

Cognitive neuroscience of people with depression

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Brief C.V. of the speaker

- ❑ **Ph.D in Psychology (Cognitive neuroscience), Institute of Psychiatry, Psychology, and Neuroscience (IOPPN), King's College London, England, supported by Royal Thai government.**
- ❑ **Visiting Fellow at Institute of Psychology, Karl-Franzens-University of Graz, Austria (2561), supported by ASEA-UNINET and OHEC (Dyscalculia: fMRI and eye-tracking device)**
- ❑ **British Academy Visiting Fellow at Department of Experimental Psychology, University of Oxford, England (2560-2561), supported by British academy and TRF (Dyscalculia: Brain stimulation – tDCS, tACS, & tRNS)**
- ❑ **Visiting Scholar at College of Medicine, Seoul National University, Republic of Korea (2562), supported by National Research Foundation of Korea (NRF) and NRCT (Mild cognitive impairment: EEG, photobiomodulation, cohort study)**



Outline of the talk

Cognitive processes of people with depression.

Electrophysiological markers of people with depression.

A multi-tasking assessment: Task design.

Main results for behavioral data

Main results for electrophysiological data (EEGs & ERPs)

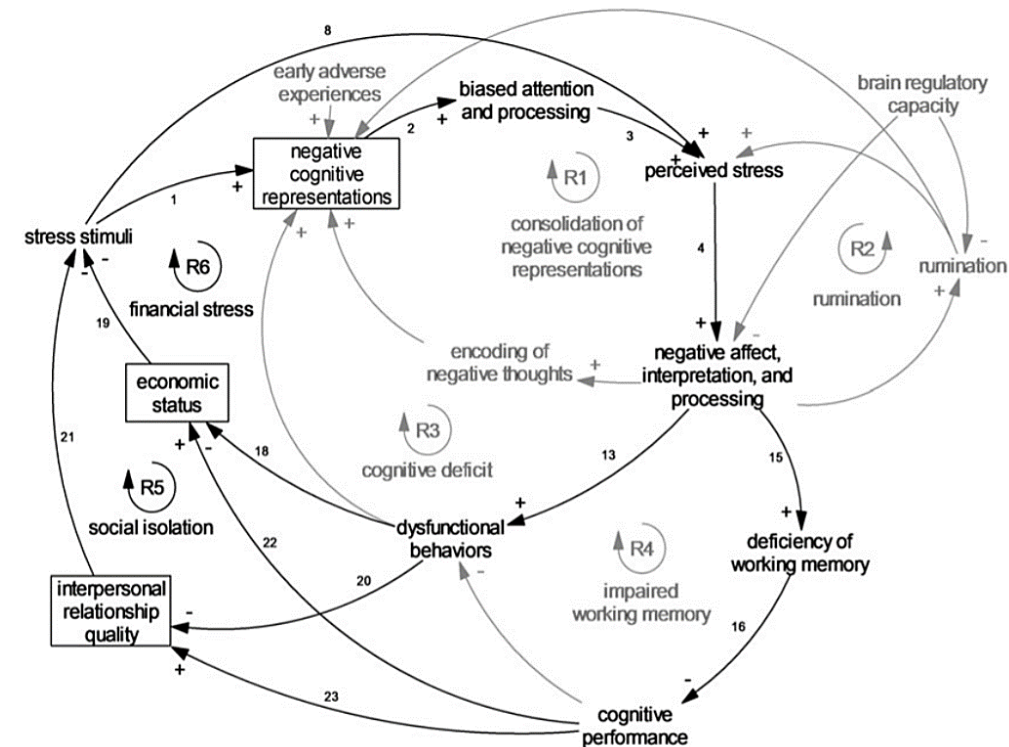
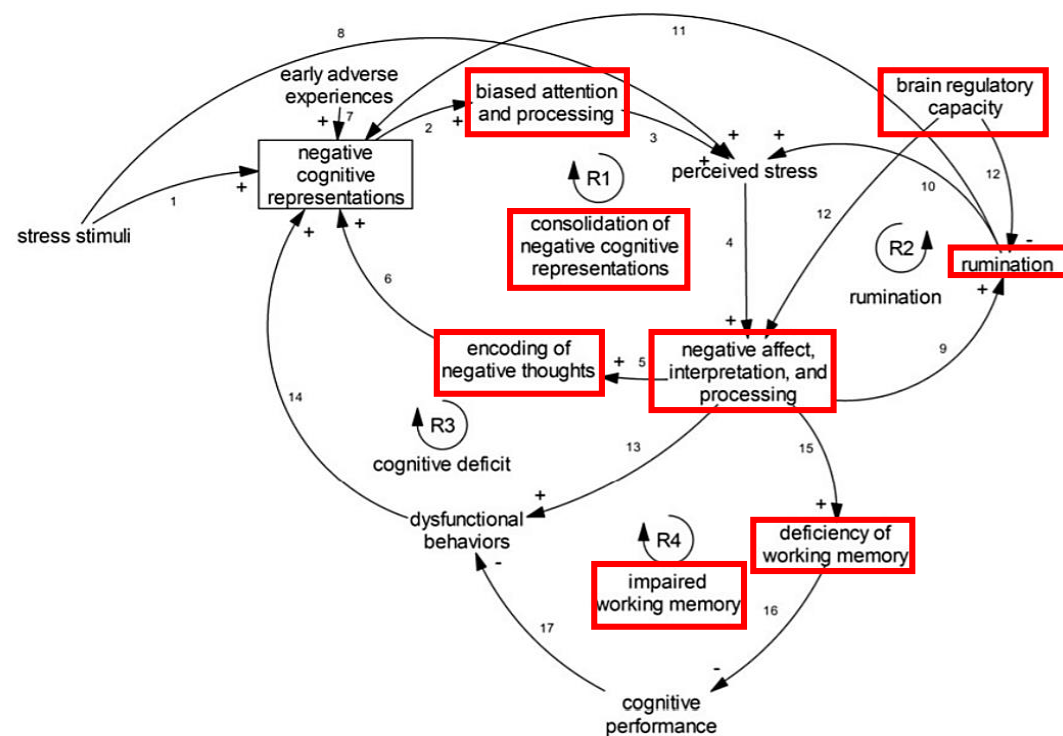
Future studies

Cognitive processes of people with depression

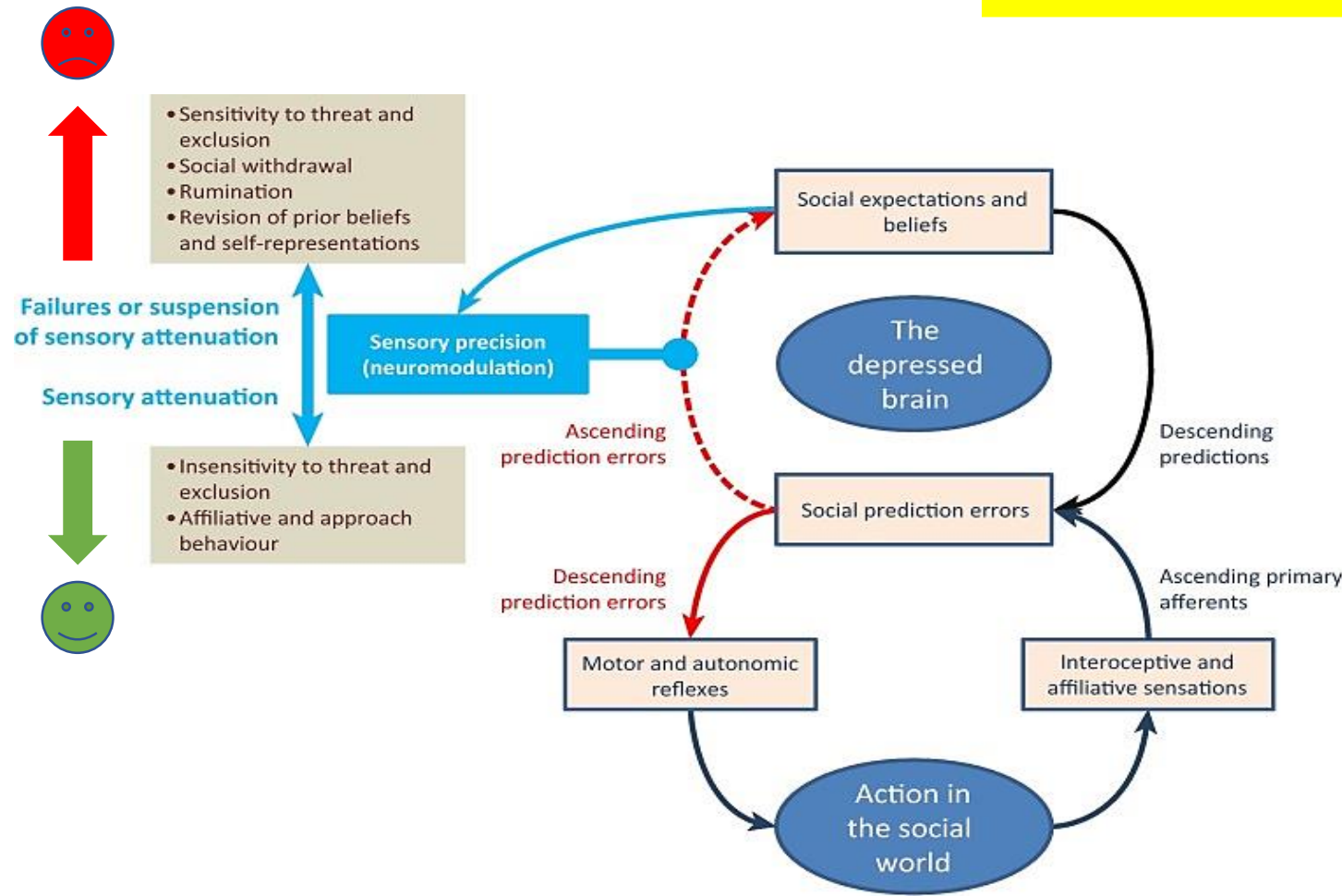


Cognitive processes of people with depression

“Clinicians who treat depression tend to work on a trial-and-error basis, whereas this model could give them a more systematic and effective method for making decisions about treatment”



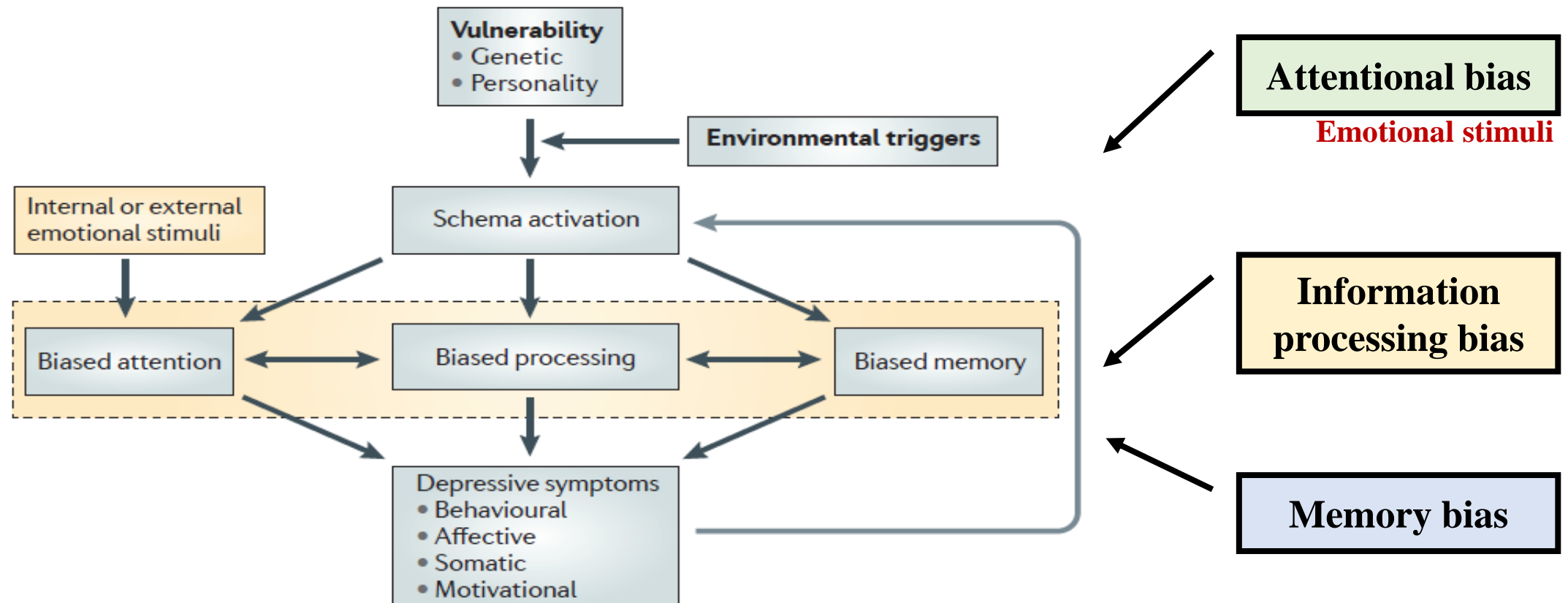
Cognitive processes of people with depression



*We suggest that psychopathology typically arises from ineffectual attempts to alleviate interpersonal difficulties and/or **hyper-reactive neurobiological responses to social stress (i.e., uncertainty)**, which often stems from early experience that social uncertainty is difficult to resolve.*

