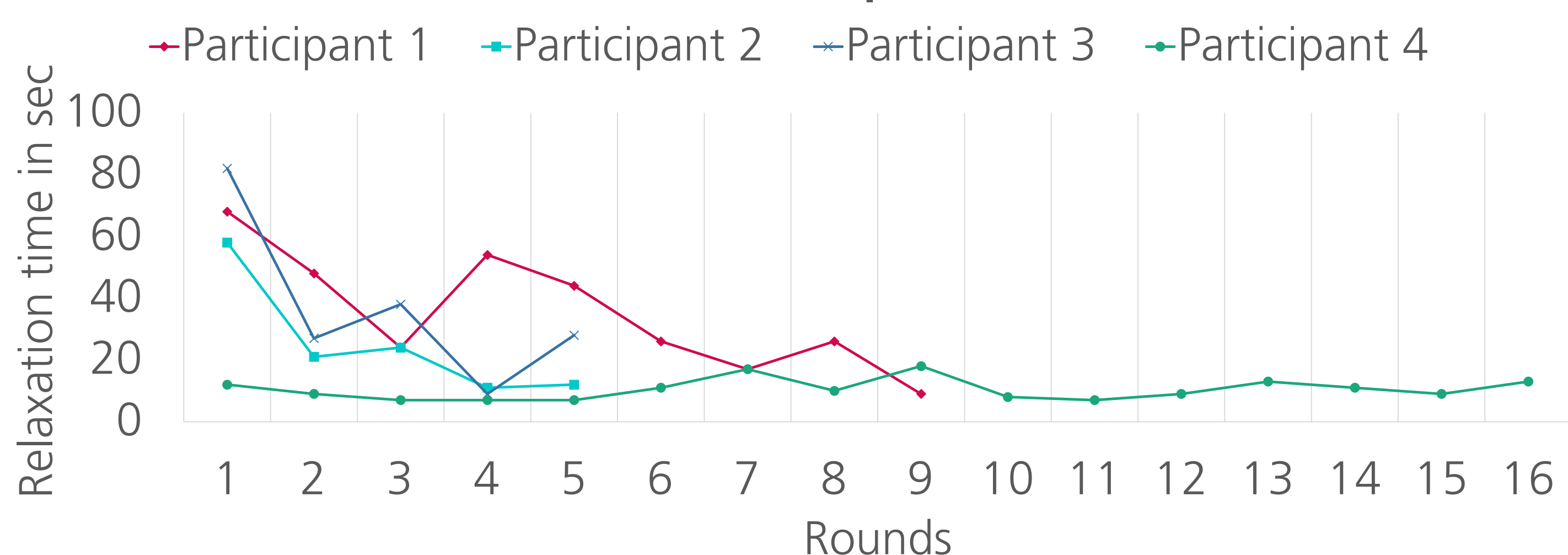
Confusion Matrix

		Actual	
		Relax	Conc.
Predicted	Relax	TP = 32	FP = 9
	Conc.	FN = 8	TN = 31

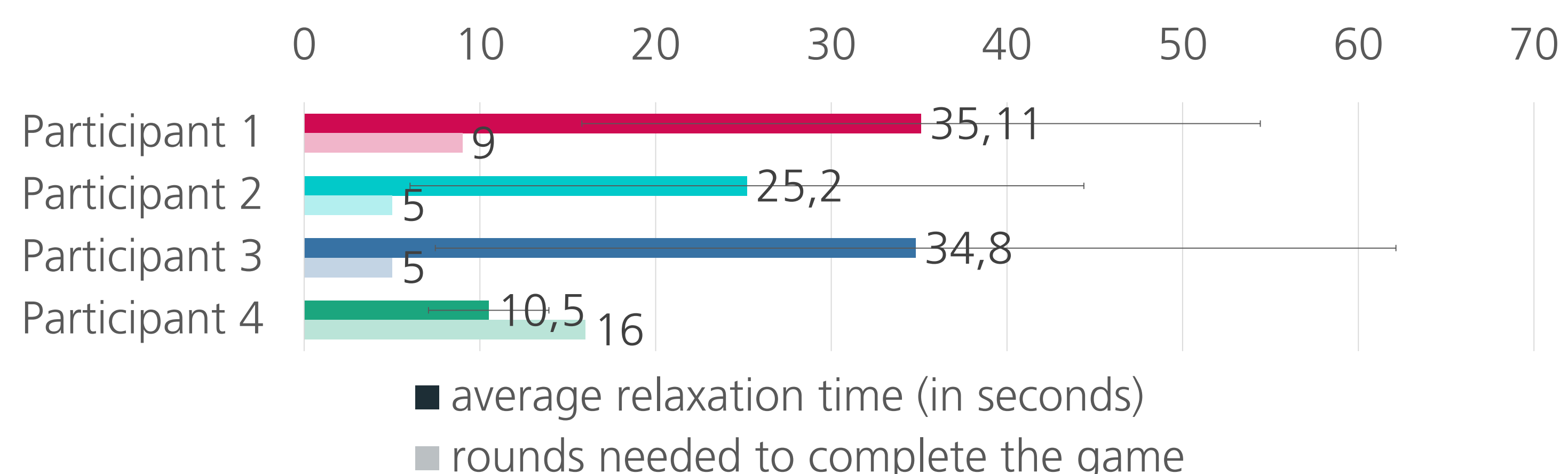
		Actual	
		Relax	Conc.
Predicted	Relax	TP = 29	FP = 11
	Conc.	FN = 11	TN = 29

		Actual	
		Relax	Conc.
Predicted	Relax	TP = 27	FP = 12
	Conc.	FN = 13	TN = 28

Relaxation time per round



Gameplay results



Conclusion & Future Work

Results of the pilot study indicate ...

1. effectiveness of the gamified neurofeedback environment.
2. a trade-off between being good at the concentration state or being able to come down to a relaxed state.

In our future research, we plan to modify the game mechanics by ...

1. coupling the strength of ammunition to the classifier output.
2. scaling difficulty with performance over time.
3. exploring calibration tasks for the collection of training data.

References:
 [1] Headspace. 2019. Your guide to health and happiness. Retrieved June 6, 2019 from <https://www.headspace.com/>
 [2] Kosunen, I., Salminen, M., Järvelä, S., Ruonala, A., Ravaja, N., & Jacucci, G. (2016). Relaworld: neuroadaptive and immersive virtual reality meditation system. In *Proceedings of the 21st International Conference on Intelligent User Interfaces*. ACM, NY, USA, 208–217. <https://doi.org/10.1145/2856767.2856796>
 [3] Kovacevic, N., Ritter, P., Tays, W., Moreno, S., & McIntosh, A. R. (2015). 'My virtual dream': Collective neurofeedback in an immersive art environment. *PLoS ONE* 10, 7 (2015), e0130129. <https://doi.org/10.1371/journal.pone.0130129>