

WORKING MEMORY OPTIMIZATION

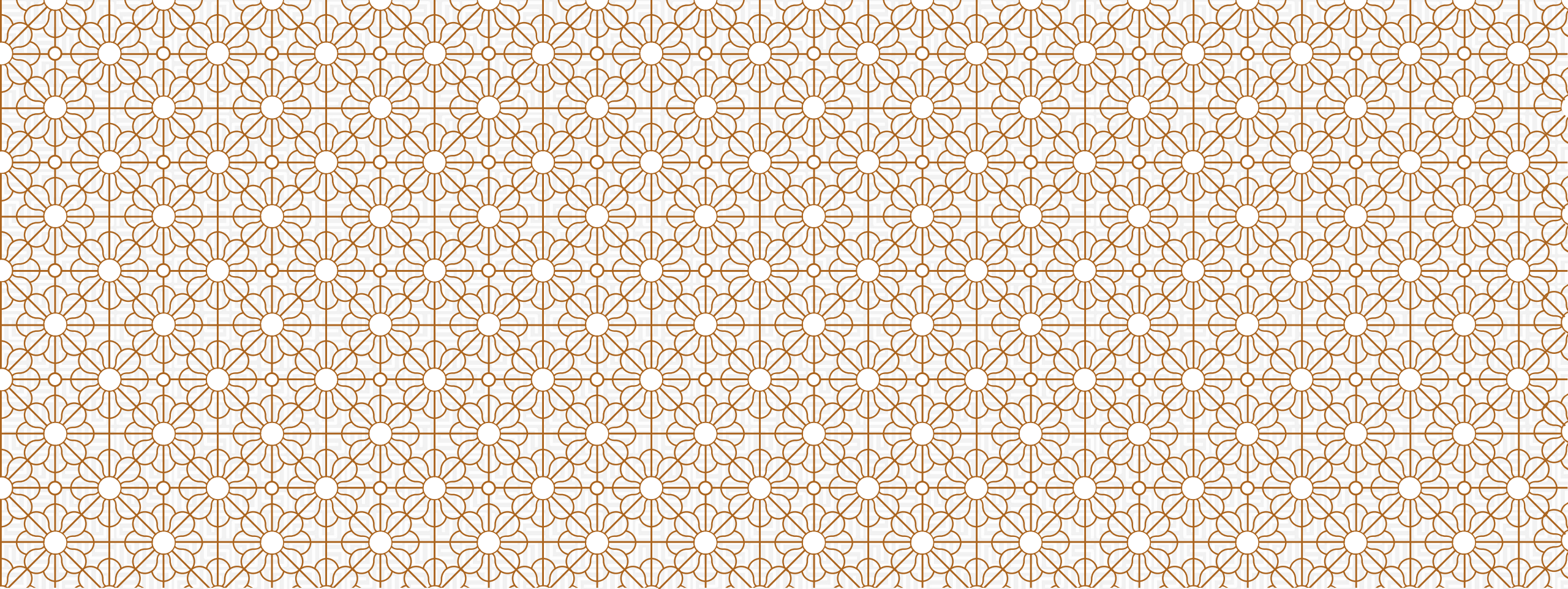


PSYCHOLOGIE

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Master Psychologie Fondamentale et Appliquée



