

## **Competition Effects in Visual Cortex Between Emotional Distractors and a Primary Task in Remitted Depression**

### ***Supplemental Information***

#### **Instructions given to participants during the Change-Detection Task**

Participants were told: For this computer game, you will see a patch (a group of parallel lines) placed over a face. After a second, the patch may shift in direction. Your goal is to click the left mouse button as quickly as possible when you see the patch shift. Do you have any questions?”

#### **Additional information regarding EEG data collection**

Continuous EEG was recorded during both change-detection tasks using a BioSemi ActiveTwo system, and recordings were taken from 34 scalp electrodes based on the 10/20 system. Two additional electrodes, an active Common Mode Sense (CMS) and a passive Driven Right Leg (DRL) electrode were used in the study. Raw EEG was recorded relative to CMS. The CMS/DRL electrodes replaced the ground for recordings through a feedback loop which drove the average potential of the subject (i.e. the Common Mode voltage) as close as possible to the “zero” ADC reference voltage in the AD-box (please see <http://www.biosemi.com/faq/cms&drl.htm> for further details). The signal was pre-amplified at the electrode with a gain of 16x. The EEG was digitized at 24-bit resolution with a sampling rate of 512 Hz using a low-pass fifth-order sinc filter with a half-power cutoff of 104 Hz.

### Split-half reliability of change-detection task

**Table S1.** Split-half reliability for SSVEP amplitudes during the change-detection task collapsed across time conditions

		Guttman Split-Half Coefficient
Sad	Gabor	0.99
	Face	0.96
Happy	Gabor	0.99
	Face	0.96
Neutral	Gabor	0.99
	Face	0.92

### Additional information regarding the negative mood induction

Participants completed a standardized negative mood induction by watching a film clip on a computer in the lab. Instructions were presented asking participants to watch the clip carefully and imagine the impact the situation would have on them and their family. The film clip was a 3-minute scene from *The Champ* (1), in which a boxer, Billy, is mortally injured in his comeback match and must then say goodbye to his son, TJ, in the dressing room after the fight. TJ witnesses his father die and then cries out “Champ, wake up” while trying to shake his father to revive him. In an analysis of 20 movie clips, this clip had the highest mean rating for ability to elicit sadness (2). In the current study, participants rated their sadness following the negative mood induction using a Visual Analog Scale (VAS) by rating how they were feeling from “very happy” to “very sad” on a scale measuring 100 mm. To calculate VAS sadness scores, participants’ ratings were measured from left to right on the 100 mm scale, and a sadness rating from 1 to 100 was recorded with higher numbers indicating greater state sadness.

We conducted a manipulation check that confirmed the negative mood induction elicited

significant increases in sadness. To examine changes in state sadness from before to after the mood induction, we conducted a 2 (Group: rMDD, no rMDD)  $\times$  2 (Time: pre, post) mixed-model analysis of variance (ANOVA) with VAS state sadness ratings serving as the dependent variable. Consistent with previous research (2), results revealed a significant main effect of Time,  $F(1, 53) = 170.16, p < .001, \eta_p^2 = .76$ , such that women experienced significant increases in state sadness from before ( $M = 28.85, SD = 16.05$ ) to after ( $M = 64.82, SD = 21.04$ ) the negative mood induction. However, the Group  $\times$  Time interaction was not significant,  $F(1, 53) = 0.40, p = .53, \eta_p^2 = .01$ , indicating that women with and without a history of MDD exhibited similar increases in sadness.

### **Exploratory analyses examining raw SSVEP amplitudes to the Gabor and emotional facial expressions separately**

Exploratory analyses were conducted to examine raw SSVEP amplitudes to the Gabor and the emotional facial expressions, respectively. Results from a 2 (Group: rMDD, no rMDD)  $\times$  2 (Time: pre, post)  $\times$  2 (Stimulus: face, Gabor)  $\times$  3 (Emotion: sad, happy, neutral) repeated measures ANOVA are depicted in Table S2 below. Mauchly's test indicated that the assumption of sphericity had been violated ( $\chi^2(2) = 6.12, p = .05$ ) for the emotion condition, therefore degrees of freedom and  $p$ -values for emotion effects and interactions were corrected using Greenhouse-Geisser estimates of sphericity ( $\epsilon = 0.91$ ). As seen in Table S2, results indicated a significant main effect of Time, such that SSVEP amplitudes decreased from pre- ( $M = 1.51 \mu V^2, SD = .80$ ) to post- ( $M = 1.33 \mu V^2, SD = .76$ ) negative mood induction. In addition, there was a significant main effect of Stimulus, such that SSVEP amplitudes to the Gabor ( $M = 2.01 \mu V^2, SD = 1.21$ ) were significantly higher than SSVEP amplitudes to faces ( $M = .83 \mu V^2, SD = .44$ ). In

contrast, there were no significant main effects of Group or Emotion. Next, to determine the form of the significant highest order interaction (Group  $\times$  Time  $\times$  Stimulus  $\times$  Emotion), we examined the Group, Time, and Emotion main effects and interactions separately for faces and the Gabor:

**Faces.** For faces, there was a main effect of Group,  $F(1, 53) = 4.46, p = .04, \eta_p^2 = .08$ , such that rMDD women exhibited higher SSVEP amplitudes to faces ( $M = .95 \mu V^2, SD = .42$ ) than never-depressed women ( $M = .71 \mu V^2, SD = .45$ ). In addition, there was a main effect of Emotion,  $F(1.32, 53) = 9.81, p = .001, \eta_p^2 = .16$ , such that women exhibited smaller SSVEP amplitudes to neutral faces ( $M = .78 \mu V^2, SD = .41$ ) compared to happy ( $M = .89 \mu V^2, SD = .53$ ) ( $p = .002$ ) or sad faces ( $M = .82 \mu V^2, SD = .43$ ) ( $p = .01$ ). In contrast, the difference in SSVEP amplitudes to sad faces compared to happy faces was nonsignificant ( $p = .06$ ). Finally, the main effect of Time was not significant,  $F(1, 53) = 2.61, p = .11, \eta_p^2 = .05$ .

Turning next to the interaction effects, there was a Time  $\times$  Emotion interaction,  $F(1.87, 53) = 3.10, p = .05, \eta_p^2 = .06$ . In contrast, the Group  $\times$  Time,  $F(1, 53) = 0.05, p = .83, \eta_p^2 = .001$ , and Group  $\times$  Emotion interaction,  $F(1.32, 53) = 1.40, p = .25, \eta_p^2 = .03$ , were both nonsignificant. However, these findings were qualified by a three-way Group  $\times$  Time  $\times$  Emotion interaction,  $F(1.87, 53) = 6.12, p = .004, \eta_p^2 = .10$ . To determine the form of this interaction, we examined the Group  $\times$  Time interaction separately for each of the three Emotion conditions.

For sad faces, there was a main effect of Group,  $F(1, 53) = 5.65, p = .02, \eta_p^2 = .10$ , such that rMDD women exhibited higher SSVEP amplitudes to sad faces ( $M = .95 \mu V^2, SD = .41$ ) than never-depressed women ( $M = .69 \mu V^2, SD = .41$ ). In addition, there was an effect of Time,  $F(1, 53) = 4.07, p = .05, \eta_p^2 = .07$ , indicating that SSVEP amplitudes to sad faces were significantly decreased from pre- ( $M = .86 \mu V^2, SD = .47$ ) to post- ( $M = .79 \mu V^2, SD = .43$ )

negative mood induction. The Group  $\times$  Time interaction was not significant,  $F(1, 53) = 3.63, p = .06, \eta_p^2 = .06$ .

For happy faces, there was a main effect of Group,  $F(1, 53) = 3.99, p = .05, \eta_p^2 = .07$ , such that rMDD women exhibited higher SSVEP amplitudes to happy faces ( $M = 1.02 \mu V^2, SD = .48$ ) than never-depressed women ( $M = .75 \mu V^2, SD = .54$ ). In addition, there was an effect of Time,  $F(1, 53) = 4.84, p = .03, \eta_p^2 = .08$ , indicating that SSVEP amplitudes to happy faces were significantly decreased from pre- ( $M = .92 \mu V^2, SD = .56$ ) to post- ( $M = .85 \mu V^2, SD = .52$ ) negative mood induction. In contrast, Group  $\times$  Time interaction,  $F(1, 53) = 2.18, p = .15, \eta_p^2 = .04$ , was nonsignificant.

For neutral faces, there was no significant main effect of Group,  $F(1, 53) = 3.41, p = .07, \eta_p^2 = .06$ , or Time,  $F(1, 53) < 0.00, p = .99, \eta_p^2 < .001$ , and these effects were not qualified by a significant Group  $\times$  Time interaction,  $F(1, 53) = 0.004, p = .95, \eta_p^2 < .001$ .

**Gabor.** For the Gabor, there was a main effect of Time,  $F(1, 53) = 29.58, p < .001, \eta_p^2 = .36$ , indicating that SSVEP amplitudes to the Gabor significantly decreased from pre- ( $M = 2.16 \mu V^2, SD = 1.29$ ) to post- ( $M = 1.86 \mu V^2, SD = .1.21$ ) negative mood induction. In contrast, there was not a significant main effect of Group,  $F(1, 53) = 0.03, p = .88, \eta_p^2 < .001$ , or Emotion,  $F(2, 1.94) = 1.51, p = .23, \eta_p^2 = .03$ .

