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Individual differences in emotion lateralisation and the processing of emotional information arising from social interactions.

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Abstract

Previous research examining the possible association between emotion lateralisation and social anxiety has found conflicting results. In this paper two studies are presented to assess two aspects related to different aspects of social anxiety: fear of negative evaluation and emotion regulation. Lateralisation for the processing of facial emotion was measured using the chimeric faces test. Individuals with greater fear of negative evaluation were more strongly lateralised to the right hemisphere for the processing of anger, happiness and sadness; and, for the processing of fearful faces the relationship was found for females only. Emotion regulation strategies were reduced to two factors: positive strategies and negative strategies. For males, but not females, greater reported use of negative emotion strategies is associated with stronger right hemisphere lateralisation for processing negative emotions. The implications for further understanding the neuropsychological processing of emotion in individuals with social anxiety are discussed.

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Introduction

According to the right hemisphere hypothesis, emotional stimuli are processed predominantly in the right hemisphere (Borod, 1992). Research with non-clinical participants has found variability in hemispheric dominance for the processing of emotional stimuli; sex, gender, and hormonal exposure are considered as possible influences on lateralisation (e.g., Bourne, 2005; Bourne & Gray, 2009; Bourne & Maxwell, 2010). Researchers have also explored this variability in terms of social phobia or social anxiety, with conflicting results. It is important to explore the processing of emotional stimuli further as there is convincing evidence that individuals with social phobia or social anxiety have atypical emotion recognition patterns, such as interpret faces more negatively (Winton, Clark, & Edelman, 1995), spend longer inspecting both positive and negative emotive faces (Wieser, Pauli, Weyers, Alpers, & Muehlberger, 2009), and are faster at classifying negative faces (Leber, Heindenreich, Stangier, & Hofmann, 2009). It is possible that one reason this variability arises is due to social anxiety being multi-faceted (Moscovitch, 2009). In this paper, two studies explore variability in lateralisation with two different dimensions of social anxiety: one's feelings in everyday social interactions (i.e., fear of negative evaluation) and one's ability to regulate their emotional reactions in everyday social interactions (i.e., emotion regulation skills).

The right hemisphere is often seen to be dominant for the processing of emotional facial expressions (Borod, 1992), although this processing is acknowledged to be on a continuum with some emotions being more strongly lateralised to the right hemisphere than others (Bourne, 2010). As such, it is not necessarily the case that there is a hemispheric dichotomy for the processing of facial emotion, but rather that the right hemisphere tends to be dominant for the processing of these stimuli. Laterality for emotion processing is often assessed using the Chimeric Faces Test (CFT; Workman et al., 2006). This is a behavioural test of strength of lateralisation, measured using vertically split chimeras whereby one half is neutral and the other is emotive. Participants are asked whether faces with emotional expression in their left or right visual field are more emotive. From their responses, it is possible to calculate a visual field bias for each participant. Given that each visual field is initially processed by the contralateral hemisphere, their preference often interpreted as their hemispheric superiority for the task. As such, a left visual field bias is interpreted as a right hemispheric superiority, whereas a right visual field bias is interpreted as a left hemispheric superiority.

Relatively little work has examined how variability in lateralisation for processing emotive faces might be associated with the ability to identify the emotional and social information that arises from interactions from others, and the work that has been done is with children. Workman, Chilvers, Yeomans, and Taylor (2006) found a positive relationship between strength of lateralisation and two social emotional tasks (emotion in the eyes, and situational cartoon test). Watling and Bourne (2007) found that stronger patterns of lateralisation were associated with a better understanding of regulating emotional expressions in self-presentational stories (where a child displays a facial expression of emotion with the intent of avoiding negative evaluation). Such findings suggest that variability in emotion lateralisation is associated with the ability to recognise both social and emotion information used when interacting with others. With this in mind it is important to increase our understanding of what factors may be related to strength of lateralisation for emotion processing.

The evidence regarding generalised anxiety disorder and trait anxiety is relatively consistent, with stronger patterns of right hemisphere lateralisation for individuals with higher levels of both clinical and non-clinical anxiety (e.g., Monk et al., 2006; O'Hare & Dien, 2008), although this relationship may only be significant for males (Bourne & Vladeanu, 2011). Research with individuals diagnosed with clinical social phobia has reported both increased (Kolassa & Miltner, 2006) and decreased strength of lateralisation (Cooney et al., 2006). Further, studies with non-clinical participants have found a positive relationship between social anxiety and strength of lateralisation (Mogg & Bradley, 2002) and with differing effects depending on the emotion being processed (Ewbank, Lawrence, Passamonti, Keane, Peers, & Calder, 2009).