INTRODUCTION

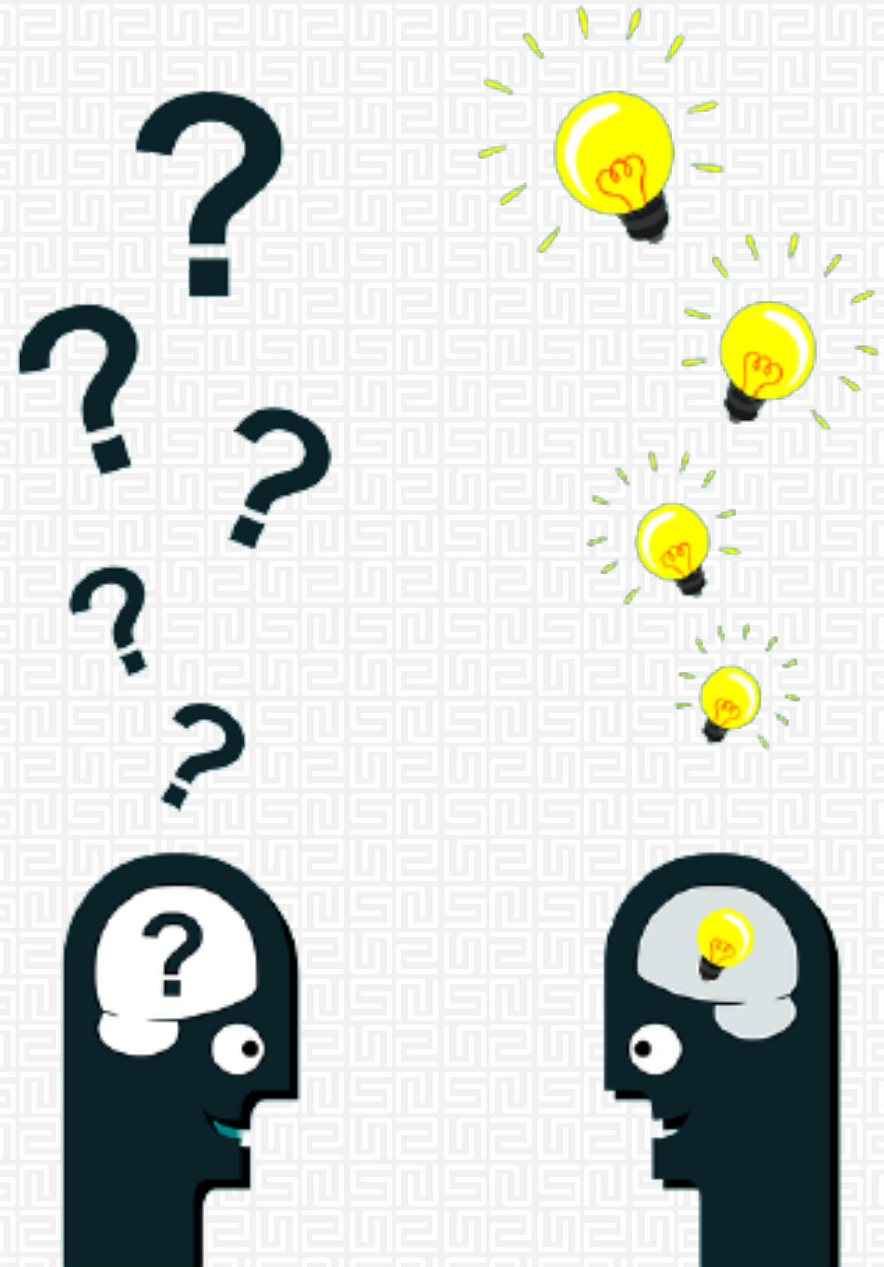


INTRODUCTION

Memory ?

We need it everyday :

- Reasoning
- Decision making
- Problem resolution
- Learning
- Language comprehension
- ...



INTRODUCTION

WORKING MEMORY

It is a process for storing and manipulating information and allows two tasks to be performed in parallel.

→ *Temporary space*

→ *Tampon entre info de la mlt et l'environnement actuel*

INTRODUCTION

WORKING MEMORY

Optimize ? Why ?

Implied in different cognitive tasks in daily-life

INTRODUCTION

WORKING MEMORY

Optimize ? Why ?



INTRODUCTION

WORKING MEMORY

Optimize ? Why ?

With disorder	Without any disorder
<ul style="list-style-type: none">○ Reduce symptoms○ Improve quality of life	<ul style="list-style-type: none">○ Increase efficiency○ Increase performance→ Delay cognitive aging

INTRODUCTION

How to optimize ?

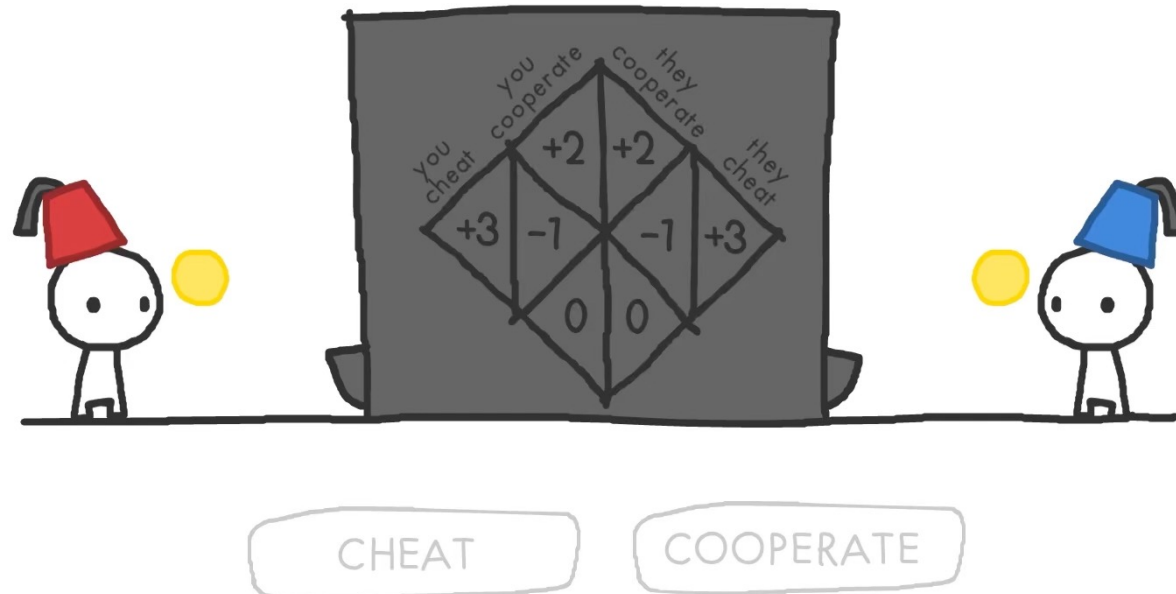
- Serious game *Deveau et al. (2015)*
- Physical activity *Marzolini &al. (2013)*
- Neurofeedback

