Gender differences in the correlation between cognitive reappraisal and alpha band power in EEG

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Running Title: Gender differences in cognitive reappraisal and alpha band power

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Abstract

Purpose: Cognitive reappraisal and expressive suppression are major emotion regulation strategies in adjusting to daily life. We hypothesized that cognitive reappraisal and expressive suppression would be related to alpha band power in brain regions. **Materials and Methods:** Fifty-nine subjects were examined with the Emotion Regulation Questionnaire, and their EEG band power during eyes closed at rest was recorded on the same day. **Results:** Reappraisal was positively correlated with alpha power of the frontal region in entire group (males and females). In males (n = 29), reappraisal was negatively correlated with beta power of left temporal region. In females (n = 30), reappraisal was positively correlated with alpha power of frontal and central regions, education years, and age. However, the suppression score was not correlated with any of the band powers. No significant differences in alpha power and delta power were observed in any of brain regions between males and females. In beta power, significant differences were observed between males and females in central, parietal, right temporal, and occipital regions, and marginally significant differences were observed in frontal and left temporal regions. In theta power, significant differences were observed between males and females in occipital region, and marginally significant differences were observed in central and parietal regions. **Conclusions:** These results indicate the tendency for reappraisal could occur more in a relaxed mental state and increases with learning and life experience in females.

Keywords: Cognitive reappraisal; Expressive suppression; Gender; Alpha band power; Prefrontal activity

1. Introduction

The human ability to regulate emotion plays an important role in adapting to life (Ochsner et al., 2005). The failure of emotion regulation can cause serious problems on an individual level and during social interactions. Individual differences in emotion regulation strategies also have important implications for depression, and maladaptive emotion regulation strategies are related to mental disorders (Joormann and Gotlib, 2010). Among emotion regulation strategies, some people use cognitive reappraisal more than expressive suppression and vice versa (Gross and John, 2003). Relatively maladaptive strategies such as expressive suppression compared to adaptive strategies such as cognitive reappraisal are more strongly associated with psychopathology (Aldao and Nolen-Hoeksema, 2010), and reappraisers have fewer depressive symptoms, whereas suppressors have more depressive symptoms (Gross and John, 2003).

Gross (Gross, 1998, 2001, 2002) divided emotion regulation strategies into antecedent-focused and response-focused strategies according to the time point at which the emotion regulation occurred. An antecedent-focused strategy is an emotion regulation strategy that individuals adopt before they change behavior and peripheral physiological response. In contrast, a response-focused strategy refers to individuals that adopt a strategy after the emotion occurs. Cognitive reappraisal belongs to antecedent-focused emotion regulation, which involves cognitively transforming the situation to change its emotional and response-focused strategy, and response modulation means directly influencing the physiological, experiential, or behavioral response in which expressive suppression is used (Gross, 1998).

Recent studies regarding emotion regulation using functional magnetic resonance imaging (fMRI) have mainly concentrated on cognitive reappraisal as an antecedent-focused strategy and expressive suppression as a response-focused strategy (Beauregard et al., 2001; Goldin et al., 2008; Lévesque et al., 2003; Ochsner et al., 2002, 2004, 2005; Ohira et al., 2006; Phan et al., 2005, Schaefer et al., 2002). One study reported that early (0–4.5 sec) prefrontal activity reduces the activities of the amygdala and insula with a lapse of time in cases of cognitive reappraisal, whereas late (10.5–15 sec) prefrontal activity increases the activities of the amygdala and insula with a lapse of time in the case of expressive suppression (Goldin et al., 2008). Cognitive reappraisal of negative stimuli increases activity in the prefrontal cortex and dorsal frontoparietal network, and, in particular, the dorsal anterior cingulate cortex and the prefrontal cortex that play an important role in choosing and applying reappraisal strategy increase, decrease, or maintain activities of the amygdala and insula, depending on the aims of reappraisal (Beauregard et al., 2001; Lévesque et al., 2003; Ochsner et al., 2002, 2004; Phan et al., 2005; Schaefer et al., 2002). Recent studies have reported that expressive suppression is positively correlated with grey matter volume in the dorsomedial prefrontal cortex (Kühn at al., 2011) and anterior insula volume (Giuliani et al., 2011).