Social anxiety is thought to have four components: fear triggers and contexts, feared stimuli, fear related safety behaviours and feared consequences (Moscovitch, 2009). One feared consequences is fear of negative evaluation (FNE), or anxiety regarding the way in which one is viewed by others. As highlighted earlier, there is evidence for facial emotion being processed atypically in individuals with high FNE, whereby threatening faces, which might imply negative social evaluation, might be processed differently from non-threatening faces. Therefore we include all six of the basic emotions when exploring individual differences in FNE.

A second key aspect of social anxiety is how one manages the situation (i.e., safety related behaviours) through emotion regulation. Emotion regulation refers to a range of cognitive strategies, either conscious or unconscious, that can be used to understand emotional interactions and inform emotional responses (see Garnefski, Van den Kommer, Kraaij, Teerds, Legerstee, & Onstein, 2002). Research has shown that different dimensions of emotion regulation are differently associated with the ability to recognise facial emotion. For instance, Szczygiel, Buczny, and Bazińska (2012) found that participants made more errors on an emotion expression matching task after viewing a disgust eliciting video using a suppression strategy than when using a reappraisal strategy or viewing with a neutral attitude in comparison to pre-test errors. Additionally, Vanderhasselt, Baeken, Van Schuerbeek, Luypaert, and De Raedt (2013) found that women who tend to use cognitive reappraisal strategies have faster responses to emotive faces (associated with increased frontal activation, particularly in the left hemisphere), while women who tend to use more expressive suppression regulation strategies had increased activation in the amygdala. These findings indicate that emotion recognition (Szczgiel et al., 2012) and processing (Vanderhasselt et al., 2013) has differing relationships depending on the emotion regulation strategies that an individual uses. Importantly, the two aforementioned studies focus on just two emotion recognition strategies. In this paper we use the Cognitive Emotion Regulation Questionnaire (Garnefski et al., 2002) which includes nine separate strategies: self-blame, blaming others, acceptance, refocus on planning, positive refocusing, rumination, positive reappraisal, putting into perspective, and catastrophising. It is possible that, by including a wider range of regulation strategies, this more detailed measure may provide a greater insight into the regulation of emotion in individuals.

Whilst there is some evidence that individual differences in strength of emotion lateralisation may vary according to levels of clinical measures such as depression and anxiety, there is no research with adults that considers whether this variability might be associated with the ability to process emotional and social information arising from interaction with others. In this paper we present two studies to address this gap; the first considers FNE and the second emotion regulation. Although previous work has considered the relationship between emotion lateralisation and social anxiety, the findings have been contradictory (e.g., Kolassa & Miltner, 2006; Bourne and Vladeanu, 2011). Given that social anxiety comprises many distinct components (see Moscovitch, 2009), it is possible that these conflicting findings result from the use of varying measures of social anxiety. Consequently, examining measures such as FNE and emotion regulation might draw out more specific aspects of the relationship between emotion lateralisation and social feelings and emotional behaviours. Although the direction of the possible relationships to be examined cannot be accurately predicted, there is considerable evidence to suggest that sex differences should be taken into account. Sex differences have been reported for FNE (Duke, 2006) and emotion regulation strategies (e.g., Zlomke & Hahn, 2010). Additionally, there is evidence for males being more strongly lateralised than females (Bourne, 2005), and the relationships between emotion lateralisation and clinical trait measures have been found only for males for measures of anxiety (Bourne & Vladeanu,

2011) and for females only for measures of depression (Bourne & Vladeanu, 2013). It is therefore possible that any relationships identified may only be evident for one sex.

Study One: Emotion lateralisation and fear of negative evaluation

Methods

Participants

There were 110 self-reported right handed participants (55 female, M_{age} = 20.5 years, SD = 2.0, range 18 – 34 years). Handedness was confirmedusing a handedness questionnaire (adapted from Dorthe, Blumenthal, Jason, & Lantz, 1995). This questionnaire is an adaptation of the Edinburgh Handedness Inventory (Oldfield, 1971). The questionnaire comprises fourteen items, each measured on a seven point Likert scale ranging from -3 (always with left hand) through to +3 (always with right hand). As such, possible handedness scores range from -42 (strongly left handed) through to +42 (strongly right handed). In this sample the mean handedness score was 32.3 (SD = 7.1, range = 15-42). No participants reported any head injury or clinical diagnosis. Ethical approval was granted by the Departmental Ethics Committee.

Chimeric Faces Test

Chimeric faces created by Workman et al. (2000; for example stimuli see Watling, Workman & Bourne, 2012) were formed with Ekman stimuli. One male and one female poser, expressing anger, disgust, fear, happiness, sadness, or surprise, was selected. Chimerics were formed from vertically split half faces. Faces subtended about 4.5° horizontally and 7° vertically at a viewing distance of 52 cm. Stimuli were presented in greyscale on a white background. For each trial, the chimeras were presented in pairs, with one face shown above the other. One stimulus showed an emotional expression in the left half face and a neutral expression in the right half face. The other face was a mirror image, showing an emotional expression in the right half face and a neutral expression in the left half face.