INTRODUCTION

HOW TO OPTIMIZE ?

Serious game

Deveau et al. (2015)



INTRODUCTION

How to optimize ?

- Serious game (Deveau &al. (2015))
- **Physical activity** (Marzolini &al. (2013))
- Neurofeedback

INTRODUCTION

HOW TO OPTIMIZE ?

Physical activity

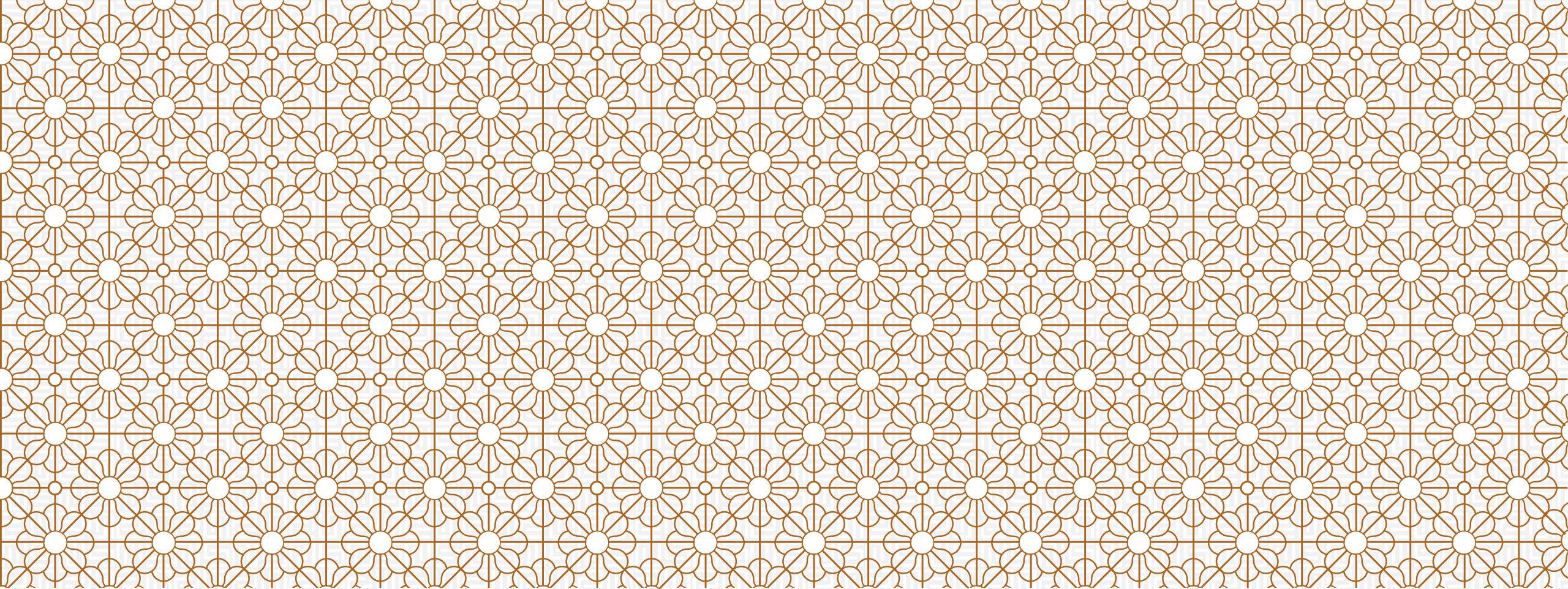
Marzolini et al. (2013)



INTRODUCTION

How to optimize ?

- Serious game (Deveau &al. (2015))
- Physical activity (Marzolini &al. (2013))
- **Neurofeedback**



NEUROFEEDBACK



NEUROFEEDBACK

Neurofeedback technique

Technique that allows a learner to self-regulate in real time their own brain activity with an electroencephalographic signal. (Nan et al. 2012)

NEUROFEEDBACK

Neurofeedback technique



NEUROFEEDBACK

What do we do with neurofeedback ?