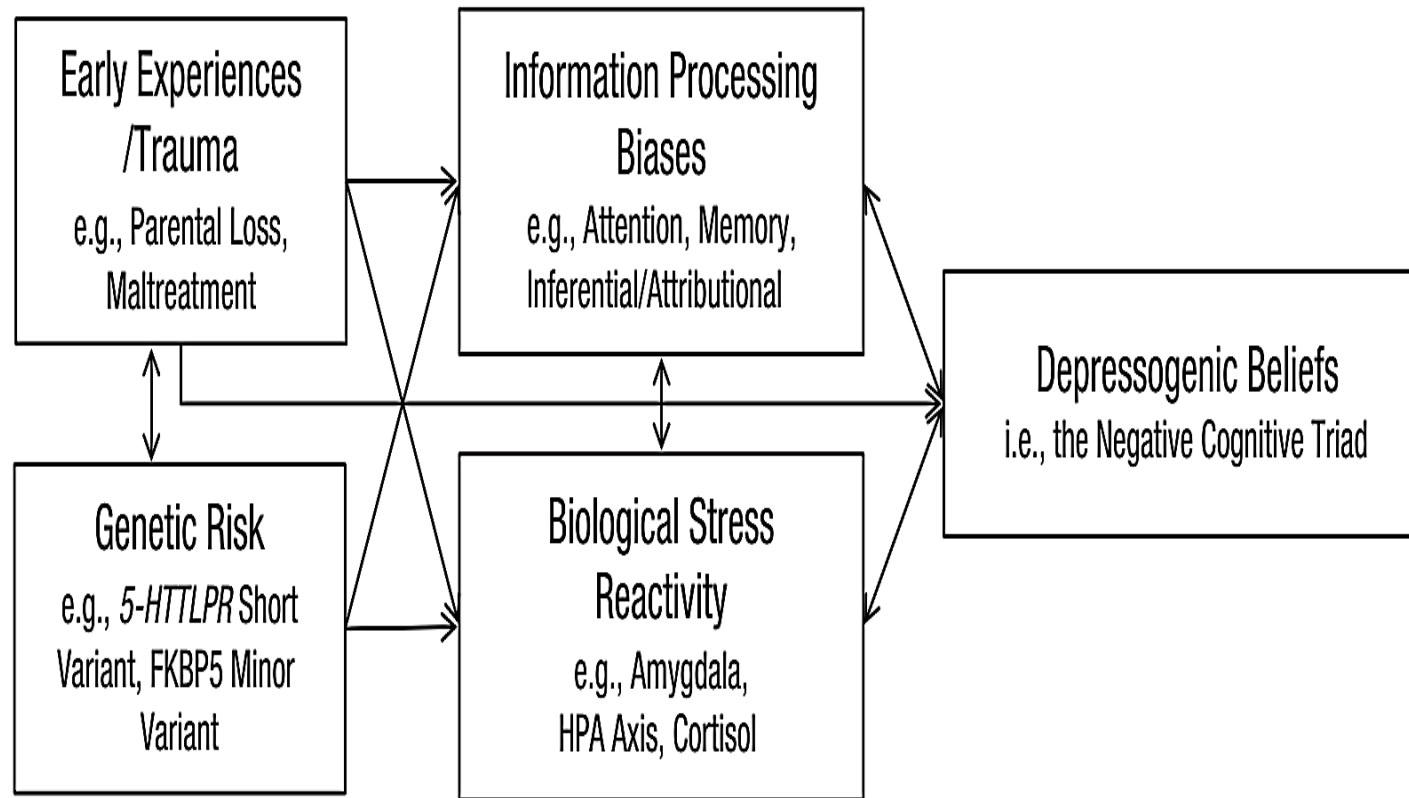
Cognitive processes of people with depression

Information processing in the cognitive model of depression



Disner, Beevers, Haigh, & and Beck (2011)

Cognitive processes of people with depression



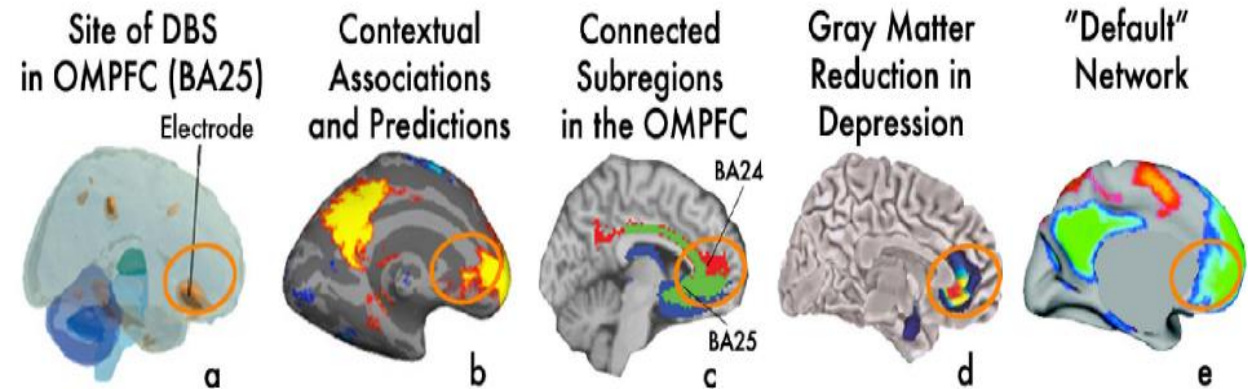
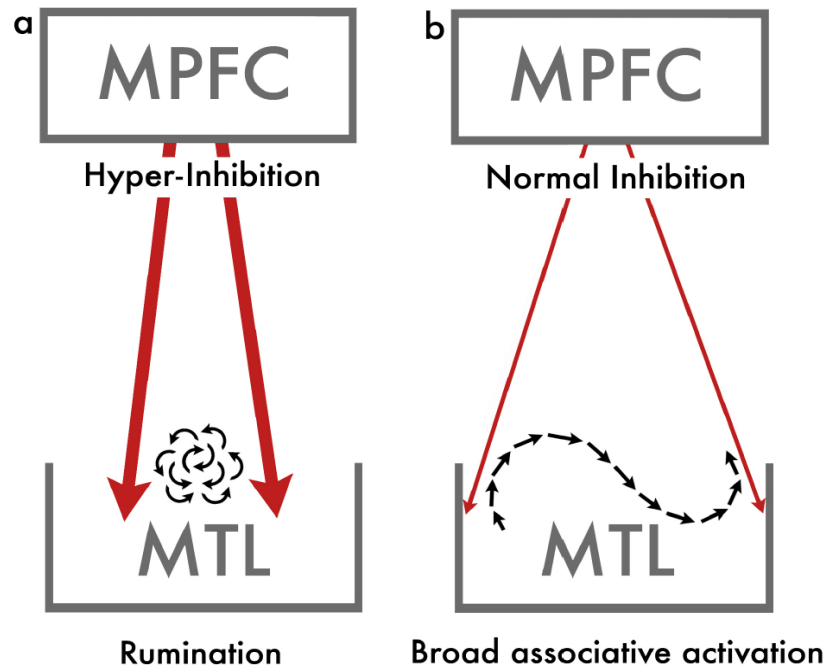
*Tendencies to **process information negatively** and experience strong biological reactions to stress (resulting from genes, trauma, or both) can lead to depressogenic beliefs about the self, world, and future. These tendencies are mediated by alterations in brain areas/networks involved in **cognition and emotion regulation**.*

Beck & Bredemeier, 2016



Biased processing of emotional stimuli. Once stimuli have been perceived from the environment, the cognitive model predicts that individuals with depression will show particular awareness for negative aspects of the stimuli.

Cognitive processes of people with depression



Converging activations in MPFC

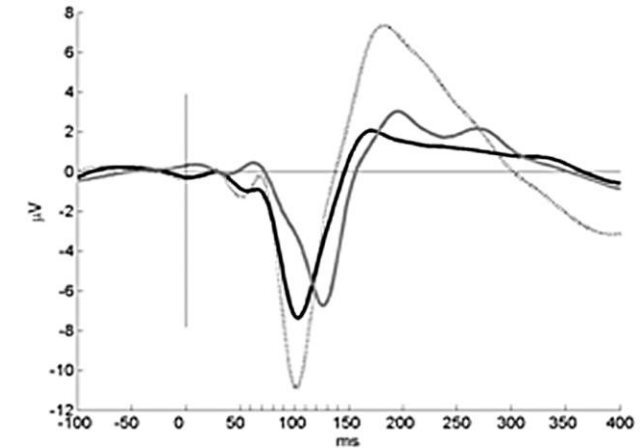
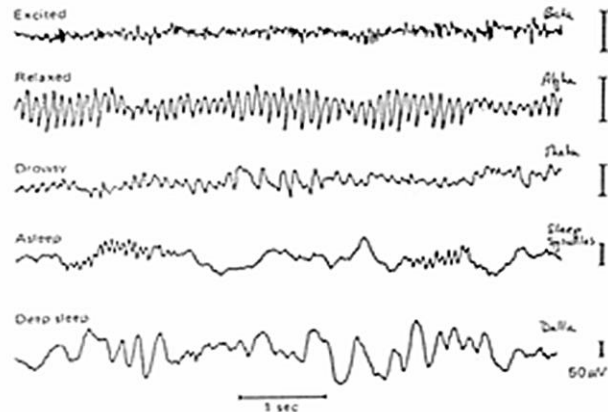
Bar, 2009

Such constrained thought is proposed here to stem from hyper-inhibition from the medial prefrontal cortex (MPFC) to the medial temporal lobe (MTL).

Electrophysiological markers of people with depression



Electrophysiological markers of people with depression



Temporal precision(ms), noninvasive, integrated brain dynamics (EEGs), specific brain processing (ERPs)

Progression of depressive symptoms

Response to the treatment

Cognitive processes of people with depression

EEG biomarkers of depressive symptoms

Delta band wave (0-4 Hz): It implied that the decrease in delta activity in major depression may indicate impairment of the **connection between the frontal and parietal/temporal/occipital regions**

Theta band wave (4-8 Hz) activity is related to the activity of the anterior cingulate cortex (ACC). The rostral ACC (rACC) has been found to play roles in assigning emotional valence to internal and external stimuli and emotional expression.

Alpha band wave (8-12 Hz): An decreased alpha activity has traditionally been interpreted to reflect decreased neural inactivity (Alpha 1) Elevated EEG alpha activity manifested depressive pathophysiology (Alpha 2).

Segrave et al., (2011); Schiller (2019); Alexander et al., (2019)

Cognitive processes of people with depression

ERPs biomarkers of depressive symptoms

P100 and P200: selective attention (P50 sensory gating).

P100 is more sensitive to stimulus features (feature-based attention) and arousal levels.

P200 is often associated with the motivational salience of a stimulus.

N200: Cognitive inhibitory control, stimulus identification and distinction.

P300: Updating of working memory and selective rehearsal.

Luck (2015); Xie, Jiang, & Zhang (2018)

A multi-tasking assessment: Task design



Task design

- **Hamilton rating scale for depression (HAM-D) – Thai version.**

Inter-rater reliability = 0.87 and Cronbach's alpha coefficient = 0.74

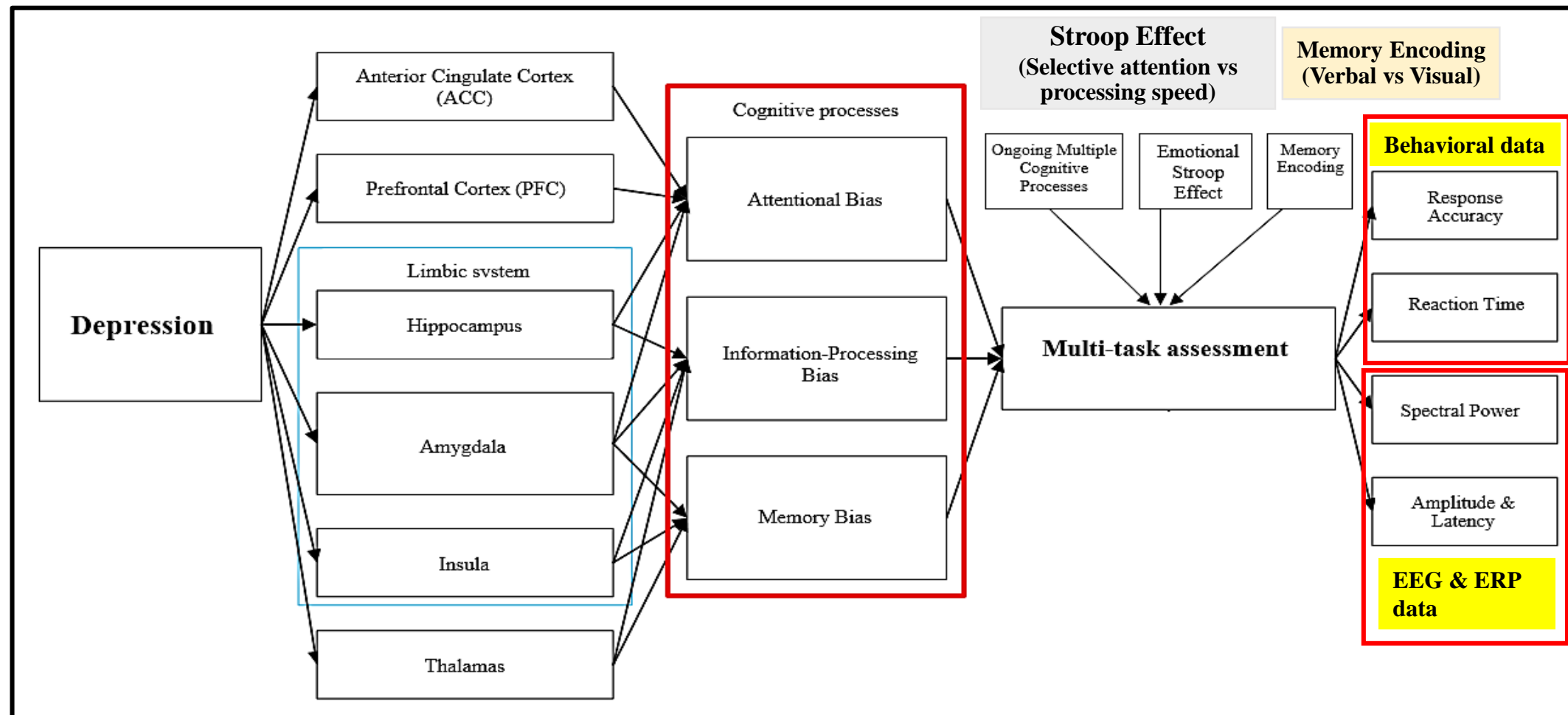
- **Patient Health Questionnaire (PHQ-9) I and II – Thai version.**