For each of the six emotions there were 24 trials, presented within one block, with the placement of the two stimuli counterbalanced and randomised. The order of the six emotion blocks was also randomised across participants. For each trial participants had to decide which of the two faces looked more emotive (e.g., angrier, happier). If they thought the top face looked happier they pressed the upwards arrow on a keyboard, if they thought the bottom face looked happier they pressed the downwards arrow. Stimuli were shown until a response was given and participants were asked to respond as quickly, but as accurately, as possible. For each emotion, a laterality quotient was calculated with scores ranging from -1 (left hemisphere, right visual field bias) through to +1 (right hemisphere, left visual field bias), with 0 representing no laterality bias (see Bourne & Gray, 2009, footnote 3 for the equation).

Fear of negative evaluation

The 12 item Brief Fear of Negative Evaluation Scale (Leary, 1983) was used in this study. For each item participants were asked to read a statement and then respond on a 5 point Likert scale depending on how much the statement was characteristic of them. Each item was scored from 1 to 5, with four of the items being reverse scored. One example item is “I am afraid others will not approve of me” and a reserves scored example item is “If I know someone is judging me, it has little effect on me”. Scores across the twelve items were summed and scale scores ranged from 6 to 60, with higher scores representing greater fear of negative evaluation.

Results

Initial analyses

Laterality quotients were analysed using one sample t tests, comparing scores to 0 (no visual field bias). For all six of the emotions laterality quotients were significantly above 0 (all t's ≥ 3.3, all p's ≤ .001, indicating a left visual field (right hemisphere) bias for all versions of the test. This was also the case when looking at males and females separately; however there were no sex differences in strength of lateralisation (see Table One).

[Insert Table One about here]

Relationship between emotion lateralisation and fear of negative evaluation

Hierarchical regression models were run, with the predictors of sex and FNE in block one and then the interaction between the two predictors added in block two. Separate regression models were run predicting strength of lateralisation for each of the six emotions (see Table Two). The overall model was significant only for the processing of fearful facial emotions. The block containing the two main predictors was significant for the processing of happiness and sadness and approaching significance for the processing of anger. Looking at the predictor statistics within block one, sex was not a significant predictor in any of the regression models. The main predictor of FNE was significant for the processing of anger, happiness, and sadness, and is approaching significance for all other emotions. In all of the models, the relationship between FNE and strength of lateralisation was positive, suggesting that individuals scoring higher on the FNE measure were more strongly lateralised for the processing of all six of the basic facial emotions.

[Insert Table Two about here]

The second block, containing the interactive predictor, only provided a significant improvement to the model for the processing of fear. Adding the interaction into the model changed the significant predictor of FNE to not significant, suggesting that the interaction explains some of the variability in emotion lateralisation, and particularly for the processing of fear. The interaction between FNE and sex was only significant for the processing of fearful facial emotions. This interaction was broken down by statistically comparing the correlation coefficients for males and females. For males there was no significant correlation between FNE and lateralisation for processing fearful faces, whereas there was a significant positive correlation for females (see Table Two). These correlations differed significantly (z = 2.3, p = .011). This finding suggests that, for females only, those with greater fear of negative evaluation are more strongly lateralised to the right hemisphere for the processing of fearful facial emotion.

Study Two: Emotion lateralisation and emotion regulation

Methods

Participants

There were 175 self-reported right handed participants (100 female, M_{age} = 22.8 years. SD = 7.4, range 18 – 55 years). None of the participants were included in Study One. Handedness was confirmed (M = 32.2, SD = 6.8, range 15 – 42) using a handedness questionnaire (adapted from

Dorthe et al., 1995). This is the same questionnaire as used in Study One. No participants reported any head injury or clinical diagnosis. Ethical approval was granted by the Departmental Ethics Committee.

Chimeric faces test

The Chimeric Faces Test was identical to study one.

Emotion regulation

Emotion regulation was measured using the Cognitive Emotion Regulation Questionnaire (Garnefski & Kraaij, 2007). The questionnaire asks participants to respond according to how they cope with events and contains nine subscales, each measuring a different facet of emotion regulation: self-blame (e.g., I feel that I am the one to blame for it), acceptance (e.g., I think that I must learn to live with it), rumination (e.g., I dwell upon the feelings the situation has evoked in me), positive refocusing (e.g., I think about pleasant experiences), refocus on planning (e.g., I think about a plan of what I can do best), positive reappraisal (e.g., I think I can learn something from the situation), putting into perspective (e.g., I tell myself that there are worse things in life), catastrophizing (e.g., I continually think how horrible the situation has been), blaming others (e.g., I feel that others are to blame for it). For each scale there are four items, measured on a five point Likert scale ranging from "never" through to "always" (scored 1 to 5). Scores on each subscale are summed, providing scores ranging from 4 to 20 where higher scores indicate greater use of that particular emotion regulation strategy.