However, studies on emotion regulation have been mainly investigated through fMRI which induces brain activation using an emotion regulation task. These studies provide information about changes in brain activities during an emotion regulation task, but did not provide information about the baseline states of individuals with regard to emotion regulation. The baseline state differs from activation because activation studies reflect the task-oriented tendency of emotion regulation strategies. No studies have demonstrated two emotion regulation strategies using EEG power spectral analysis. Alpha band power is inversely related to the activity of the corresponding region of the brain (Shagass, 1972), and combined EEG and fMRI–positron emission tomography studies show that increased alpha power is related to decreased blood flow in the inferior frontal, cingulate, superior temporal, and occipital cortices (Goldman et al., 2002; Sadato et al., 1998). Therefore, we hypothesized that cognitive reappraisal and expressive suppression would also be related to alpha band power in brain regions, which would reflect the ordinary conditions of brain activity.

Especially, we were interested in gender differences for the correlation between emotion regulation and brain waves, because gender differences during affective processing and emotion regulation have been reported in previous neuroimaging studies (Domes et al., 2010; McRae et al., 2008; Wager et al., 2003). During performance of an emotion regulation task, women recruit the orbitofrontal cortex, the anterior cingulate, and the dorsolateral prefrontal cortex to a lesser extent than men (Domes et al., 2010). In contrast, men show lesser activity increases in prefrontal regions that are associated with reappraisal, and greater decreases in the amygdala (McRae et al., 2008). In addition, men show more lateralization of emotional activity, and women show more brainstem activation in affective paradigms (Wager et al., 2003).

In addition, recent emotion regulation studies have compared older adults to younger adults based on neural response (Opitz et al., 2012; Winecoff et al., 2011), and some fMRI and behavioral studies have been performed in individuals aged 10–23 years using an emotion regulation task (McRae et al., 2012; Silvers et al., 2012). However, no correlation study has been conducted between individual predisposition for emotion regulation and education years or age in the default mode without any stimuli evoking emotion regulation. Therefore, we were interested in the correlation between results on an emotion regulation questionnaire and education years and age.

2. Materials and methods

2.1. Participants

Fifty-nine psychologically healthy subjects participated in this study (mean age = 21.5 years, standard deviation (SD) = 2.9, range: 18–29; mean education years = 14.1 years, SD = 1.8, range: 12–18). The subject’s demographic characteristics are shown in Table 1. No significant differences were observed for education years (13.69 vs. 14.53, $t(57) = -1.825$, $p = .073$) or age (21.34 vs. 21.67, $t(57) = -.420$, $p = .676$) between males and females. We analyzed men and women separately, because gender differences in affective processing and emotion regulation have been reported in previous neuroimaging studies (Domes et al., 2010; McRae et al., 2008; Wager et al., 2003). The subjects were recruited from the local community through a web advertisement. An initial screening interview excluded subjects if they had any identifiable neurological disorder or head injury, personal history of psychiatric disease, family history of psychiatric illness, acute diseases related to internal or surgical medicine, or seizures. All subjects were right-handed. Handedness was determined by asking which hand the subject tended to use for writing and other precise motor skills. The subjects were all non-smokers, abstained from alcohol for at least 3 days before this study, and ingested at most 3 cups of coffee per day. This study was performed 2–3 days after menstruation began to control for changes in EEG by the menstrual cycle due to the effects of the menstrual cycle on alpha power (Kaneda et al., 1997; Solis-Ortiz et al., 1994).

All subjects signed a written informed consent form that was approved by the Institutional Review Boards of The Catholic University of Korea prior to their participation in the study.