Cronbach's alpha coefficient = 0.79 (PHQ-9 I) and = 0.71 (PHQ-9 II)

- **Beck Depression Inventory II (BDI-I and II) – Thai version**

Test-retest= 0.74 and Cronbach's alpha coefficient = 0.93 for BDI I

Task design

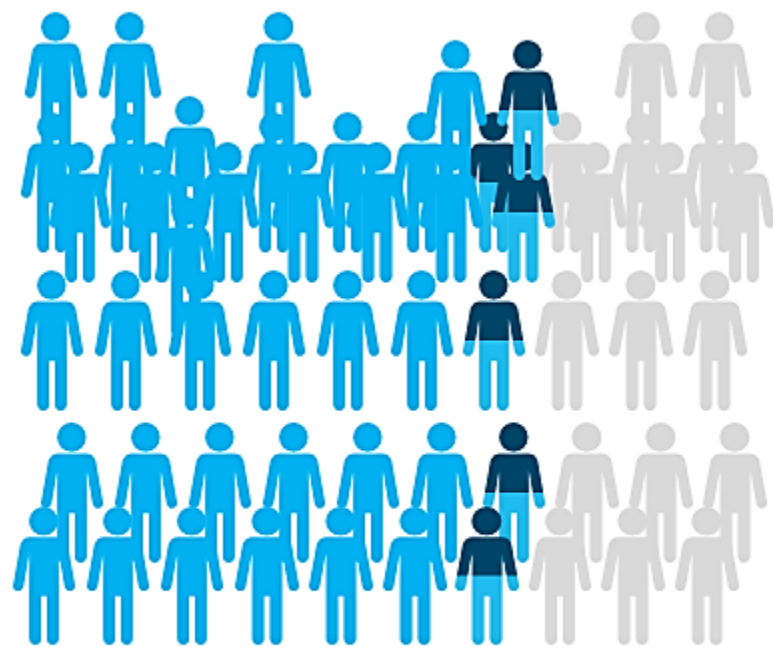


Task design

- **Participant:** 88 People who were diagnosed with depression by psychiatrist at Ang Sila Health Promoting Hospital in Chon Buri province, Thailand.
- All participants gave written informed consent, and the study was approved by the **Burapha University research ethics committee**.
- Interview and PHQ-9 were used to classified the severity of depression.



Task design



Initial sample = 350 people

PHQ- 9 Screening



Minimal depression = 30 people



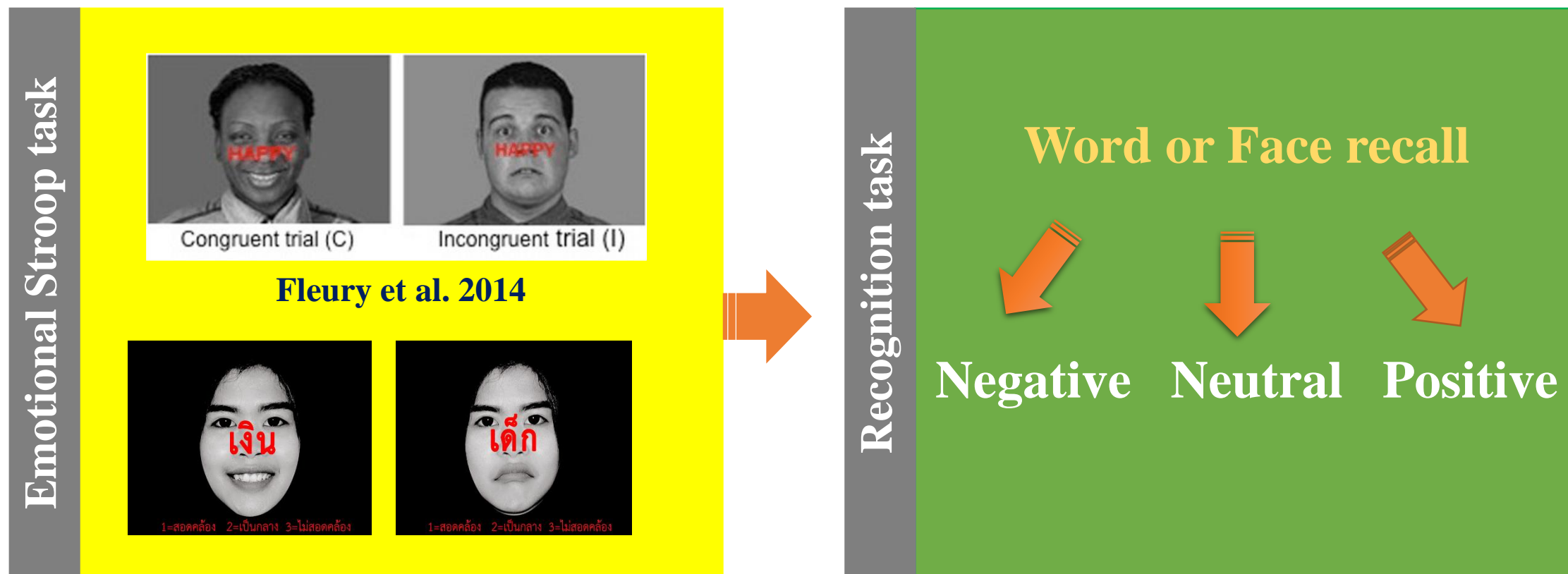
Mild depression = 29 people



Moderate depression = 29 people

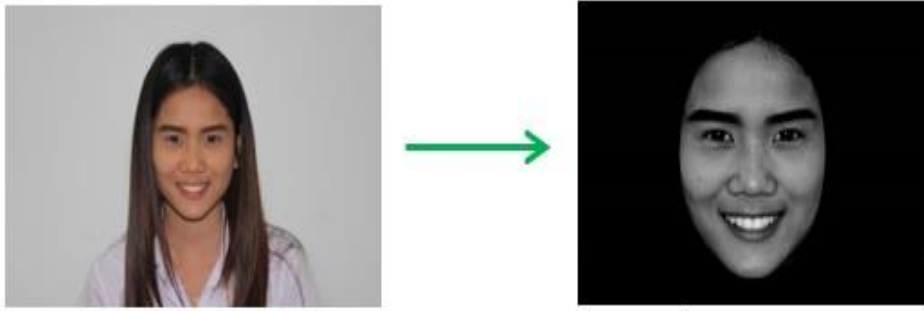
Task design

The multitask (Emotional Stroop task and recognition task)

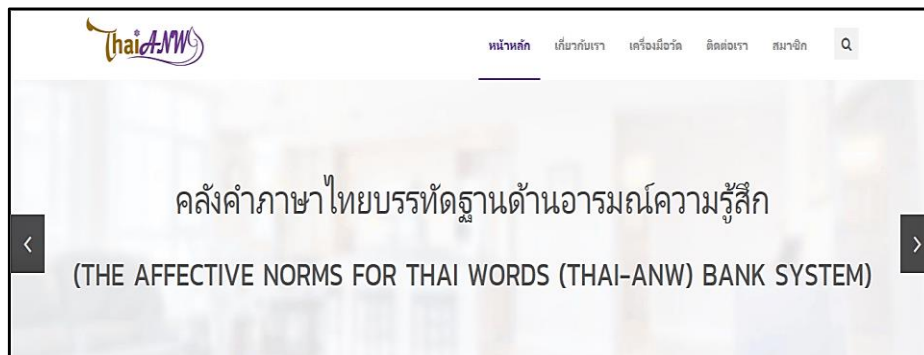


Task design

The multitask (Emotional Stroop task and recognition task)



We took photos from 38 male and female undergraduate from two universities (Esan Technology University and Nakornpanom University).



Thai-ANW Bank system contains 528 words consisting of three dimensions of emotion (Valence, Arousal, and Dominant: VAD model) (Ngamprom, Chadcham, & Wongupparaj, 2018).

Task design

The multitask (Emotional Stroop task and recognition task)

Facial stimulus



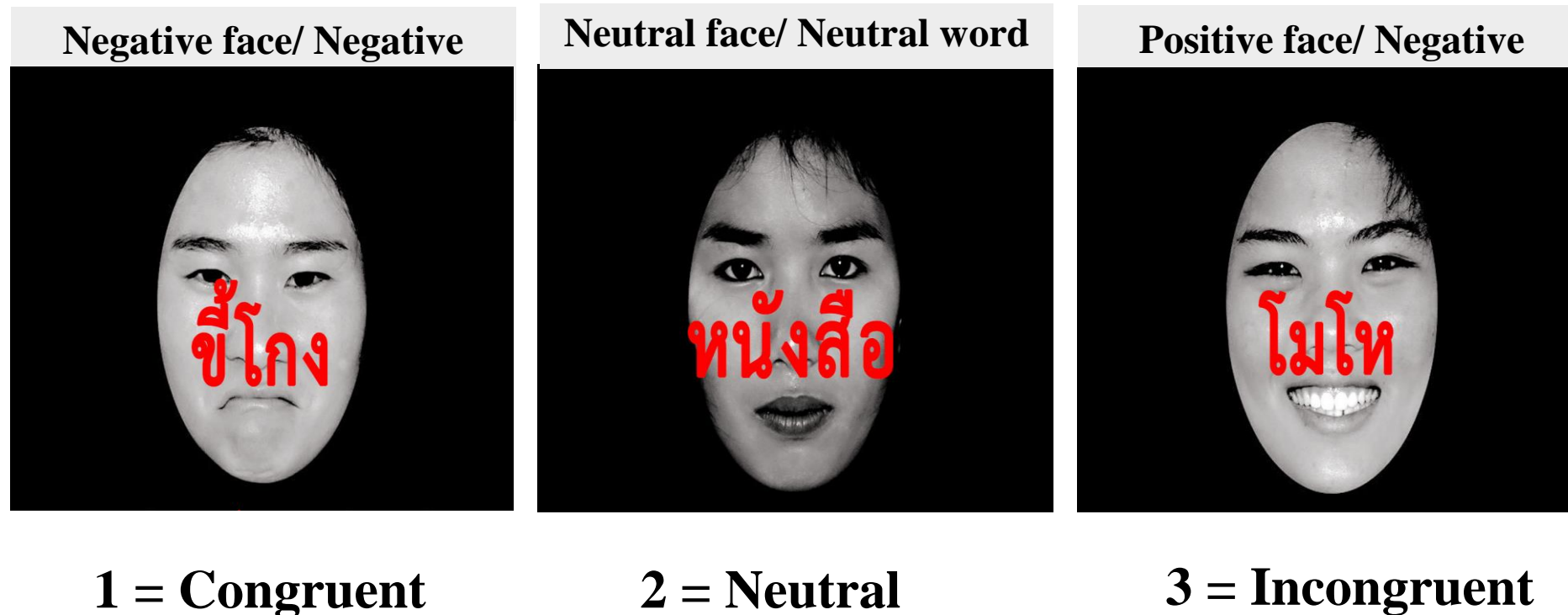
Thai affective word

The facial stimuli were modified by Photoshop and these photos were divided into three types of emotional expression (Negative, Neutral, and Positive). The picture size is 960*720 millimeters and the picture solution is 96 dpi.

The word stimuli were written in red and placed at the middle of the facial stimuli (Delle-Vigne, Wang, Kornreich, Verbanck, & Campanella, 2014, pp. 171-173; Isaac et al., 2012, p. 76). The front size was 48 inches and the front style was TH SarabunPSK (the official front in Thailand).