⇒ We measure the cerebral activities of different waves

NEUROFEEDBACK

EEG's technique

Brain waves :

- Theta : 4 to 8Hz (*Enriquez-Geppert and al. 2017; Klimesch et al. 1997*)
- Sensorimotor rhythm : 12 to 15Hz (*Autenrieth and al. 2020*)
- **Alpha : 8 to 12Hz** (*Escalano et al. 2011; Angelakis et al. 2007*)
 - Upper alpha : 10 to 12 Hz

Working memory

Involved in memory process

NEUROFEEDBACK

Schema of a typical neurofeedback training

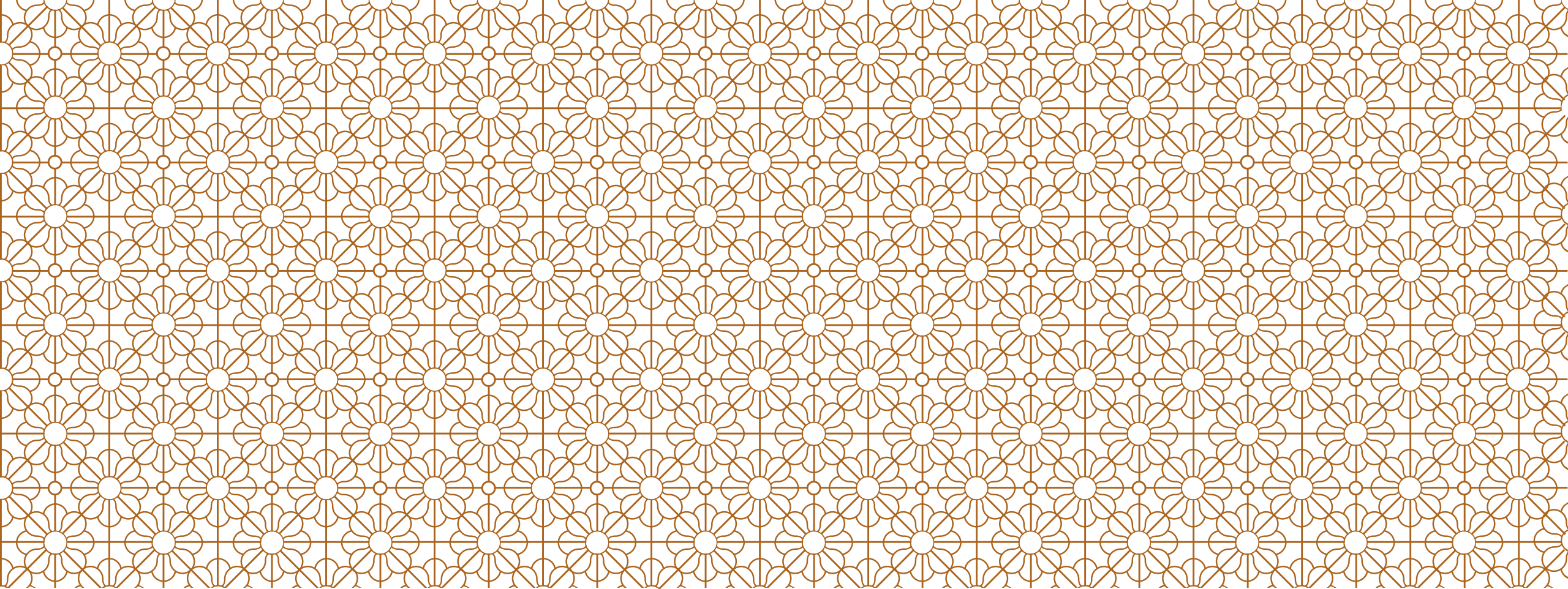
(Enriquez et al. 2017)



NEUROFEEDBACK

What is the task of the participant during the neurofeedback training ?

