Research Traineeships 2021 proposal

1. Title of the project

VR creativity II: The Neural Correlates of Creative Ideation and Cognitive Absorption in Virtual Reality Environments

2. Coordinators

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3. VR creativity II: A proposal to complete project "VR creativity"

This proposal aims to build on our earlier work that was funded by the TSHD Research Traineeship program. This previous proposal received funding for two traineeships in the 2019/2020 academic year. The first half year was spent on training the skills of the trainees and designing the experiment. However, due to the known restrictions that came with the pandemic, our experiments were cancelled, and we were not able to collect data in the second half of that academic year. The proposal presented here is therefore similar to our previous proposal. The major change is a revised experimental tool (using 360° video instead of developing VR simulation), which is now largely ready to be conducted due to our previously funded efforts. *Funding the present proposal would enable us to immediately conduct the data collection needed to finish our study within 4 months of time.*

4. Project summary

New media design has made a large impact on how people generate creative ideas (Literat & Glaveanu, 2018). Virtual reality (VR) in particular is now being put forward as one of the key technologies that will reshape creative problem solving (Hu et al., 2021). **Immersive VR has shown to increase a user's Cognitive Absorption (CA)** (Alimardani & Braak, 2021), which measures a user's perceived usability and sense of flow during interaction with a new information technology (Agarwal & Karahanna, 2000; Nakamura & Csikszentmihalyi, 2014). **Yet, the potential of VR for supporting creative ideation and the process under which the brain responds to immersive environments, is still poorly understood** (Frich et al., 2019; Abraham, 2018)**.**

Therefore, in this project, we will answer the following RQs:

RQ1: What is the relationship between creative ideation and cognitive absorption in VR and non-immersive environments?

RQ2: What are the neural correlates of the interaction between cognitive absorption and creative ideation in virtual reality?

Forty participants will be recruited to participate in a within-subject experiment. They will be asked to generate ideas in two conditions with two different media types: 1) 360° video in VR, 2) 360° video on a 2d computer screen. In the VR condition, participants watch 360° video in a head mounted display and can be fully immersed (Fig. 1). EEG brain activity will be collected using a wireless EEG cap (g.Nautilus, available at MindLabs) before (Pre-baseline), during and after (Post-baseline) the idea generation task (CIT) (Fig. 2). Subsequently, participants will report their cognitive absorption at the end of each condition using the CA standard questionnaire (Agarwal & Karahanna, 2000). The idea generation task is

a variation of the commonly used alternative uses task (AUT) (Guilford, 1967). In this task, participants will be instructed to generate as many creative solutions as they can for a given problem that aligns in the 360° environment presented. Three independent raters will score the originality and usefulness of each generated problem solution (Beaty et al., 2019).

The outcome measures of the experiment will be subjective (CA), behavioral (Creative performance) and neurophysiological responses (EEG). As for EEG analysis, the difference in spectral band powers (theta, alpha, beta, and gamma activity) from the Pre-baseline to task and Post-baseline phases will be computed and compared between the experimental conditions (i.e. VR vs. non-VR). **A correlation analysis will be performed on the EEG features, creative performance and CA levels.**

Fig. 1. Example of a 360° video. In this example, people are presented with a 360° beach that is used by the local fishing community. While presented with the 360°, participants are asked to come up with as many creative solutions for the local fisherpersons to still catch fish, while the sea is too rough to use their boats.

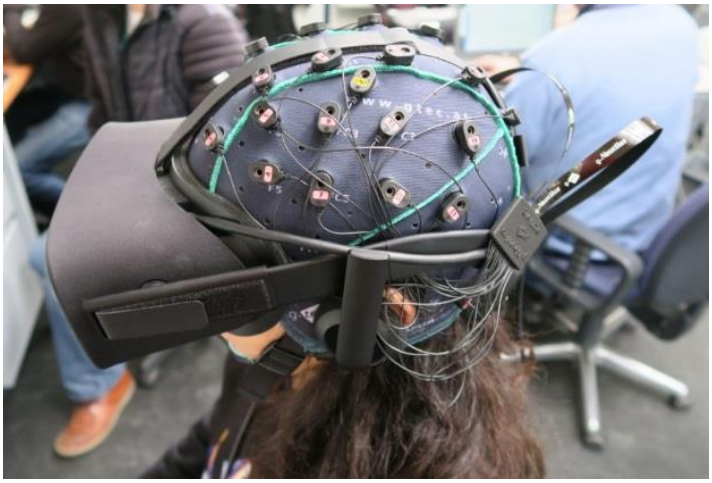

Fig.2. Experimental setup during the VR condition

5. Project timeline

September 01, 2021	Open vacancy for recruitment of the trainee
October 01, 2021	Kick-off project with the hired trainee
October 15, 2021	Start data collection at Mindlabs (We already have finalized the experiment protocol and reserved necessary equipment including EEG and VR headset. We also have received clearance from the ethics board for this project which is valid until 30 June 2022. The trainee would only need about 10-15 hours of training with the EEG and VR headset to master the protocol and be able to conduct the experiments independently. As soon as the trainee is selected, we can post the study on the Sona system and start recruiting subjects)
November 30, 2021	Finish data collection and start analysis
December 20, 2021	Finish data analysis and start writing up
January 31, 2022	Termination of the project, send paper to VR or neuro-ergonomics conferences, data management, and planning the follow-up

6. Research trainee profile

The trainee will be a master student who has knowledge -or is interested- in cognitive science and brain imaging techniques. The research trainee will collect EEG signals during the experiment and will perform feature extraction and data analysis. Therefore, a certain level of programming skills is required and experience with signal processing is a plus. This research theme is particularly suitable for students enrolled in the CSAI program but could be suitable for an NMD student with a background in (neuro-)psychology.

References

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