Task design

The multitask (Emotional Stroop task):
180 stimuli (58 congruent, 33 neutral, and 93 incongruent)



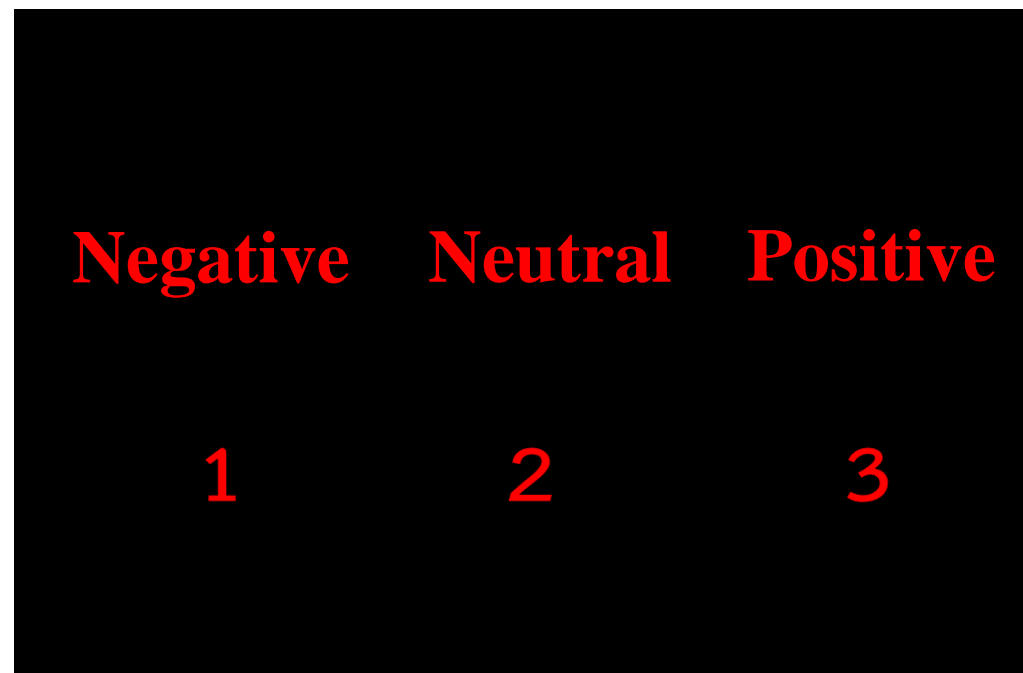
Task design

The multitask (Recognition task):

180 stimuli (80 negative, 51 neutral, and 49 positive)



Facial recognition

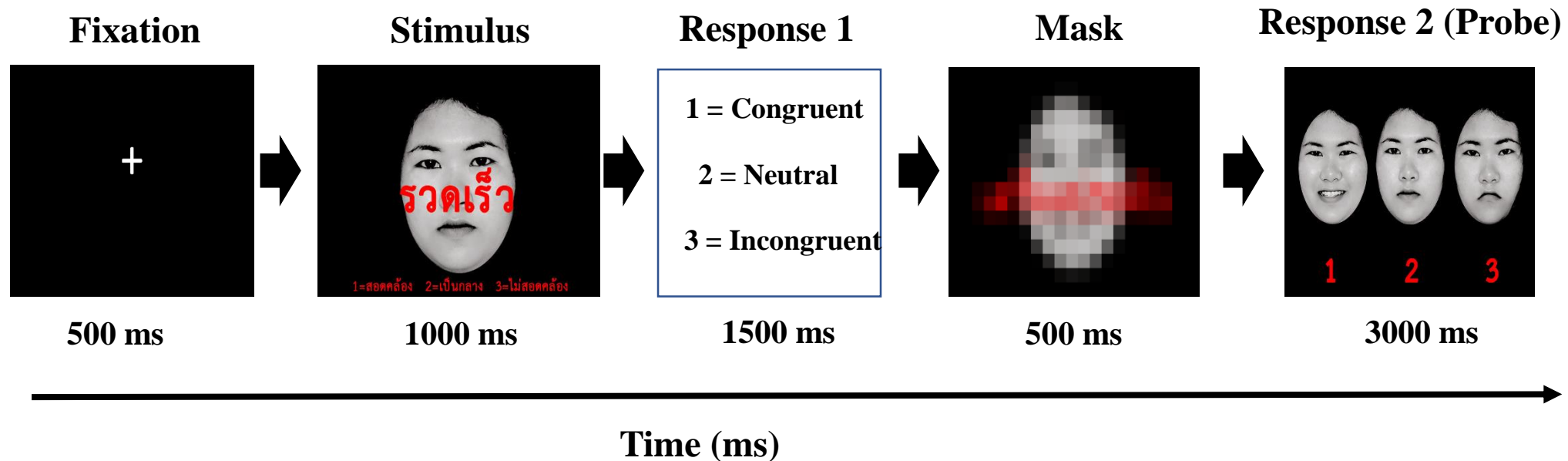


Word recognition

Task design

The multitask (Emotional Stroop and recognition task):

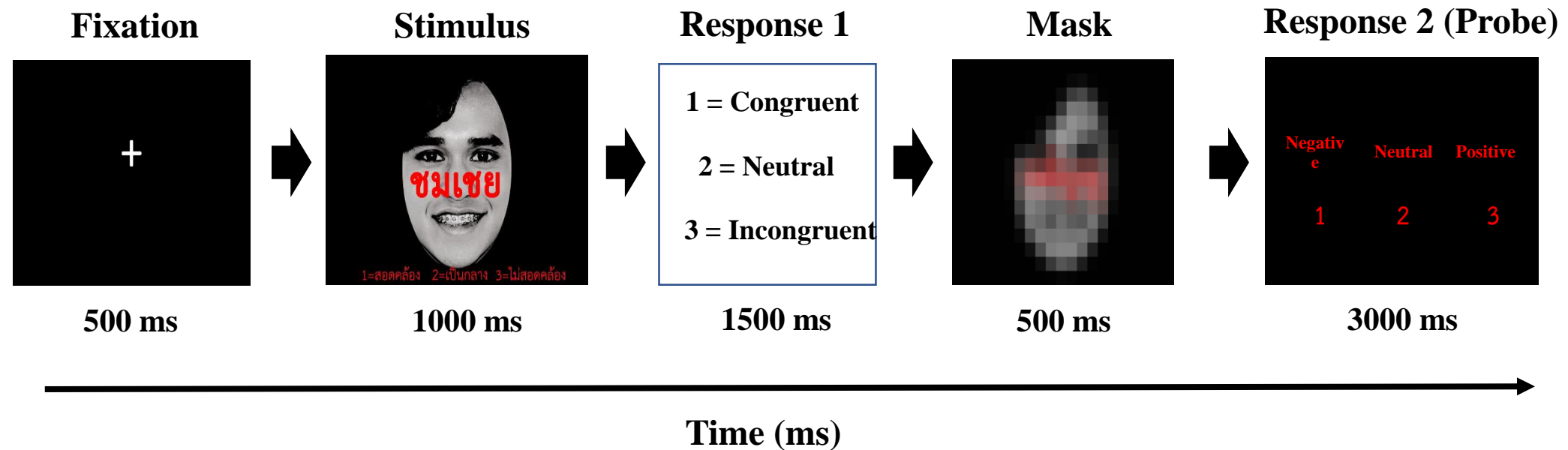
Block 1: Emotional Stroop and face recognition (180 trials)



Task design

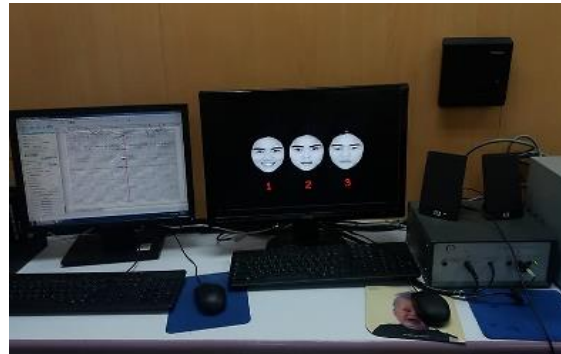
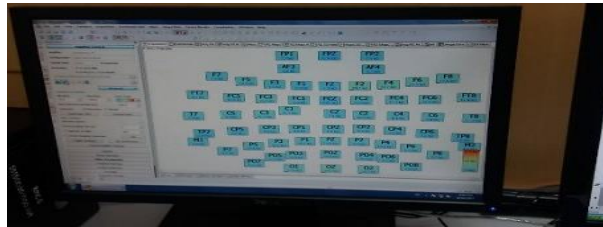
The multitask (Emotional Stroop and recognition task):

Block 2: Emotional Stroop and word recognition (180 trials)



Task design

Electrophysiological Recording and Analysis

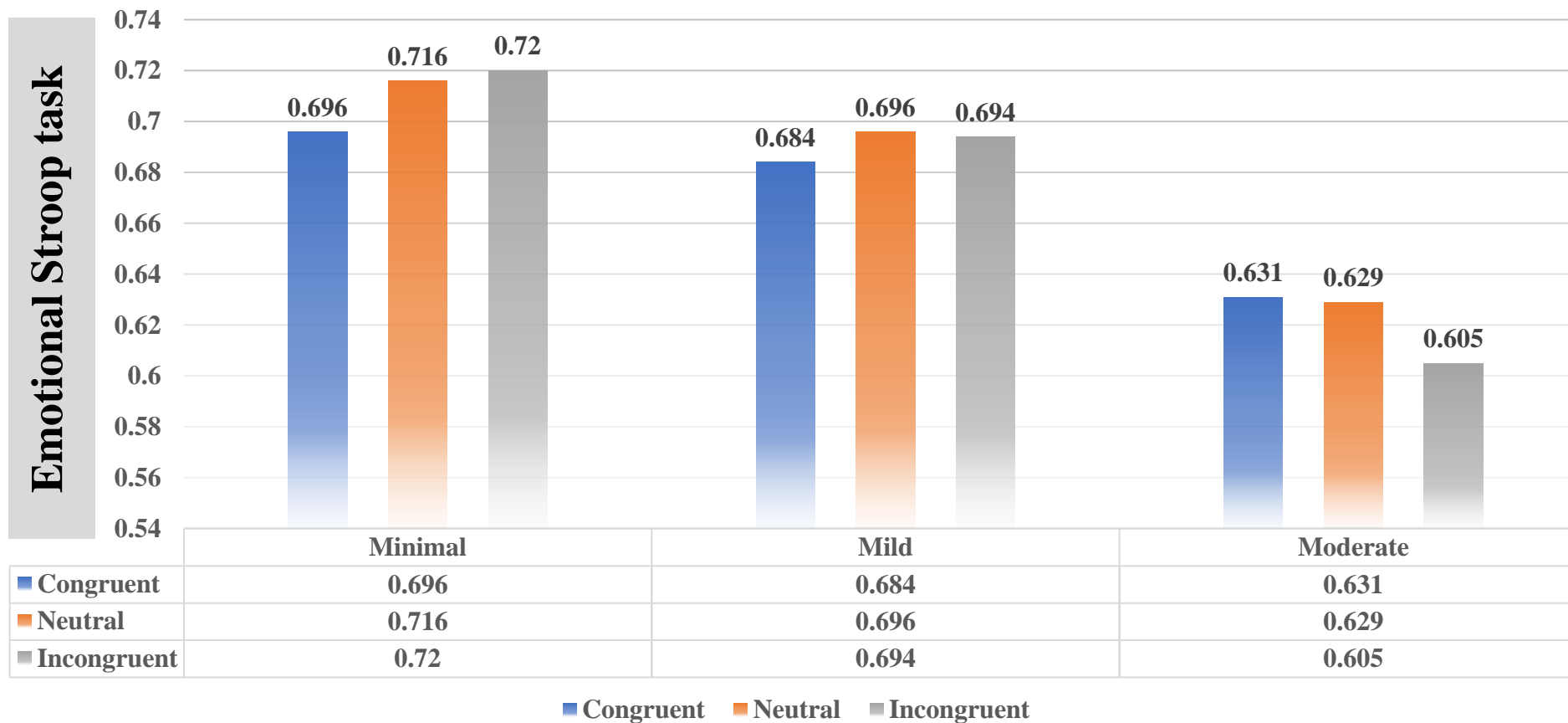


Main results for behavioral data



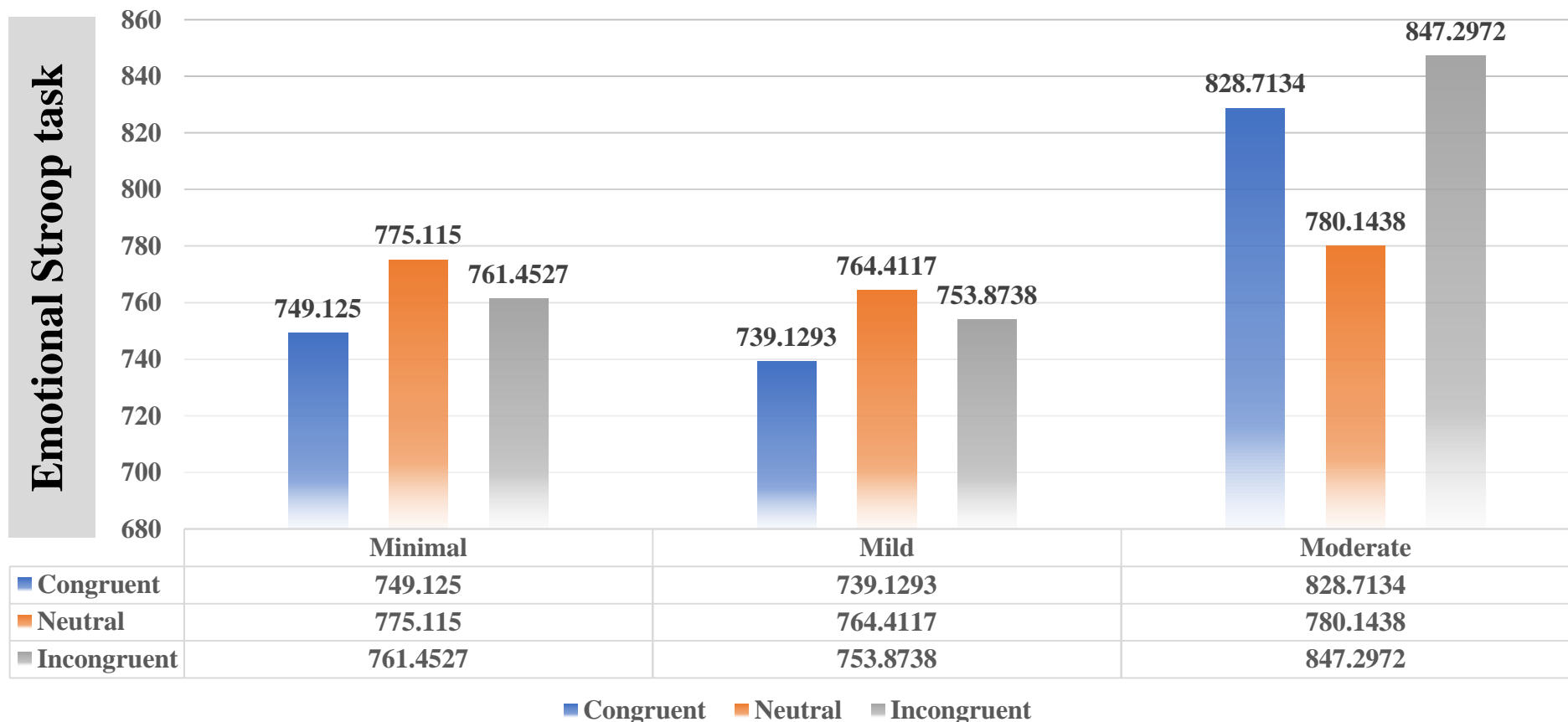
Results

Behavioural results (Response accuracy)