2.2. Procedures

The Emotion Regulation Questionnaire (ERQ) consists of 10 items (cognitive reappraisal factor [six items] and expressive suppression factor [four items]) and the items are rated on a scale from 1 (strongly disagree) to 7 (strongly agree). Cognitive reappraisal is used to interpret a potentially emotion-eliciting situation in a way that changes its emotional impact. Expressive suppression is used to inhibit ongoing emotion-expressive behavior (Gross and John, 2003). After subjects had filled out the ERQ, their delta (1–3 Hz), theta (4–7 Hz), alpha (8–12 Hz), and beta (13–25 Hz) band powers during eyes closed at rest were recorded by quantitative EEG (qEEG) on the same day. qEEG was measured for approximately 2 minutes, 30 seconds with eyes alternatively closed (first half) and open (second half) and for a total of about 5 minutes. EEG activity was recorded and amplified using a NeuroScan NuAmps amplifier (Compumedics USA, El Paso, TX, USA), and 34 Ag–AgCl electrodes mounted in a Quik Cap using a modified 10–20 placement scheme to record the EEG from 34 positions (FP1, FP2, F7, F3, Fz, F4, F8, FT7, FC3, FCz, FC4, FT8, T3, C3, Cz, C4, T4, TP7, CP3, CPz, CP4, TP8, T5, P3, Pz, P4, T6, O1, Oz, O2, FT9, FT10, PO1, PO2). A vertical electrooculogram (EOG) was recorded using two electrodes, one located above and one below the right eye. The horizontal EOG was recorded at the outer canthus of each eye. EEG data were recorded with a 0.1–100-Hz band-pass filter at a sampling rate of 1,000 Hz. The ground electrode was placed on the forehead, and the reference was placed on bilateral mastoids.

2.3. Acquisition and analysis of delta, theta, alpha, and beta band powers

We acquired delta, theta, alpha, and beta band powers from 34 positions on the scalp. After epochs containing bioelectric artifacts > -100–+100 μV in any channel were rejected, 15 epochs (total 30 seconds without artifacts) were acquired in the eye closed condition. The spectral power in each subject was extracted in 1 Hz bins using fast Fourier transformation. Then, the average delta (1–3 Hz), theta (4–7 Hz), alpha (8–12 Hz), and beta (13–25 Hz) band powers (μV^2) were acquired and used for analysis.

2.4. Statistical analyses

After grouping channels into 6 regions by averaging channels (Table 2), we performed correlation analysis between ERQ scores (reappraisal and suppression) and delta, theta, alpha, and beta band powers of each regions for the entire group (n = 59), and for the male (n = 29) and female groups (n = 30) separately. Because we were also interested in the relationship between ERQ scores and education years and age, we performed a correlation analysis between ERQ scores and education years and age. Analysis of variance (ANOVA) was performed to analyze the differences in brain waves and ERQ scores between males and females.

3. Results

3.1. Correlation analysis between ERQ scores and brain wave powers

Entire group (29 males and 30 females)

Reappraisal (n= 59) was positively correlated with alpha power of frontal region (r = .264, p

= .043). Reappraisal was not correlated with education years and age (all *ps* > .05). Expressive suppression score was not correlated with any of the band powers of any regions in the entire group or with education years or age (all *ps* > .05) (Figure 1 (A) & Table 3).

Male group (n = 29)

Reappraisal (n= 29) was negatively correlated with beta power of left temporal region (*r* = -.372, *p* = .047). Reappraisal was not correlated with education years and age. Expressive suppression score was not correlated with any of the band powers of any regions in the male group or with education years or age (all *ps* > .05) (Figure 1 (B) & Table 3).

Female group (n = 30)

Reappraisal (n= 30) was positively correlated with alpha powers of frontal region (*r* = .413, *p* = 0.023) and central region (*r* = .391, *p* = 0.033) (Figure 1 (C, D) & Table 3). Reappraisal (n = 30) was positively correlated with education years (*r* = .447, *p* = .013) and age (*r* = .469, *p* = .009). Expressive suppression score was not correlated with any of the band powers of any regions in the female group or with education years or age (all *ps* > 0.05)