⇒ Increase their alpha waves



OBJECTIF AND HYPOTHESES

OBJECTIF



Improve working memory through neurofeedback training

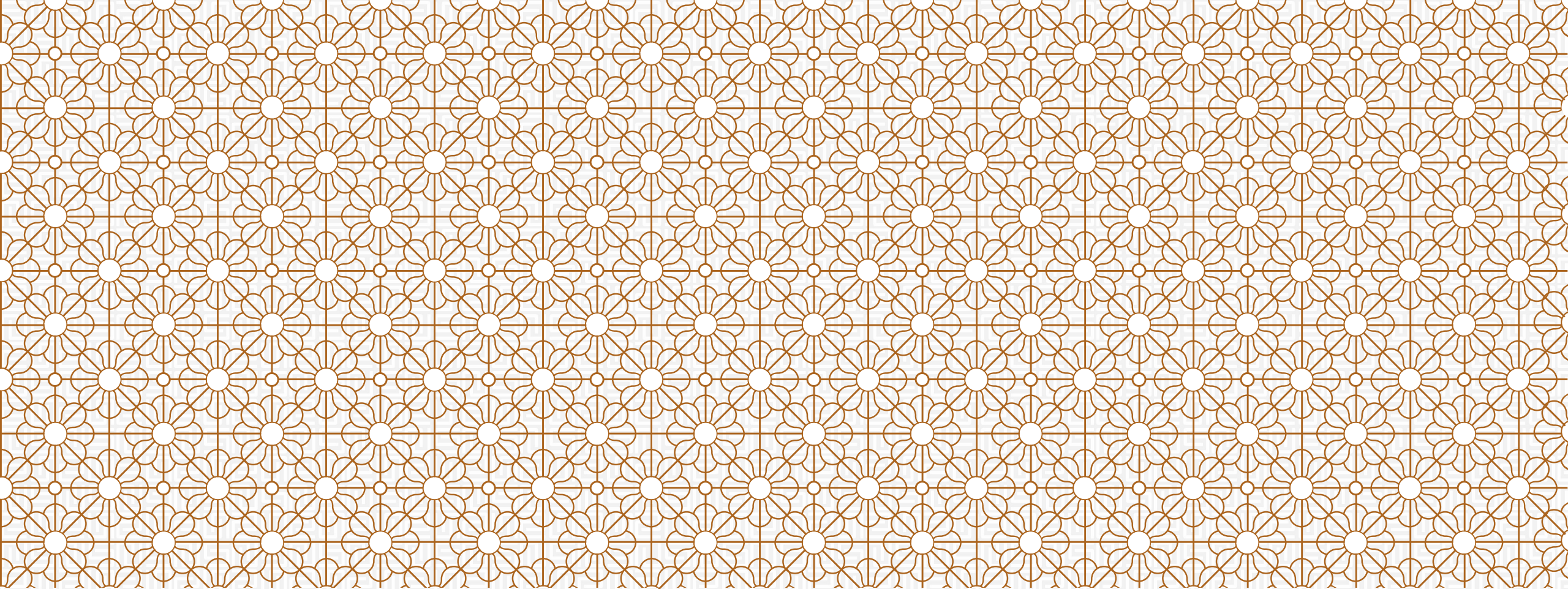
2 variations :

- **1** training/week (G1)
 - **3** training/week (G2)
- } during 5 weeks

HYPOTHESES



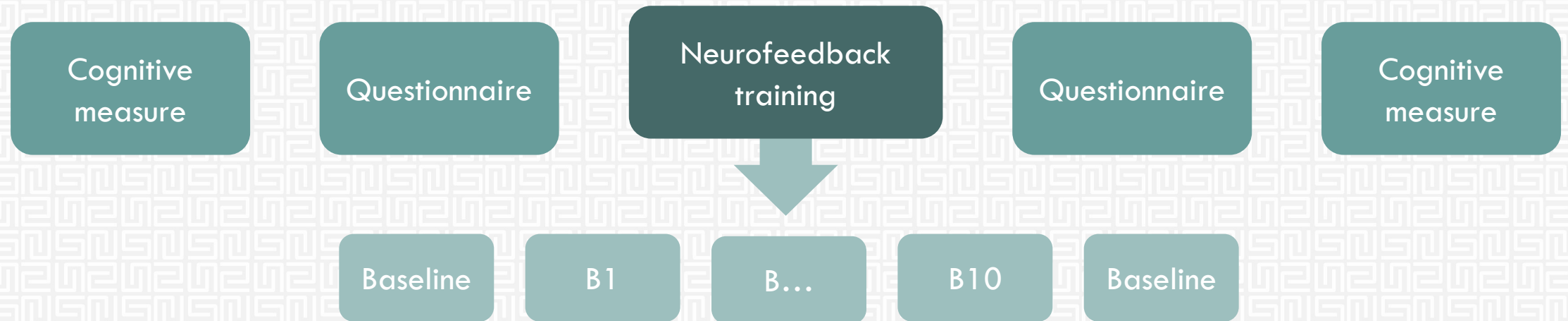
- 1. The group with 3 training by week will have a better score on the cognitive measure the group with only one training by week.**
- 2. It will be easier for the group with 3 training by week to modulate their alpha waves than the group with only one training by week.**