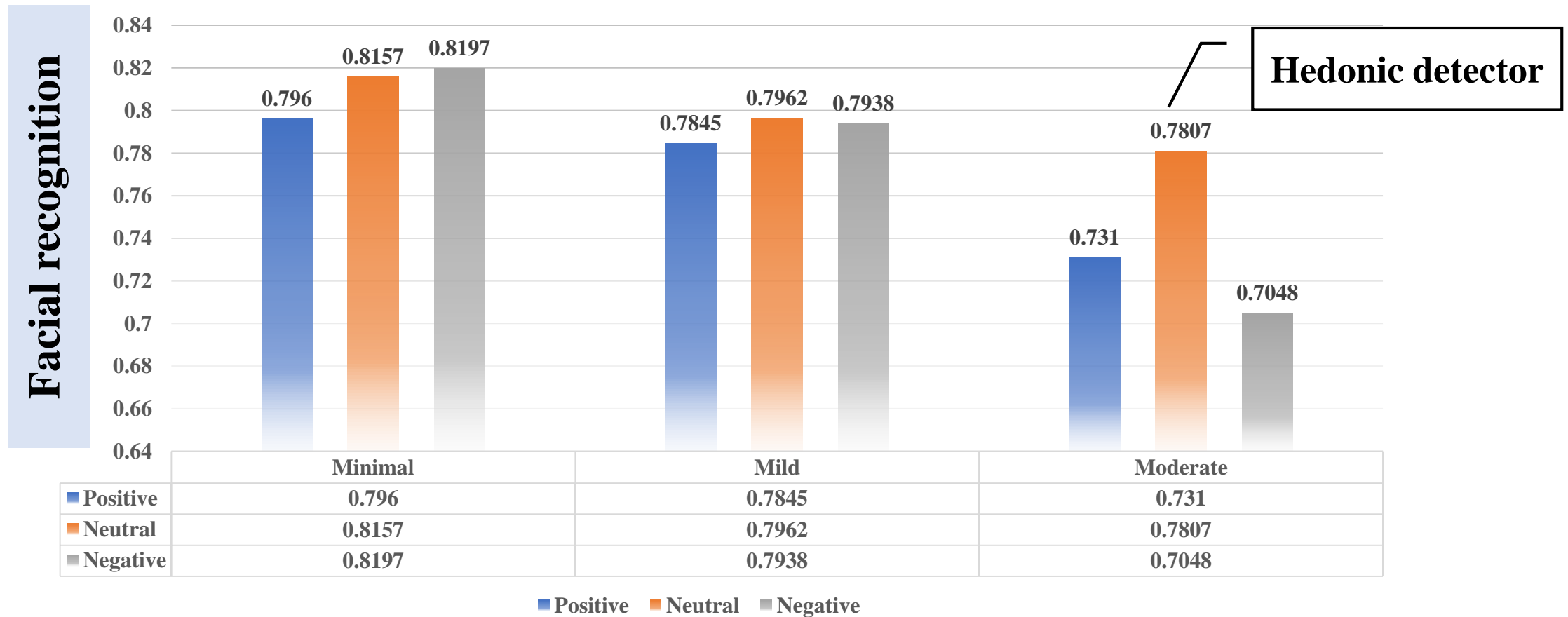
Results

Behavioural results (Reaction time)



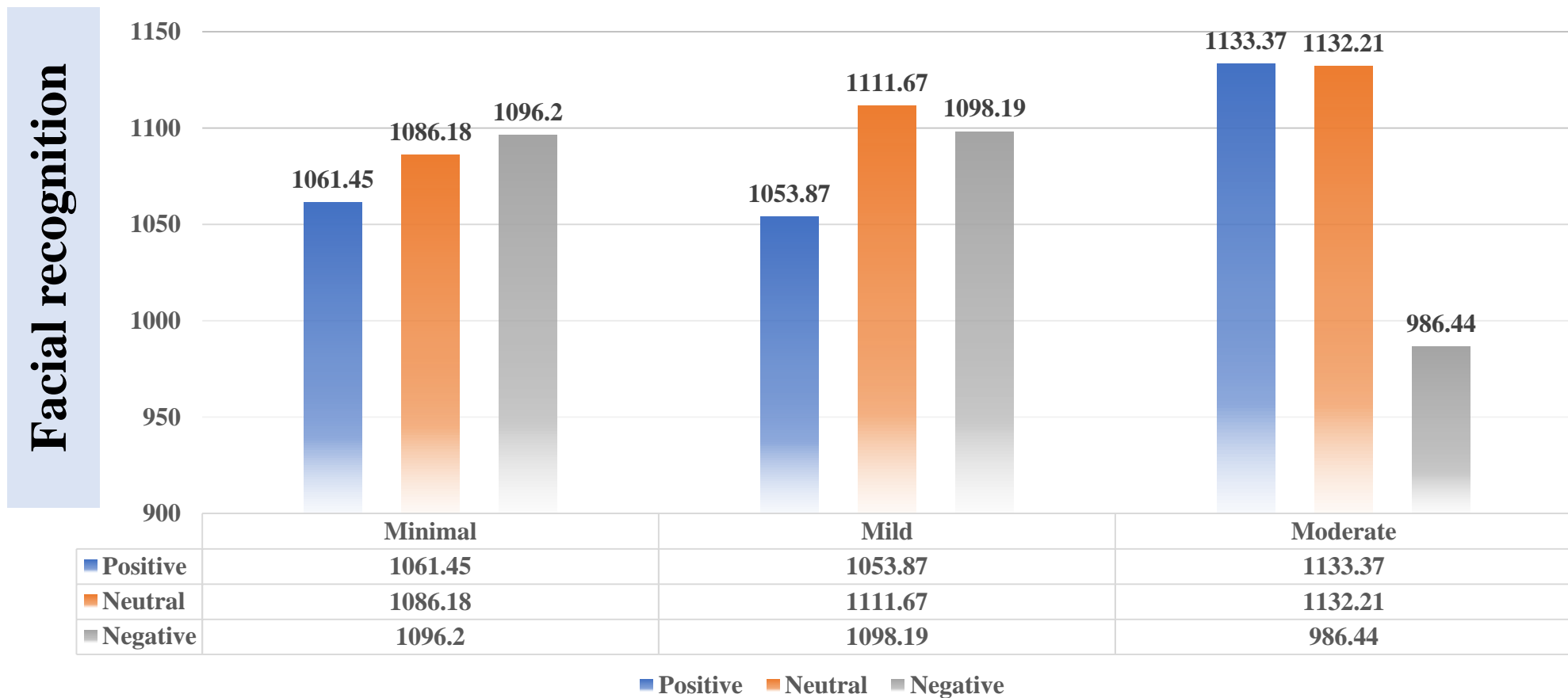
Results

Behavioural results (Response accuracy)



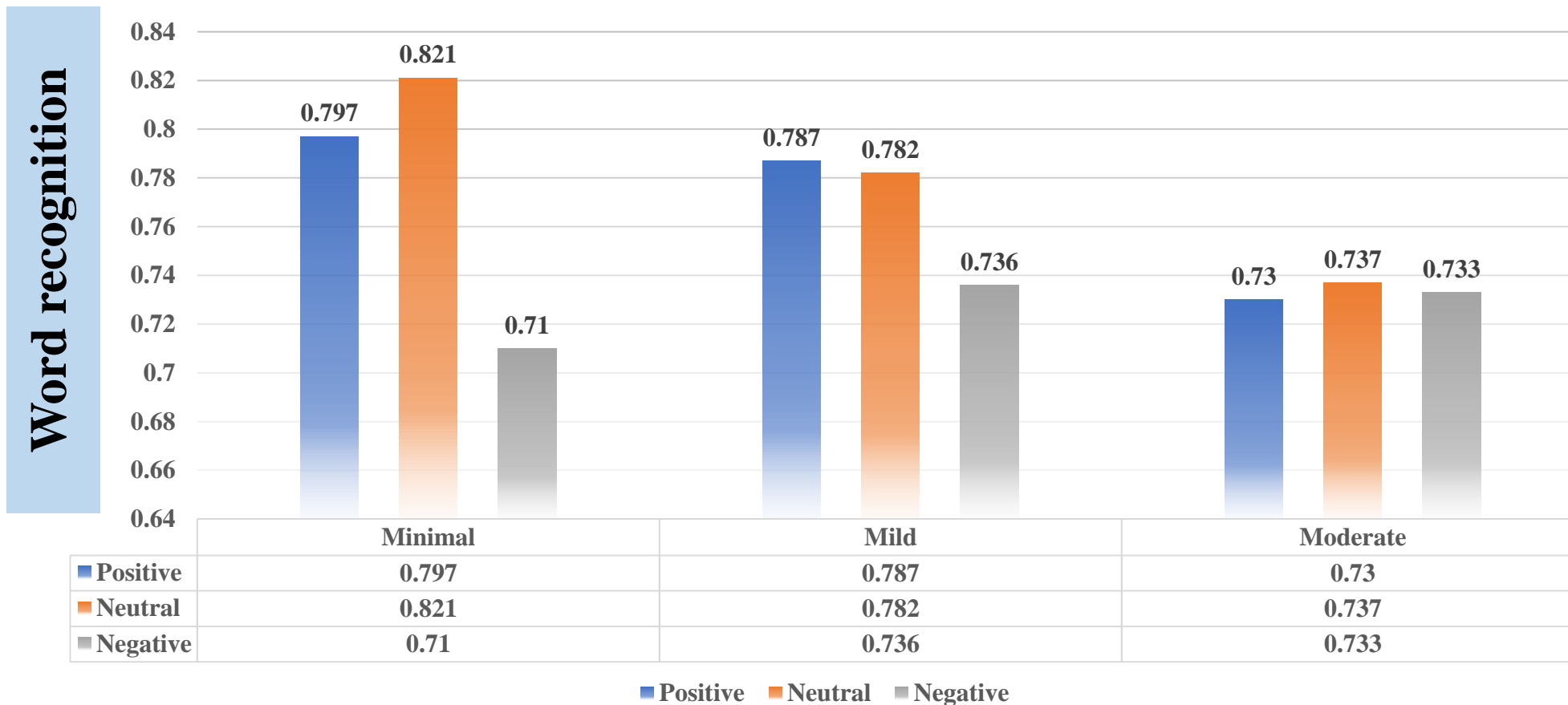
Results

Behavioural results (Reaction time)



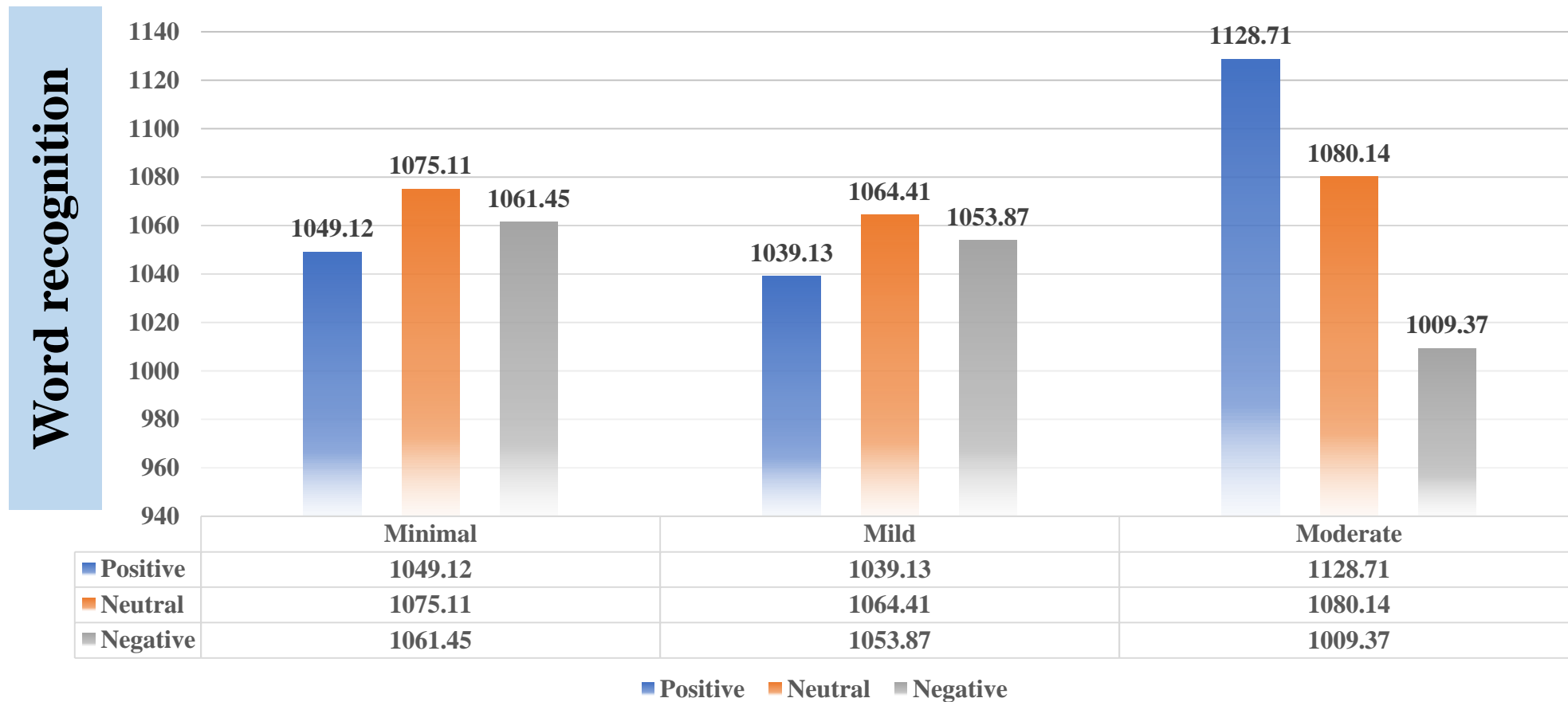
Results

Behavioural results (Response accuracy)