3. 2. Differences in brain wave powers between males and females

No significant differences in alpha power were observed in any of brain regions between males and females (all *ps* > 0.05). In beta power, significant differences were observed between males and females in central region (0.75±0.35 vs. 1.03±0.60, *F*(1,57) = 4.843, *p* = .032), parietal region (0.77±0.39 vs. 1.11±0.70, *F*(1,57) = 5.221, *p* = .026), right temporal region (0.57±0.25 vs. 0.77±0.33, *F*(1,57) = 7.065, *p* = .010), and occipital region (0.57±0.37 vs. 0.95±0.72, *F*(1,57) = 6.381, *p* = .014), and marginally significant differences were observed in frontal region (0.73±0.39 vs. 0.97±0.53, *F*(1,57) = 3.965, *p* = .051) and left temporal region (0.56±0.41 vs. 0.74±0.35, *F*(1,57) = 3.160, *p* = .081) (Table 4). No significant differences in delta power were observed in any of brain regions between males and females (all *ps* > 0.05). In theta power, significant differences were observed between males and females in occipital region (1.67±1.17 vs. 2.61±2.02, *F*(1,57) = 4.721, *p* = .034), and marginally significant differences were observed in central region (3.59±1.77 vs. 4.65±2.93, *F*(1,57) = 2.819, *p* = .099) and parietal region (2.88±1.39 vs. 3.95±2.72, *F*(1,57) = 3.599, *p* = .063) (Table 4). Although the ANOVA did not show significant differences between two groups in alpha power correlated with reappraisal, the mean values of female's alpha power were higher than those of male's in all regions.

3. 3. Differences in ERQ between males and females

No significant differences were observed between males and females in reappraisal (5.08 vs. 5.13, $t(46.98) = -.234$, $p = .816$) or suppression (3.93 vs. 3.75, $t(57) = .652$, $p = .517$).

4. Discussion

Reappraisal was positively correlated with alpha power of frontal region in the entire group ($r = .264$, $p = .043$). In the correlation analyses according to gender, reappraisal was positively correlated with alpha power of frontal region ($r = .413$, $p = 0.023$) and central region ($r = .391$, $p = 0.033$) and was positively correlated with education years ($r = .447$, $p = .013$) and age ($r = .469$, $p = .009$) in females. In contrast, reappraisal was negatively correlated with beta power of left temporal region ($r = -.372$, $p = .047$) in males.

According to our results, reappraisal was related to the alpha band power in the entire group and the females, indicating that reappraisal is related to a relaxed mental state of the brain. Our study estimated the relationship between emotion regulation strategies and alpha band power without any stimuli. The results showed that alpha band power was correlated with reappraisal but not suppression. Because reappraisers have fewer depressive symptoms (Gross and John, 2003), alpha band power related to reappraisal may be an indicator of mental health.

Reappraisal was positively correlated with alpha band power mainly in frontal regions of the brain. The tendency for reappraisal could occur more in a relaxed mental state. Although this result seems to be opposite to previous fMRI studies (Goldin et al., 2008; Ochsner et al., 2004, 2005), it actually reflects the importance of the relaxed mental state during resting baseline. In addition, an activation study using fMRI reported that prefrontal cortical activity reduces negative emotion via the nucleus accumbens/ventral striatum generating positive appraisals and the amygdala generating negative appraisals during reappraisal (Wager et al., 2008). The neural activation pattern relevant to the reappraisal task did not appear in our study because it was not an activation study using visual stimuli but an EEG study estimating ordinary brain conditions. Rather, the present study estimated the default mode of the brain. Reappraisal was positively correlated with alpha power of the frontal region in the entire group. The alpha powers of frontal and central regions were positively correlated with reappraisal in females, but was not correlated with reappraisal in males. In males, reappraisal was negatively correlated with beta power of left temporal region, which may indicate that beta power of the left temporal lobe or the amygdala in the resting state is lower in males using high level of reappraisal strategy. Although our study was performed in the default mode without any stimuli, the gender difference in the correlation between brain waves and reappraisal may be relevant to gender differences in brain activation regions relevant to emotion regulation tasks (Domes et al., 2010; McRae et al., 2008).