EXPERIMENTAL DESIGN

EXPERIMENTAL DESIGN

Average time : 120 min



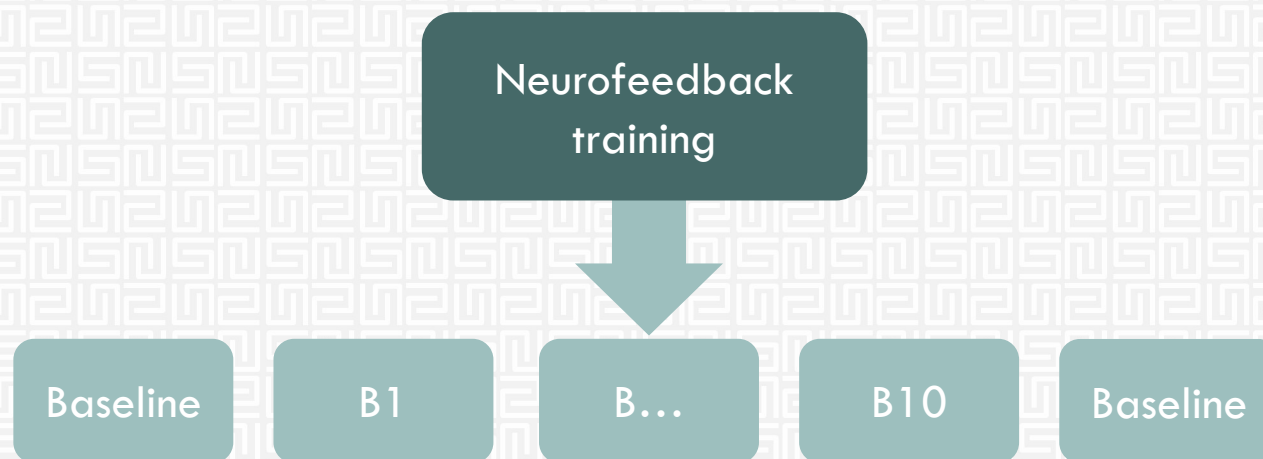
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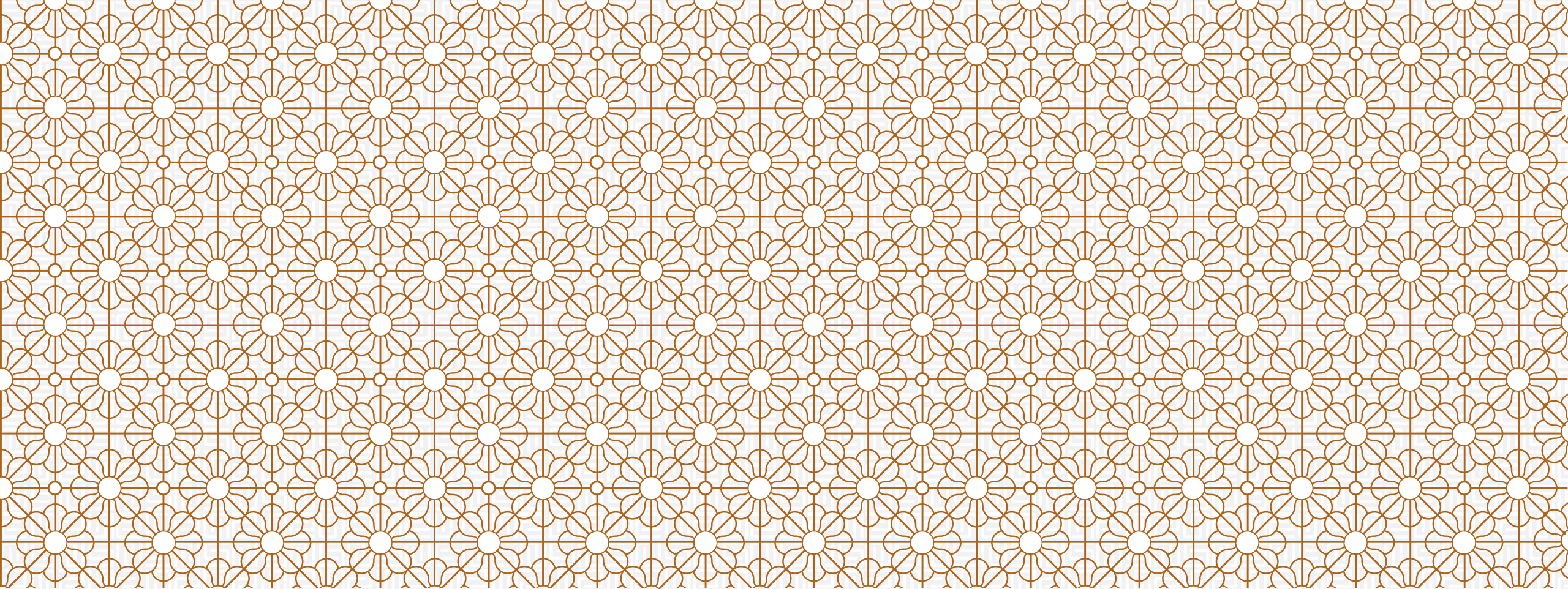
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EXPERIMENTAL DESIGN