Examining the interaction effects, there was a Group  $\times$  Time interaction,  $F(1, 53) = 7.41, p = .01, \eta_p^2 = .12$ . To determine the form of this interaction, we examined the Time effect separately for each group. For never-depressed women, there was an effect of Time,  $F(1, 27) = 20.86, p < .001, \eta_p^2 = .44$ , such that SSVEP amplitudes to the Gabor decreased from pre- ( $M = 2.26 \mu V^2, SD = 1.21$ ) to post- ( $M = 1.82 \mu V^2, SD = 1.14$ ) negative mood induction. Similarly, among rMDD women, there was also an effect of Time,  $F(1, 26) = 10.34, p = .003, \eta_p^2 = .29$ ,

such that SSVEP amplitudes to the Gabor decreased from pre- ( $M = 2.06 \mu V^2$ ,  $SD = 1.38$ ) to post- ( $M = 1.91 \mu V^2$ ,  $SD = 1.29$ ) negative mood induction. Although both groups displayed a significant time effect, this effect was stronger among never-depressed women suggesting the mood induction had a stronger effect in reducing SSVEP amplitudes to the Gabor among these individuals. Finally, the Group  $\times$  Emotion,  $F(1.94, 53) = 0.05$ ,  $p = .95$ ,  $\eta_p^2 = .001$ , Time  $\times$  Emotion,  $F(1.93, 53) = 0.35$ ,  $p = .70$ ,  $\eta_p^2 = .01$ , and Group  $\times$  Time  $\times$  Emotion,  $F(1.93, 53) = 0.15$ ,  $p = .85$ ,  $\eta_p^2 = .003$ , interactions were all nonsignificant.

**Table S2.** Results of exploratory 2 x 2 x 2 x 3 repeated measures ANOVA

	$F$	$\eta_p^2$
Group	0.22	0.004
Time	27.41	0.34***
Stimulus	72.40	0.58***
Emotion	1.78	0.03
Group $\times$ Time	4.71	0.08*
Group $\times$ Stimulus	1.16	0.02
Group $\times$ Emotion	0.78	0.01
Time $\times$ Stimulus	18.83	0.26***
Time $\times$ Emotion	1.96	0.04
Stimulus $\times$ Emotion	11.01	0.17***
Group $\times$ Time $\times$ Stimulus	7.22	0.12**
Group $\times$ Time $\times$ Emotion	1.29	0.02
Group $\times$ Stimulus $\times$ Emotion	0.59	0.01
Time $\times$ Stimulus $\times$ Emotion	0.28	0.01
Group $\times$ Time $\times$ Stimulus $\times$ Emotion	3.00	0.05*

\* $p \leq .05$ , \*\* $p \leq .01$ , \*\*\* $p \leq .001$

### Demographic and clinical characteristics of the sample

Demographic and clinical characteristics of the sample are presented in Tables S3 and S4 below. Among women with a remitted history of depression, 63% ( $n = 19$ ) had a past history of recurrent MDD (i.e., two or more past MDD episodes), 30% ( $n = 9$ ) had a history of a past

anxiety disorder (agoraphobia [ $n=1$ ], obsessive-compulsive disorder [ $n=1$ ], panic disorder [ $n=2$ ], posttraumatic stress disorder [ $n=5$ ], and social anxiety disorder [ $n=1$ ]), 40% ( $n=12$ ) had a past alcohol [ $n=9$ ] and/or substance [ $n=3$ ] related disorder, and 3% ( $n=1$ ) had a past eating disorder (anorexia nervosa [ $n=1$ ]).

**Table S3.** Demographic and clinical characteristics of the sample

Variable	Group		$t/\chi^2$
	rMDD	no rMDD	
Age, $M$ ( $SD$ )	31.63 (6.14)	31.96 (6.42)	0.20
Median Income	30,001-35,000	50,001-55,000	1.82
% Caucasian	81%	71%	0.77
4-item Cowan's $K$ , $M$ ( $SD$ )	2.26 (1.20)	2.63 (0.86)	1.33
6-item Cowan's $K$ , $M$ ( $SD$ )	1.83 (0.84)	1.83 (0.87)	-0.35
VAS-Pre, $M$ ( $SD$ )	31.74 (16.28)	26.07 (15.60)	1.32
VAS-Post, $M$ ( $SD$ )	65.93 (19.48)	63.75 (22.76)	0.38
BDI-II, $M$ ( $SD$ )	12.93 (9.73)	3.25 (3.37)	5.26***

*Note.* VAS: Visual Analog Scale; BDI-II: Beck Depression Inventory II.

\*\*\* $p \leq .001$

**Table S4.** Characteristics of MDD episodes within the rMDD group

Variable	$M$ ( $SD$ )
Average Number of Episodes	2.70 (2.58)
Days Since Last Episode	683.40 (518.79)
Duration of Last Episode (Days)	182.77 (459.52)
Total Duration of All Episodes (Days)	683.40 (518.79)

## Supplemental References

1. Zeffirelli F. *The Champ*. USA: MGM; 1979.
2. Hewig J, Hagemann D, Seifert J, Gollwitzer M, Naumann E, Bartussek D. A revised film set for the induction of basic emotions. *Cogn Emot*. 2005;19:1095-1109.