Reappraisal was positively correlated with education years and age in females, which indicates that reappraisal is related to cognitive set shifting and alternative thinking derived from learning and life experience of females. That is, when the levels of learning and experience are low, females seem to lack mental resources for reappraisal. Although recently there were studies comparing older adults to younger adults with regard to neural activity for reappraisal (Opitz et al., 2012; Winecoff et al., 2011), and fMRI and behavioral studies for individuals aged 10–23 years using emotion regulation task (McRae et al., 2012. Silvers et al., 2012), no study has reported a correlation between age and reappraisal in the default mode without any stimuli evoking emotion regulation. Therefore, the age-related result of the present study shows the importance of emotion regulation in terms of life experience.

The expressive suppression score was not correlated with any of the band powers of any of the regions or with education years or age in the entire group or individually as males and females (all *ps* > 0.05). According to a study regarding individual differences in emotion regulation, suppressors mask their inner feelings and do not express emotion in stressful situations (Gross and John, 2003). Suppression might have complex aspects not expressed by brain wave power.

On mean values, the delta, theta, alpha, and beta powers of females were higher than those of males in all regions except delta powers of temporal and occipital regions. However, no significant differences in alpha power which showed correlations with reappraisal in frontal region and central region in females were observed in any of the regions between males and females. And for beta power, significant differences were observed in central, parietal, right temporal, occipital regions between males and females and marginally significant differences in frontal and left temporal regions between males and females. For theta power, significant differences were observed in occipital regions, and marginally significant differences in central and parietal regions were observed between males and females. Reappraisal was positively correlated with alpha powers of frontal and central regions in females, whereas reappraisal was negatively correlated with beta power of left temporal region in males. Significant and marginally significant differences were observed in multiple regions in beta and theta powers between male and female groups, which could explain the reason why reappraisal was negatively correlated with beta power of left temporal region in the male group but not in the female group. Also, the mean values of delta, theta, alpha, and beta powers of females tended to be higher than those of males, which may be due to the fact that the skull of the adult female is smaller and thinner than that of the adult male (Clemente, 1985), and, in some aspects, may explain gender differences in the correlation between cognitive reappraisal and alpha band power.

Some limitations in the present study should be discussed. First, because gender differences in affective processing and emotion regulation have been reported in previous neuroimaging studies (Domes et al., 2010; McRae et al., 2008; Wager et al., 2003), this study examined males and females separately as well as the entire group. However, we could not explain clearly reason for gender differences in the correlation between cognitive reappraisal and alpha band power in EEG. Any clear reason for gender differences should be examined later. Second, the age range of subjects included in this study was narrow, and the subjects were of younger age (range: 18–29 years old). Thus, the results could be unclear in case of emotion regulation strategies for individuals outside that age range. Therefore, studies extended to subjects with a wider age range are needed in the future.

5. Conclusion

Our results showed that the prefrontal activity appearing in the alpha band power was correlated with reappraisal in females but not in males, indicating that the tendency for reappraisal could occur more in a relaxed mental state in females. Also, the reappraisal score was positively correlated with education years and age in females, indicating that reappraisal increases with learning and life experience in females. Studies on emotion regulation at a resting baseline of the brain will be needed to verify the cause and effect between relaxation and reappraisal with regard to gender difference.

Declaration of Interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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Figure and Table Legends

Figure 1. Correlation graph between reappraisal score and alpha and beta band powers in entire (A), male (B), and female (C, D) groups.

Table 1. Demographic characteristics of entire, male, and female groups.

Table 2. Groupings of channels for regional qEEG activity.

Table 3. Correlation table between reappraisal score and alpha and beta band powers in entire, male, and female groups.
*. significance ($p < .05$, two-tailed), [a]. Pearson's r correlation.

Table 4. Results of ANOVA for brain wave powers (delta, theta, alpha and beta band powers) of males and females.
*. $p < .05$, [m]. marginal significance.