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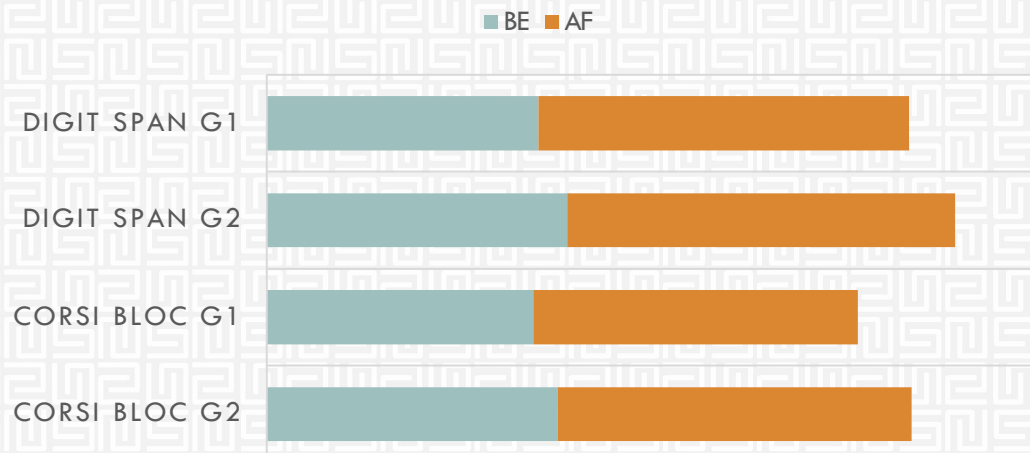


EXPECTED RESULTS

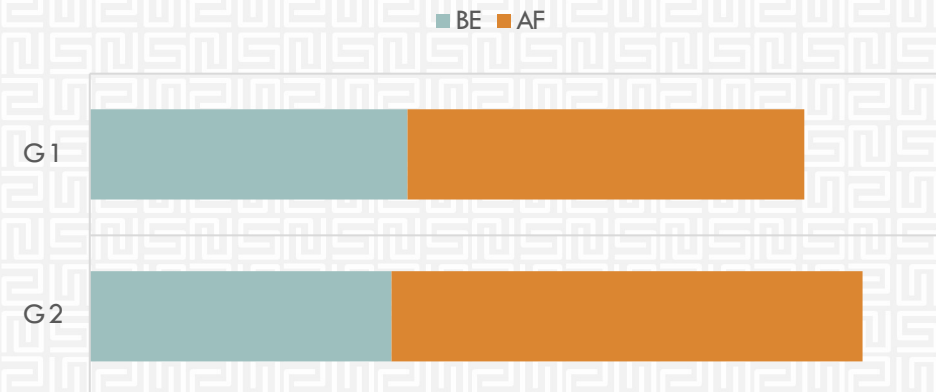
EXPECTED RESULTS

H1 : The group with 3 training by week will have a better score on the **cognitive measure** the group with only one training by week.