Results

Behavioural results (Reaction time)



Results

Summary of the findings

Task and response	Effect size
Emotional Stroop task: Response accuracy	0.020
Emotional Stroop task: Reaction time	0.128*
Facial recognition task: Response accuracy	0.020
Facial recognition task: Reaction time	0.317*
Word recognition task: Response accuracy	0.048
Word recognition task: Reaction time	0.160*

* $p < .05$

Main results for electrophysiological data (EEGs & ERPs)



Results

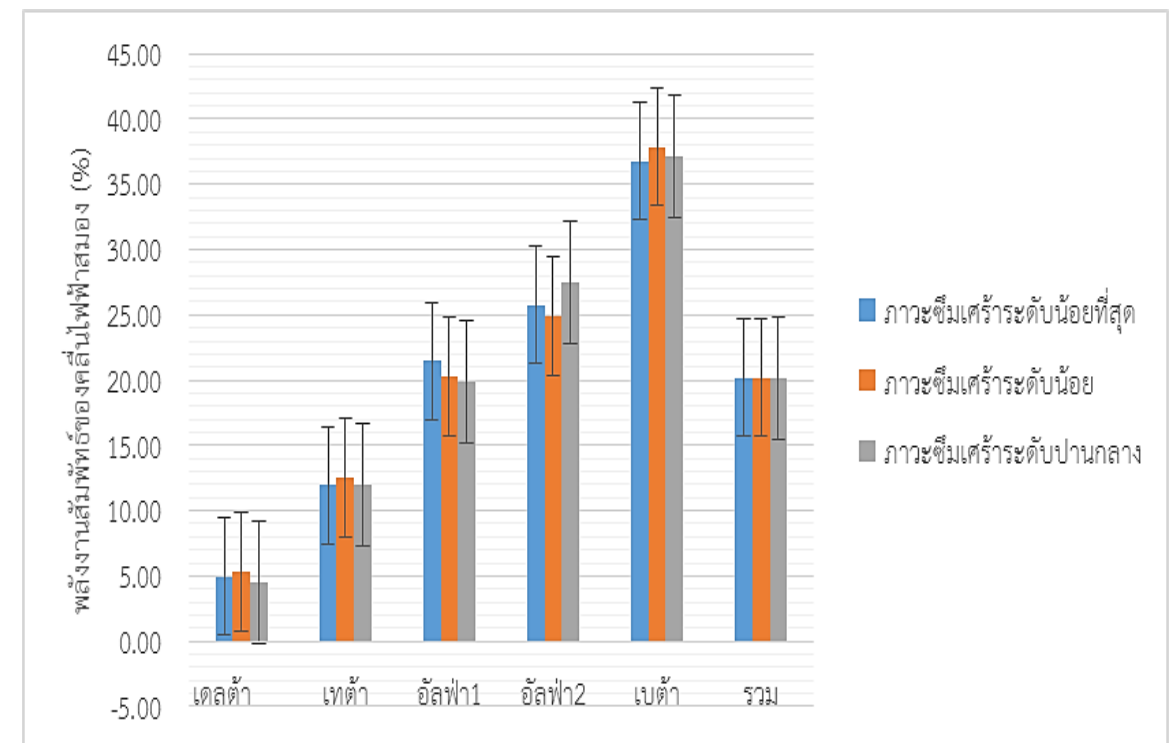
Resting-State EEG Relative Power (RP)

ผลรวมเฉลี่ยพลังงานสัมพัทธ์ของคลื่นไฟฟ้าสมอง (%)									
กลุ่ม	กลุ่มภาวะซึมเศร้า ระดับน้อยที่สุด (n=30)		กลุ่มภาวะซึมเศร้า ระดับน้อย (n=29)		กลุ่มภาวะซึมเศร้า ระดับปานกลาง (n=29)		F	p	ES
	M	SD	M	SD	M	SD			
เดลต้า	3.88	0.95	4.25	0.91	4.24	0.60	1.97	.15	.21
เทต้า	9.98	0.87	10.07	1.05	9.86	1.48	.24	.79	.08
อัลฟ่า1	21.69	1.43	21.67	1.67	21.78	2.46	.02	.98	.02
อัลฟ่า2	26.17	1.97	26.36	2.03	26.39	1.31	.13	.88	.05
เบต้า	38.09	2.95	37.74	3.80	39.09	3.48	1.22	.30	.17
รวม	19.96	0.13	20.02	0.11	20.27	0.53	7.81	.10	.39

Results

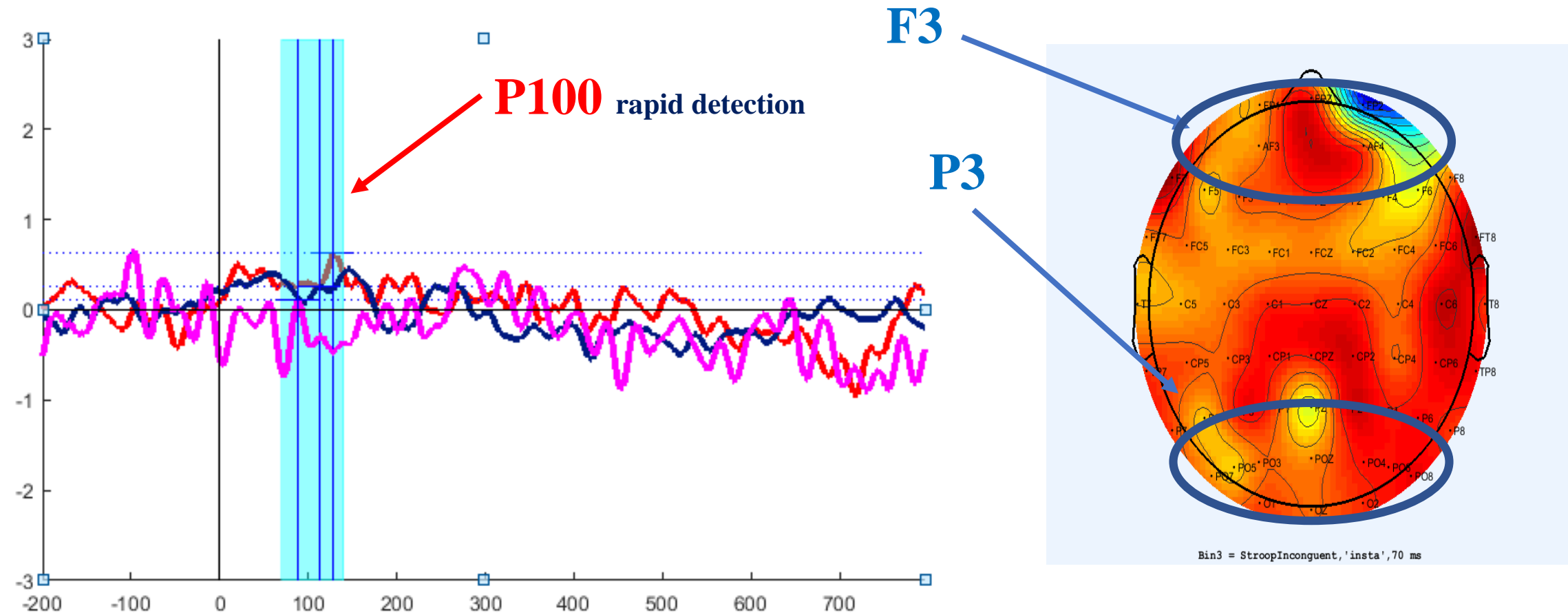
EEG Relative Power(RP) while conducting the multitask.

ผลรวมเฉลี่ยพลังงานสัมพันธ์ของคลื่นไฟฟ้าสมอง (%)									
กลุ่ม	กลุ่มภาวะซึมเศร้าระดับน้อยที่สุด (n=30)		กลุ่มภาวะซึมเศร้าระดับน้อย (n=29)		กลุ่มภาวะซึมเศร้าระดับปานกลาง (n=29)		F	p	ES
	M	SD	M	SD	M	SD			
เดลต้า	4.98	0.83	5.34	0.68	4.49	0.54	10.79	<.05	.45
เทต้า	11.97	1.07	12.55	1.04	11.94	0.87	3.44	<.05	.27
อัลฟา1	21.47	1.63	20.30	0.92	19.88	0.75	14.84	<.05	.51
อัลฟา2	25.78	2.28	24.91	1.18	27.50	1.06	19.32	<.05	.56
เบต้า	36.74	3.44	37.85	2.12	37.14	2.00	1.36	0.26	.18
รวม	20.19	1.85	20.19	1.19	20.19	1.04	1.26	0.29	.17