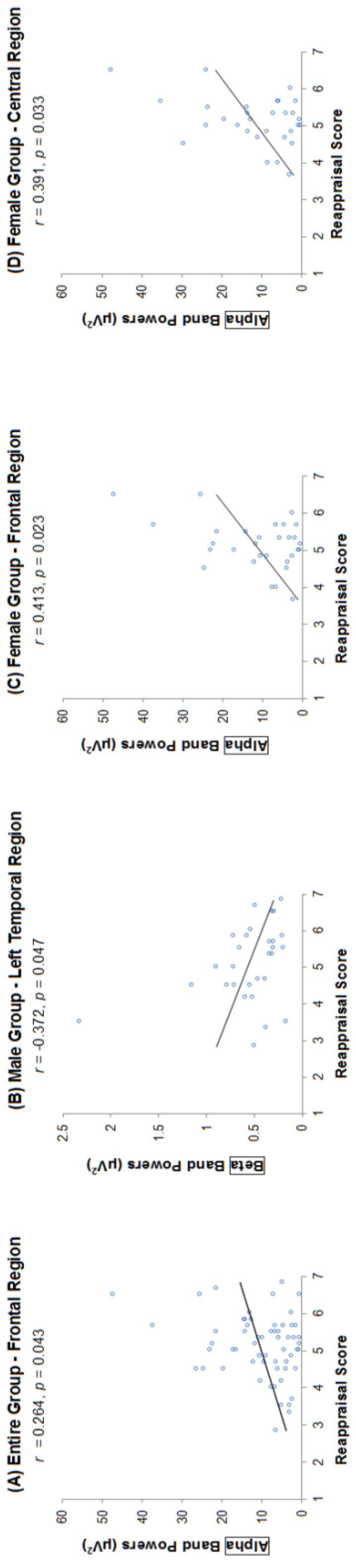

Figure 1. Correlation graph between reappraisal score and alpha and beta band powers in entire (A), male (B), and female (C, D) groups.

	Entire group (n=59)		Male group (n=29)		Female group (n=30)	
	Education	**Age**	**Education**	**Age**	**Education**	**Age**
MEAN	14.1	21.5	13.7	21.3	14.5	21.7
SD	1.8	2.9	1.8	3.0	1.8	2.9
Range	12–18	18–29	12–18	18–29	12–18	19–29

Table 1. Demographic characteristics of entire, male, and female groups.

Brain Region	Grouping of Electrodes
Frontal	FP1, FP2, F3, FZ, F4
Central	FC3, FCZ, FC4, C3, CZ, C4
Parietal	CP3, CPZ, CP4, P3, PZ, P4
Temporal (Left)	T3, TP7, T5
Temporal (Right)	T4, TP8, T6
Occipital	O1, OZ, O2

Table 2. Groupings of channels for regional qEEG activity.

Alpha band power

			Brain regions					
			Frontal	**Central**	**Parietal**	**Temporal L**	**Temporal R**	**Occipital**
Entire	**Reappraisal**	*r*[a]	0.264*	0.22	0.142	0.113	0.183	0.17
		p	0.043	0.094	0.283	0.395	0.166	0.198
		n	59	59	59	59	59	59
	Suppression	*r*	-0.057	-0.046	0.033	0.065	-0.014	0.025
		p	0.668	0.727	0.806	0.625	0.914	0.849
		n	59	59	59	59	59	59
Males	**Reappraisal**	*r*	0.166	0.09	0.071	0.049	0.075	0.041
		p	0.391	0.644	0.715	0.801	0.698	0.833
		n	29	29	29	29	29	29
	Suppression	*r*	0.071	0.025	0.087	0.083	0.08	-0.006
		p	0.714	0.899	0.655	0.669	0.681	0.975
		n	29	29	29	29	29	29
Females	**Reappraisal**	*r*	0.413*	0.391*	0.244	0.189	0.314	0.349
		p	0.023	0.033	0.193	0.318	0.091	0.058
		n	30	30	30	30	30	30
	Suppression	*r*	-0.107	-0.078	0.003	0.08	-0.034	0.066
		p	0.574	0.68	0.985	0.675	0.859	0.728
		n	30	30	30	30	30	30