NUMBER OF CORRECT RESPONSE ON DIGIT SPAN AND CORSI BLOC TASKS BEFORE AND AFTER NFB TRAINING*



RATE OF CORRECT RESPONSE FOR N-BACK TASK BEFORE AND AFTER NFB TRAINING*

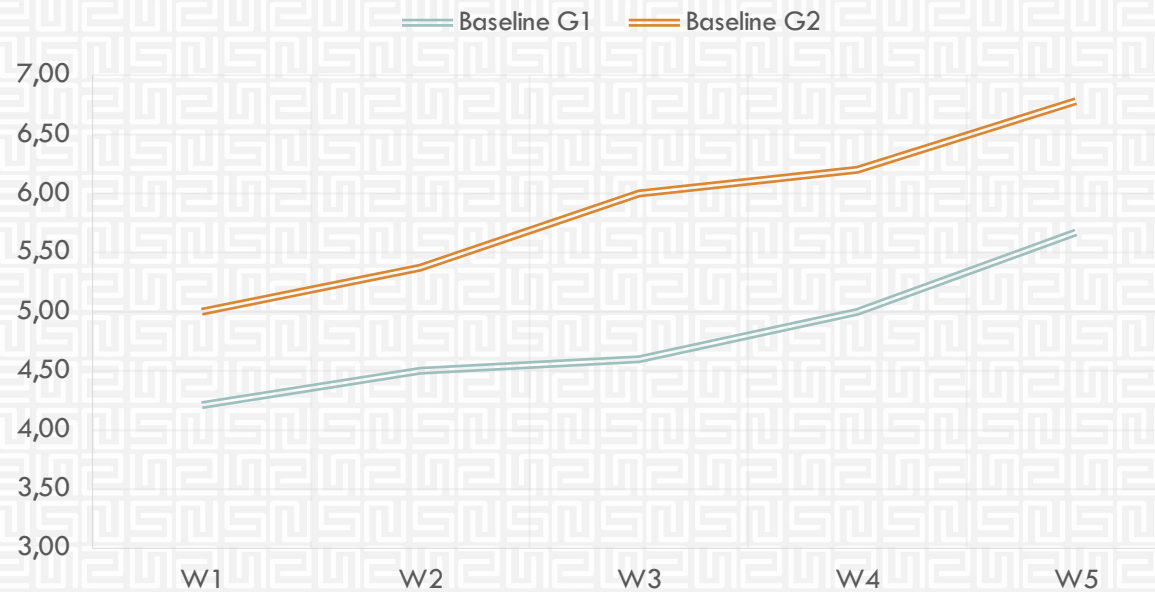


*These results are the difference between the first cognitive measure and the last of the whole session

EXPECTED RESULTS

H2 : It will be easier for the group with 3 training by week to modulate their **alpha wave** than the group with only one training by week.

MEAN OF B2-B1 BY WEEKS



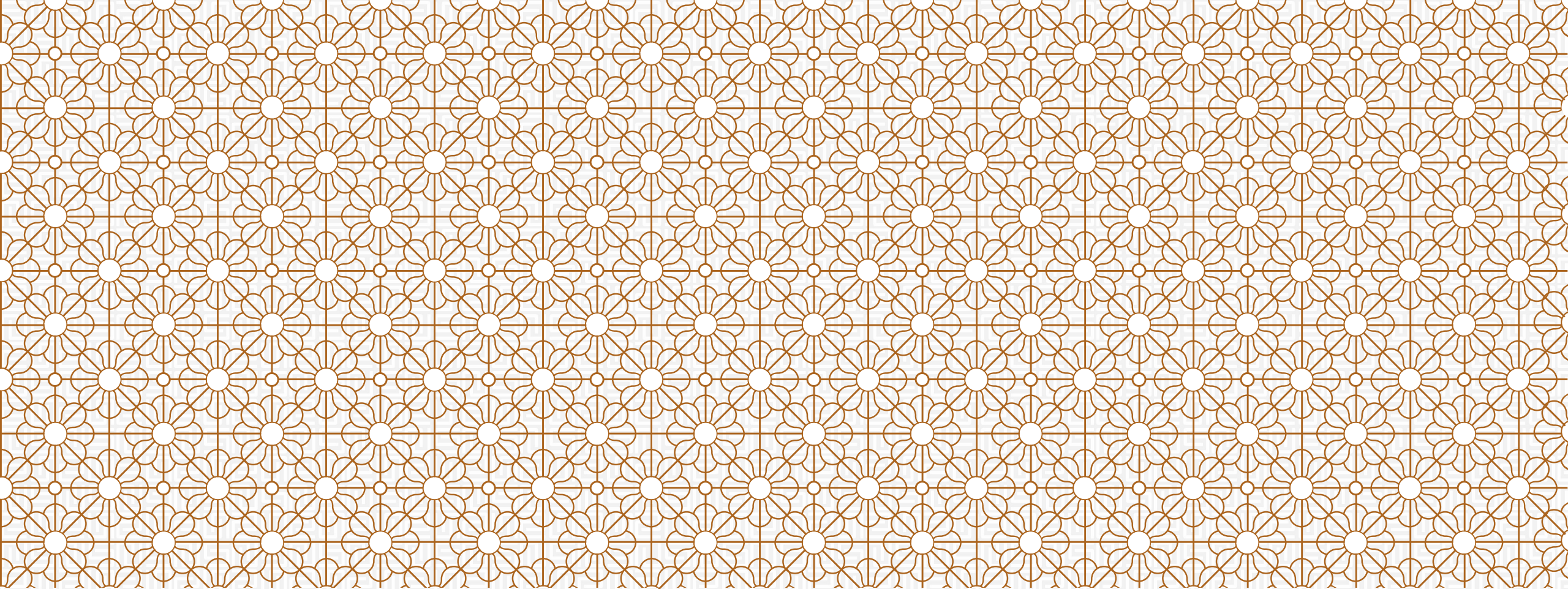
TO EXPLORE...

Questionnaire

- Cognitive load?
- Motivation?

During the training

- The strategies used to modulate the alpha wave ?



LIMITATIONS

LIMITATIONS

- Accessibility ?
- In an ecologic environment ?
- Habituation effect to the task
- Transfer these performances to other tasks ?
- Is it durable ?

Thank you for your attention !



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