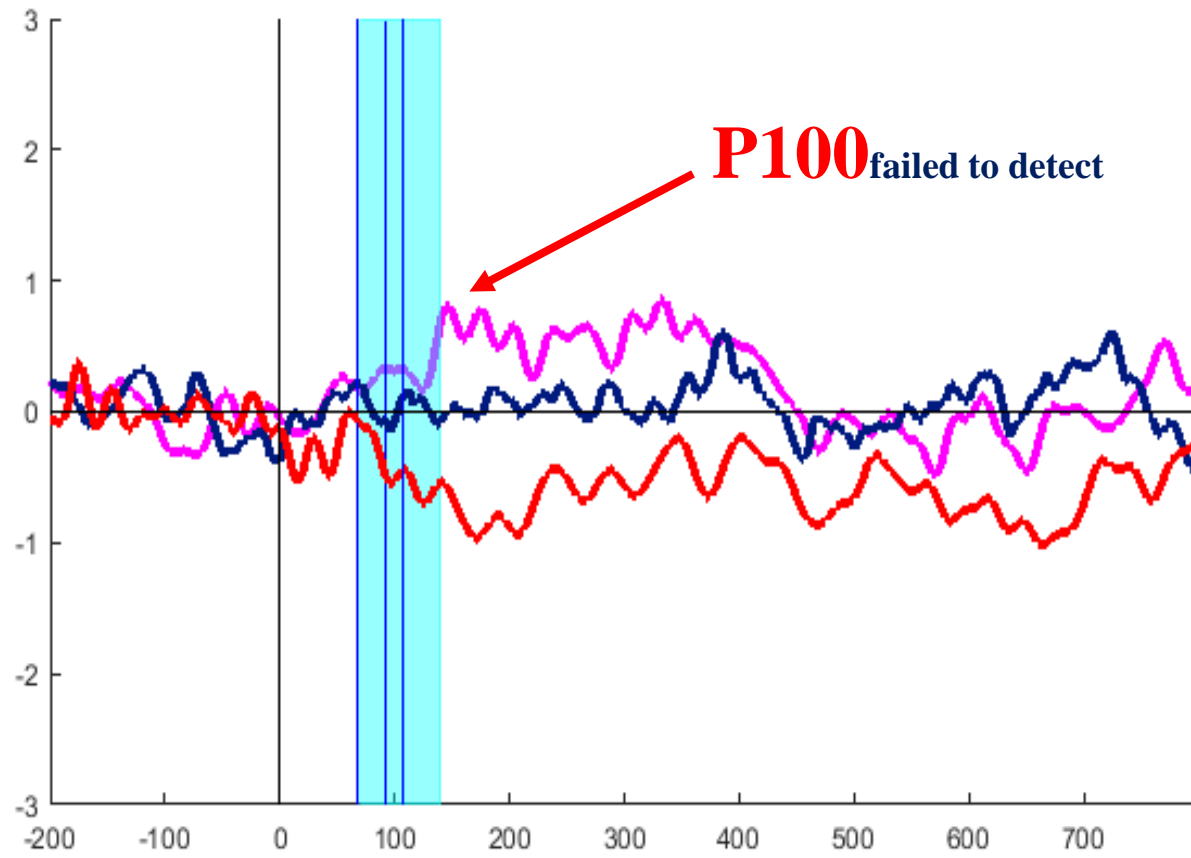
Results

Emotional Stroop task

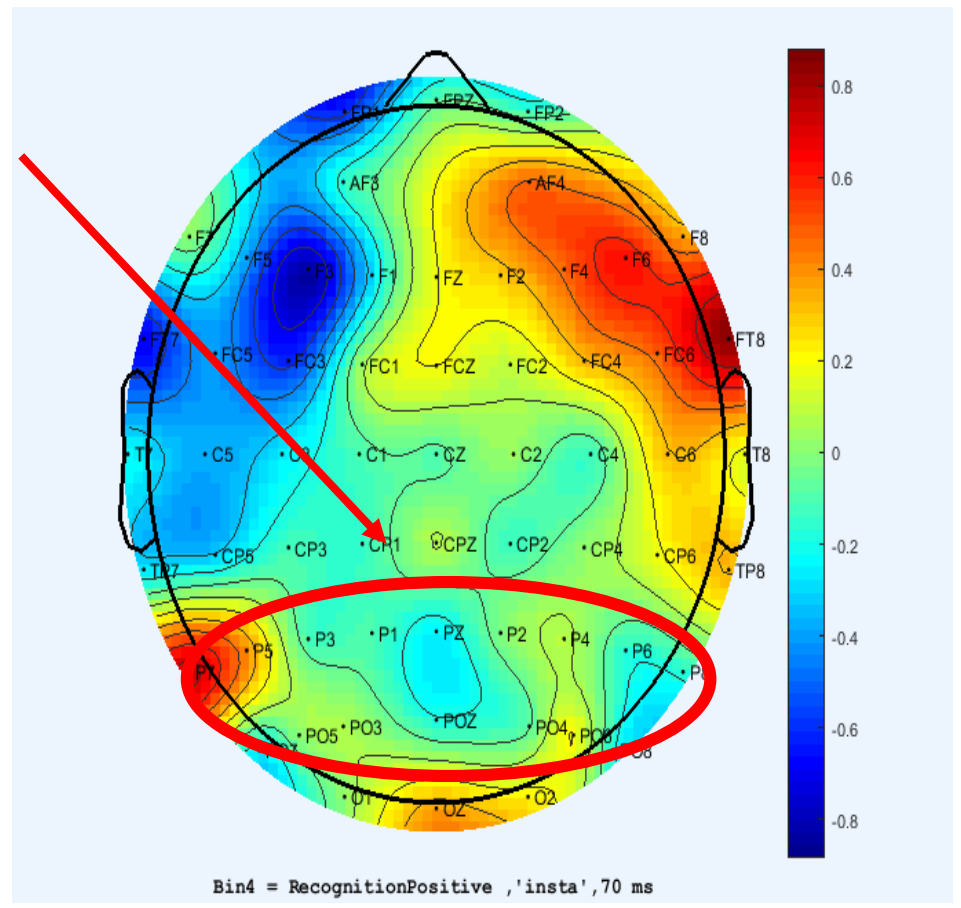


Results

Recognition Task

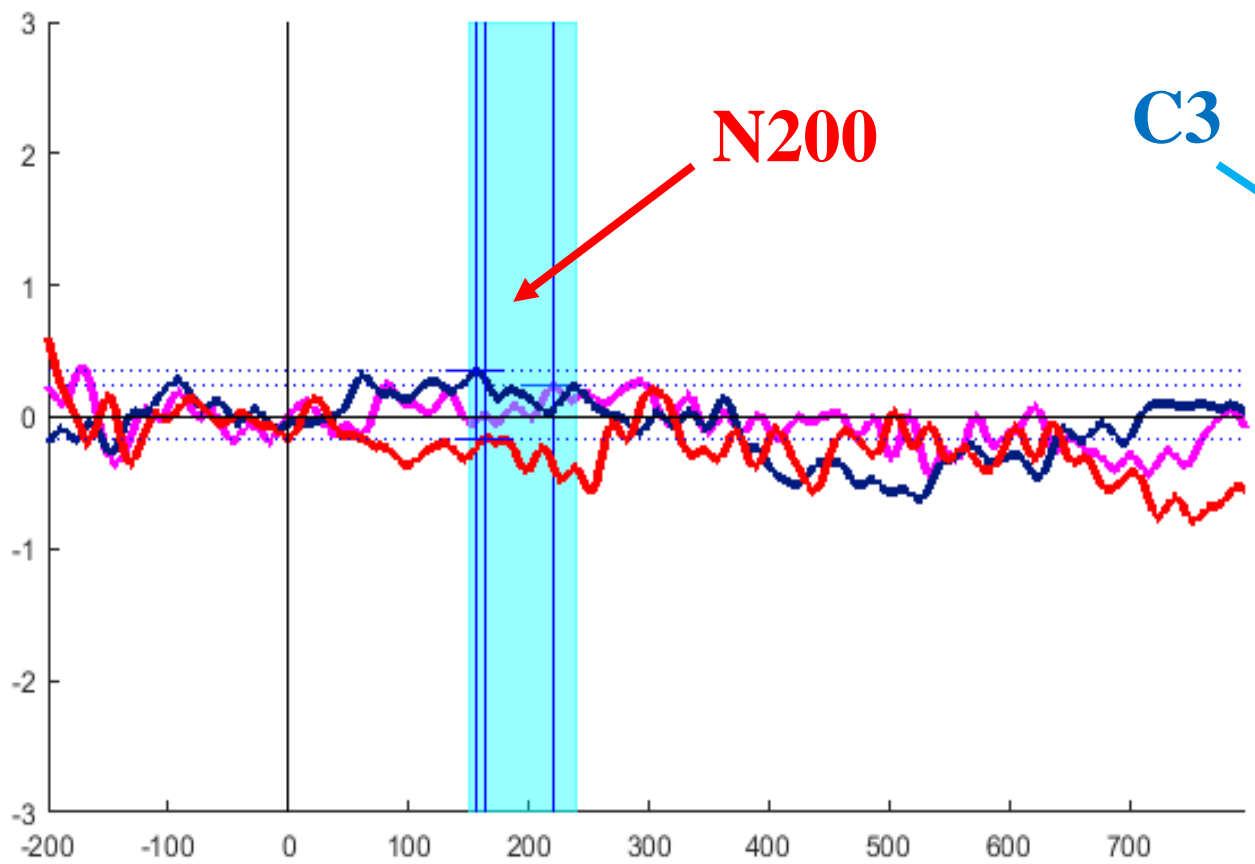


P3

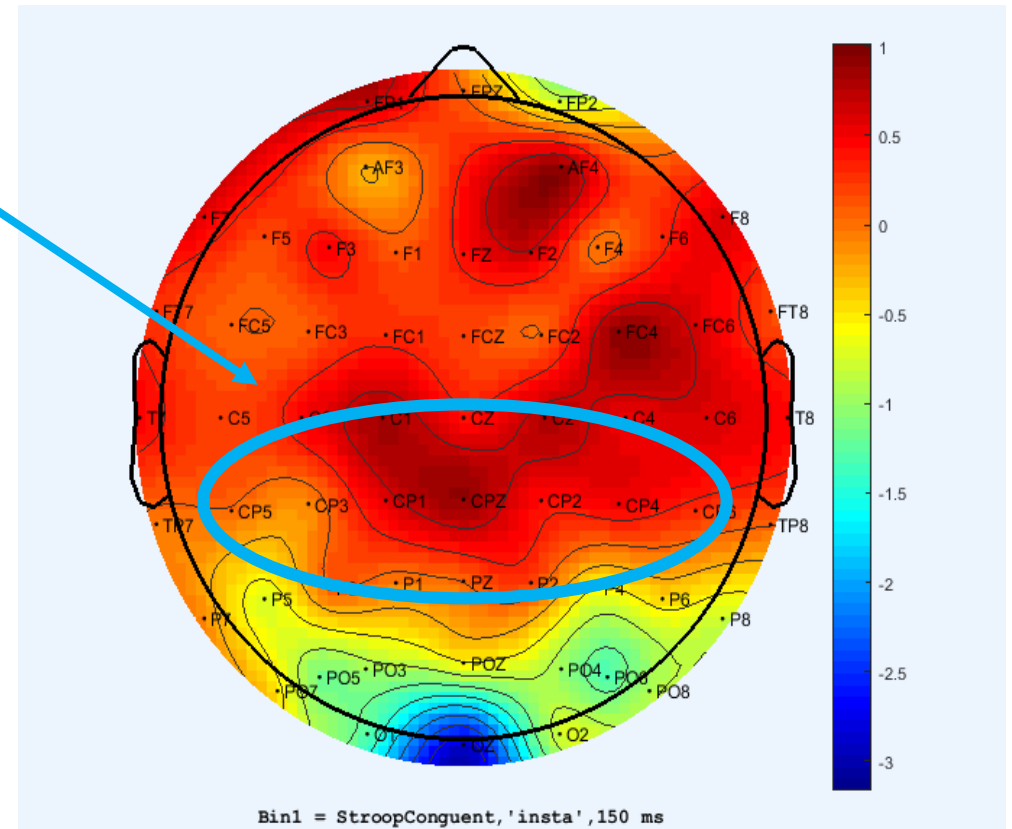


Results

Emotional Stroop task

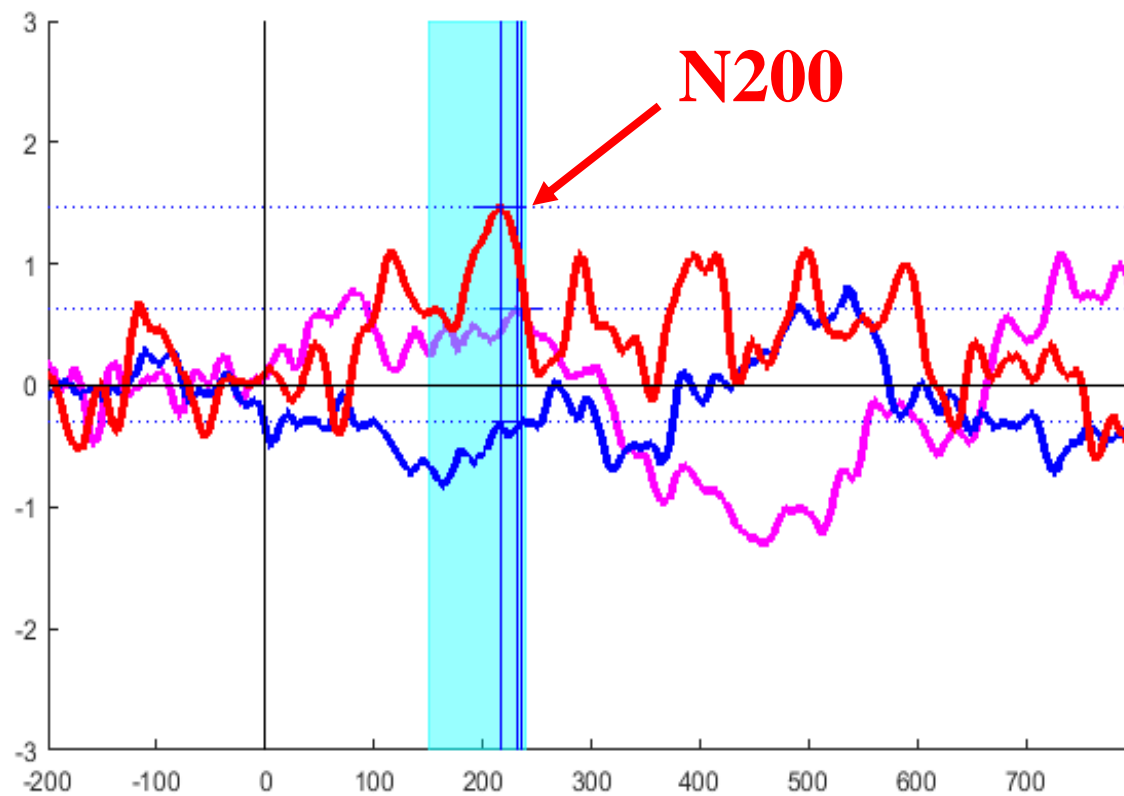


C3

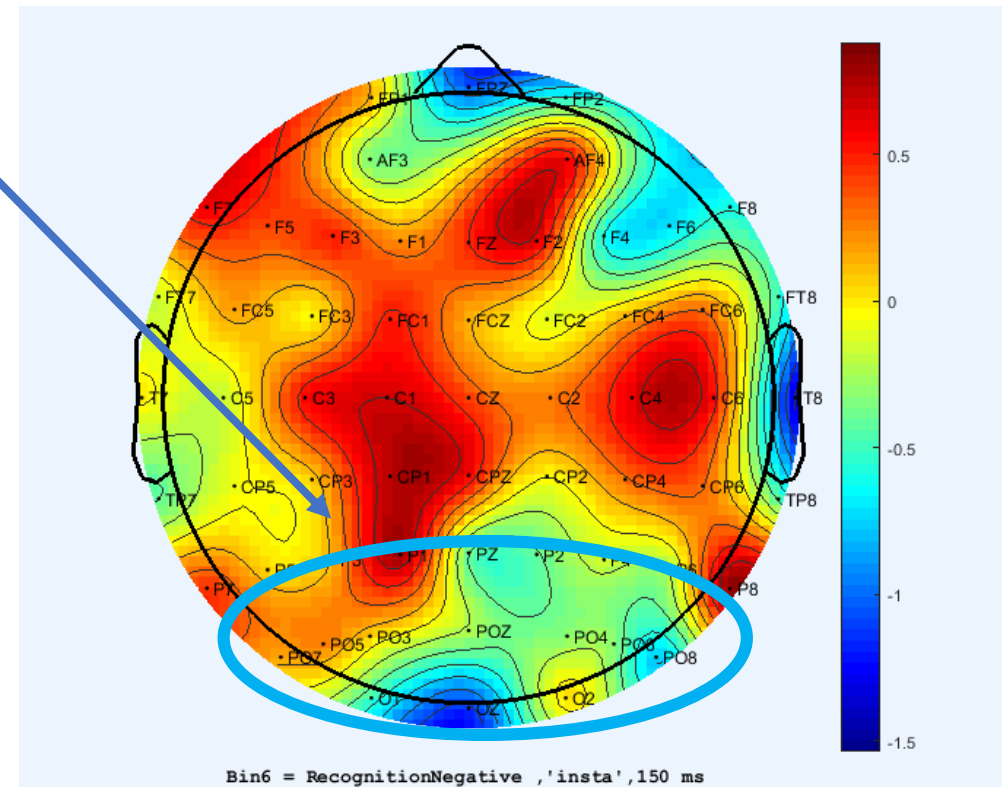


Results

Recognition Task