Beta band power

			Brain regions					
			Frontal	**Central**	**Parietal**	**Temporal L**	**Temporal R**	**Occipital**
Entire	**Reappraisal**	*r*	0.018	0.008	0.001	-0.209	-0.106	-0.06
		p	0.891	0.954	0.993	0.111	0.422	0.653
		n	59	59	59	59	59	59
	Suppression	*r*	-0.094	-0.001	0.072	-0.068	-0.082	0.012
		p	0.48	0.992	0.59	0.61	0.535	0.93
		n	59	59	59	59	59	59
Males	**Reappraisal**	*r*	-0.042	-0.088	-0.097	-0.372*	-0.334	-0.254
		p	0.827	0.649	0.617	0.047	0.077	0.183
		n	29	29	29	29	29	29
	Suppression	*r*	-0.159	-0.054	0.046	-0.197	-0.136	-0.176
		p	0.409	0.779	0.814	0.306	0.483	0.36
		n	29	29	29	29	29	29
Females	**Reappraisal**	*r*	0.072	0.077	0.065	0.045	0.109	0.049
		p	0.706	0.686	0.733	0.811	0.566	0.797
		n	30	30	30	30	30	30
	Suppression	*r*	-0.02	0.066	0.133	0.108	-0.003	0.145
		p	0.918	0.729	0.482	0.57	0.987	0.445
		n	30	30	30	30	30	30

Table 3. Correlation table between reappraisal score and alpha and beta band powers in entire, male, and female groups. *. significance ($p < .05$, two-tailed), [a]. Pearson's r correlation.

Delta band power

	Males			**Females**			***F***	***p***	
	Mean	**SD**	***n***	**Mean**	**SD**	***n***			
Frontal	23.88	11.16	29	28.64	15.24	30	1.863	.178	
Central	14.64	4.17	29	16.60	7.54	30	1.503	.225	
Parietal	13.89	5.18	29	15.26	7.90	30	.611	.438	
Temporal (Left)	12.10	5.51	29	11.44	5.94	30	.197	.659	
Temporal (Right)	12.65	8.14	29	11.44	6.37	30	.409	.525	
Occipital	9.40	4.42	29	11.16	6.43	30	1.491	.227	

Theta band power

	Males			**Females**			***F***	***p***	
	Mean	**SD**	***n***	**Mean**	**SD**	***n***			
Frontal	4.18	2.13	29	4.96	2.97	30	1.338	.252	
Central	3.59	1.77	29	4.65	2.93	30	2.819	.099	$^{\text{m}}$
Parietal	2.88	1.39	29	3.95	2.72	30	3.599	.063	$^{\text{m}}$
Temporal (Left)	1.48	0.67	29	1.95	1.54	30	2.221	.142	
Temporal (Right)	1.61	0.90	29	2.16	1.72	30	2.320	.133	
Occipital	1.67	1.17	29	2.61	2.02	30	4.721	.034	*

Alpha band power

	Males			**Females**			***F***	***p***
	Mean	**SD**	***n***	**Mean**	**SD**	***n***		
Frontal	9.27	6.42	29	11.81	11.46	30	1.087	.301
Central	10.58	7.54	29	12.18	11.50	30	.396	.532
Parietal	12.03	9.75	29	13.37	12.21	30	.215	.645
Temporal (Left)	4.26	2.88	29	5.48	5.78	30	1.048	.310
Temporal (Right)	5.35	4.15	29	7.82	8.05	30	2.179	.145
Occipital	10.04	10.32	29	12.55	12.36	30	.711	.403

Beta band power

	Males			**Females**			***F***	***p***	
	Mean	**SD**	***n***	**Mean**	**SD**	***n***			
Frontal	0.73	0.39	29	0.97	0.53	30	3.965	.051	$^{\text{m}}$
Central	0.75	0.35	29	1.03	0.60	30	4.843	.032	*
Parietal	0.77	0.39	29	1.11	0.70	30	5.221	.026	*
Temporal (Left)	0.56	0.41	29	0.74	0.35	30	3.160	.081	$^{\text{m}}$
Temporal (Right)	0.57	0.25	29	0.77	0.33	30	7.065	.010	*
Occipital	0.57	0.37	29	0.95	0.72	30	6.381	.014	*

Table 4. Results of ANOVA for brain wave powers (delta, theta, alpha and beta band powers) of males and females. *. $p < .05$, $^{\text{m}}$. marginal significance.