**Title of the video**

Regulation of arousal via online neurofeedback improves human performance in a demanding sensory-motor task

Can Listening to “audio” actually reduce airplane accidents?

**Motivation/Short information of the authors/research group**

為什麼人類在壓力的環境下時時常犯錯？

Why do Humans always make mistakes in a stressful condition?

如果只是犯一個微小的錯誤，那無關緊要。

Making a minor mistake might be inconsequential.

但如果錯誤所產生的後果過於巨大，我們需要盡可能避免錯誤的產生

But If the consequences of mistakes are too significant, we need to avoid their occurrence as much as possible.

舉例來說，若飛行員面臨突發事故，卻因壓力過大導致操作不當，則會使所有人陷入危險的處境

For example, if a pilot faces an emergency but operates improperly due to excessive pressure, it will put everyone in a dangerous situation.

來自哥倫比亞大學的團隊，嘗試利用神經回饋的方式，操縱人類的壓力狀態，促使表現力提升

A team from Columbia University is attempting to use neurofeedback to manipulate the stress levels of humans, in order to enhance human performance under stressful situation.

**Research background/ Prior knowledge**

Yerkes–Dodson law

The Yerkes-Dodson law is a model of the relationship between stress and task performance.

It proposes that too little or too much arousal results in poorer performance.

With an intermediate level of stress or arousal, you will reach your peak level of performance.

So, Can we manipulate our arousal to reach the peak level of performance?

In the paper ‘Regulation of arousal via online neurofeedback improves human performance in a demanding sensory-motor task’, they attempted to use the neural feedback generated by EEG to remind the subjects of their arousal state, in order to achieve optimal performance in line with the Yerkes–Dodson relationship.

**Proposed method / Technical details / Innovations**

**Devices, neuromonitoring method, experiment design, .etc**

**experiment design**

**BAT (Boundary Avoidance Task)**

Subjects performed a Boundary Avoidance Task in a virtual-reality (VR) environment, where they need to manipulate a joystick to navigate through a series of rectangular red zones.

**Game over**

The game will ended abruptly whenever the pilot missed a ring.

**Level of game**

**There are two different levels of difficulty, namely the hard and easy modes.**

**Experimental procedure**

During initial screening in session 1, only novice participants who are able to repeatedly fly through 66% of course type easy within 40 min were admitted for the main experiment in session 2.

If participants perform poorly in flying, they will be excluded from the experiment.

Session 2 started with 10 min of EEG collection while participants repeatedly attempted to fly through the easy course.

This EEG-based decoder was trained then to discriminate the state of arousal, and subsequently used to generate feedback in the main EEG experiment.

**Feedback Condition**

There are three types of different condition.

**BCI,**

The higher the level of arousal detected by EEG signal, the louder the heartbeat feedback.

**Silence**

No audio was presented

**sham**

the decoder output was linearly combined in equal parts with random sham signal

in other words, the audio is irrelevant to the level of arousal.

**Instruction for participant**

instructions were as follows: “Consider missing a ring is equivalent to crashing a plane” and “When- ever you hear heartbeat audio, please try to assume a mental state where the audio becomes and stays as low in volume as possible”

Subjects were kept blind with regard to the purpose of the study and the existence of the sham condition. The closed-loop experiment lasted for 40 minutes. **The difficulty of the flying task alternated, and the feedback condition was chosen randomly.**

**Results / Achievements / Significance / Contributions / Impact …**

1.

在困難模式中，根據BCI所做出的神經反饋的表現顯著高於silence 跟 sham

In the hard flying mode, the neurofeedback performance based on BCI was significantly higher than that based on silence and sham.

However, for the easy mode, no significant differences were found between any of the conditions.

2.

Significant changes in pupil size and HRV were observed in condition BCI relative to control conditions during course type hard.

Higher heart rate variability implies lower arousal, this is consistent with the experiment's hypothesis.

Smaller pupil size implies higher cognitive control, Higher cognitive control means that it is easier to successfully accomplish complex tasks.

Conclusion and Future work

This paper demonstrate that task performance is significantly increased when the true neurofeedback is provided.

在未來潛力的應用上，透過神經反饋所建立的模型，有充分的證據表明，可以利用模型來對治療心理疾病產生顯著的改善

In terms of potential future applications, there is **increasing** evidence to suggest that the model established through neurofeedback can be used to improve the treatment **in mental illness**.

That's all for my sharing. Thank you for watching.