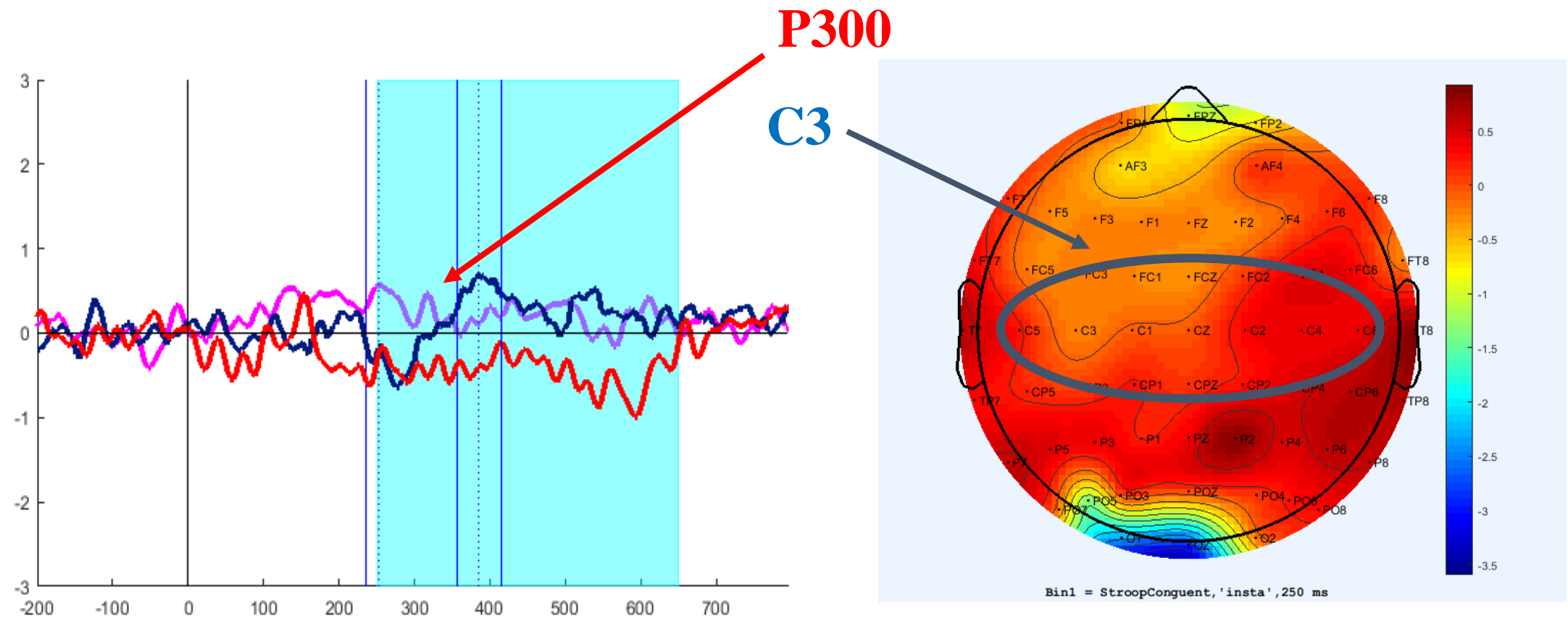


O1



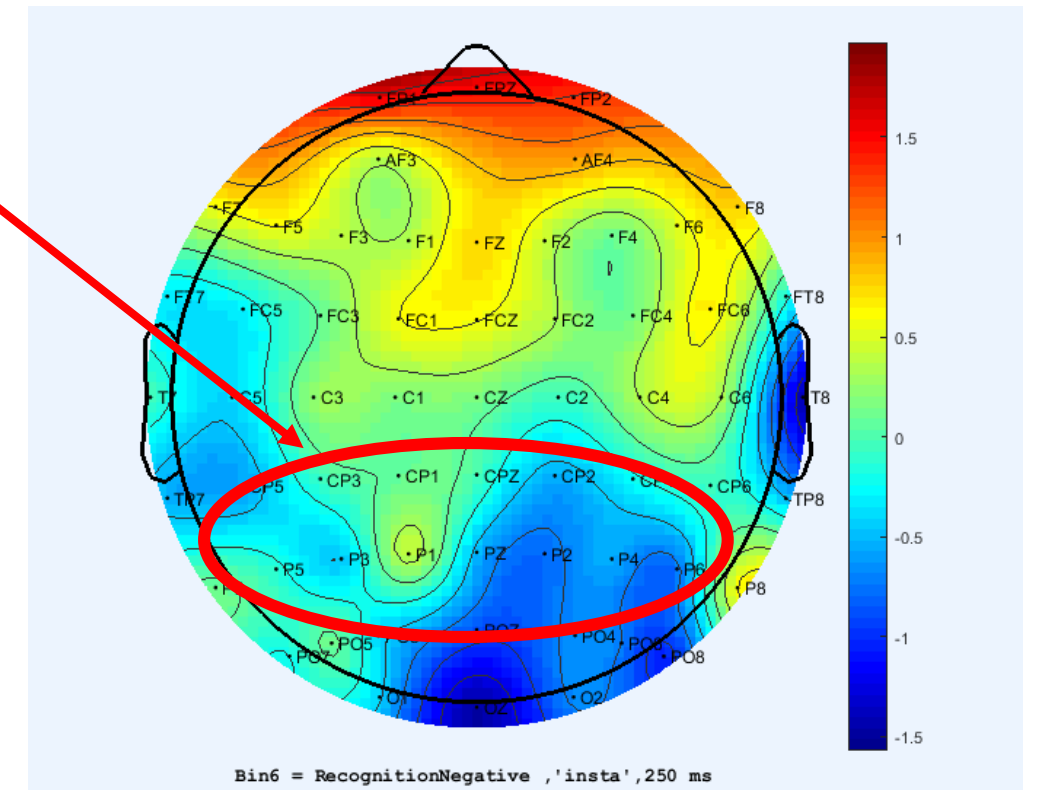
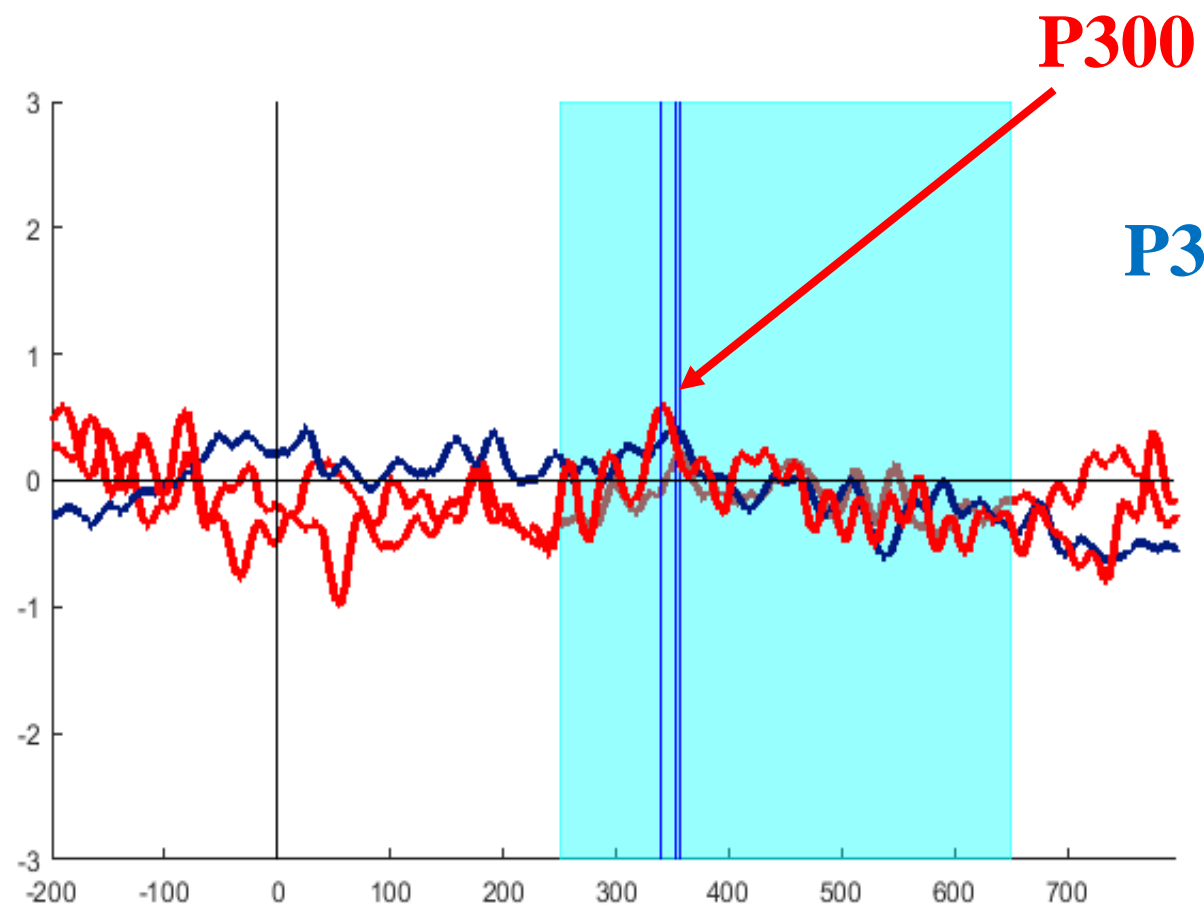
Results

Emotional Stroop Task



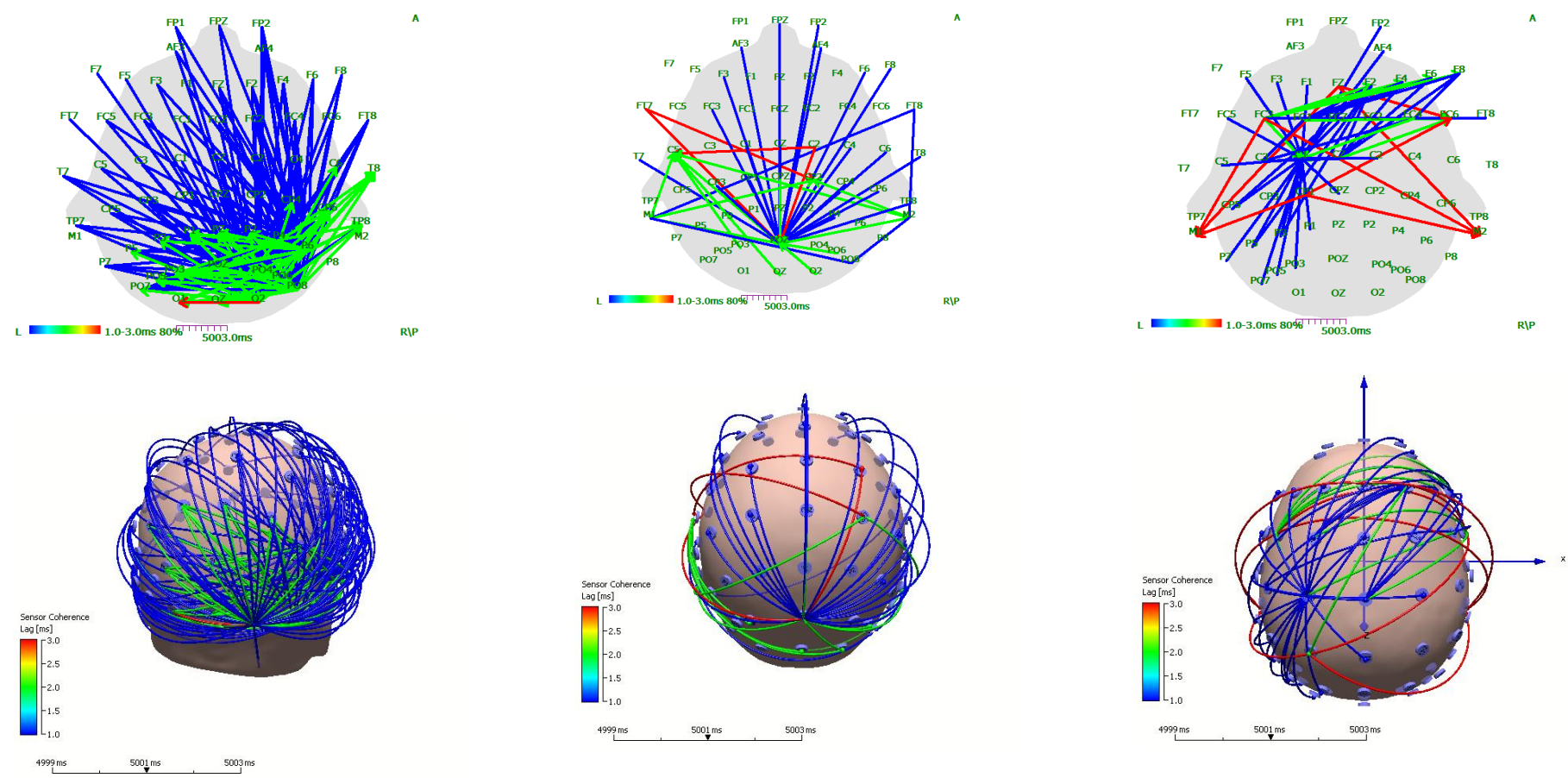
Results

Recognition Task



Results

Coherent analysis of lower alpha: Minimal vs Mild vs Moderate depression



**Thank you so much for your
kind attention**

Q&A