Results

Initial analyses

One-sample t tests were used to compare the laterality quotients to 0 (i.e., no visual field bias). A significant left visual field bias was found across all six of the emotions ($p < .001$ for all analyses). Looking at the laterality quotients for males and females separately, again all showed a significant right hemisphere bias (all $ps \leq .001$). There were no sex differences in strength of lateralisation for processing facial emotion (see Table One). For the nine emotion regulation subscales there was only one significant sex difference, with females scoring significantly higher than males ($p = .045$) on the positive refocusing subscale (see Table Three).

[Insert Table Three about here]

Factor analysis of emotion regulation scores

In order to simplify the analysis of the relationship between emotion regulation and emotion lateralisation, the nine emotion regulation scores were reduced to a smaller number of latent variables using factor analysis with varimax rotation. Two factors were extracted (Table Three). Factor 1 had an eigenvalue of 2.4 and explained 26.8% of the variability of scores on the emotion regulation questionnaire. The five scales that were included in this factor seem to represent positive emotion regulation strategies. Factor 2 had an eigenvalue of 2.3 and explained 25.0% of the variability of scores on the emotion regulation questionnaire. The four scales that were included in this factor seem to represent negative emotion regulation strategies.

Relationship between emotion lateralisation and emotion regulation

The zero order correlations between the two emotion regulation factors and the laterality quotients, for all participants and for males and females separately, are shown in Table Four. Inspection of these correlations appears to show a sex difference, with significant relationships for negative emotion regulation for males and significant relationships with positive emotion regulation for females. These relationships were further examined using multiple linear regression analyses.

[Insert Table Four about here]

Multiple regressions were used with laterality quotient for the six basic emotions as the outcome variables. Sex, positive emotion regulation, negative emotion regulation were entered into the first block and the interactions between sex and each of the emotion regulation factor scores were included as predictor variables into the second block. The analyses are summarised in Table 3.

The overall model was significant for predicting strength of lateralisation for anger, disgust, and fear. The amount of variability explained ranged from 4.1% to 4.8%. The change statistics for block one, containing the predictors of sex, positive emotion regulation strategies and negative emotion regulation strategies, were all not significant. Looking at the individual predictors within this block, there is only one significant finding, that the use of positive emotion strategies is predictive of stronger right hemisphere lateralisation for the processing of disgust (although this finding goes away in block two).

The changes statistics for block two, which contained the two interactive predictors, was significant for anger, disgust, and fear, and almost significant for sadness. Looking at the individual predictors, sex was not a significant predictor in any of the analyses, nor was positive emotion regulation. Negative emotion regulation was a significant predictor of strength of lateralisation for the processing of all four of the negative emotions: anger, disgust, fear and sadness. The predictor was only not significant for the positive emotions happiness and surprise. For all of the negative emotions, the relationship was positive, suggesting that individuals who score higher on the negative emotion regulation scale are more strongly lateralised to the right hemisphere for processing negative facial emotion.

For the interactions with sex, there were no significant findings for positive emotion regulation, however there were two interactions that were approaching significance: anger at $p = .052$ and happiness at $p = .053$. For both emotions, there was no significant relationship in the zero order correlations for males, but there were significant positive correlations for females. When statistically comparing the correlations, the sex difference was approaching significance for anger ($p = .067$) and happiness ($p = .059$).

The interaction between negative emotion regulation and sex was a significant predictor of strength of lateralisation for the processing of disgust, fear, and sadness. Inspection of the zero order correlations (see Table 3), shows the same pattern across all the emotions; for males there is a positive correlation, whereas for females there is no correlation between negative emotion regulation and strength of lateralisation for processing facial emotion. Statistical comparison of these correlations showed a significant difference for disgust ($p = .026$), fear ($p = .042$), and sadness ($p = .019$).

Discussion

In this paper, two studies were presented in which individual differences in strength of lateralisation for processing facial emotion were examined in relation to two different aspects of social anxiety: fear of negative evaluation and emotion regulation. For FNE, individuals with greater fear of negative evaluation were more strongly lateralised to the right hemisphere for processing facial emotion, particularly for the processing of angry, happy, and sad facial expressions of emotion. For the processing of fearful facial emotions, this relationship was only found for females. For emotion regulation, negative strategies were associated with lateralisation for the processing of negative emotions only with individuals who score highly on the use of negative emotion regulation strategies being more strongly lateralised to the right hemisphere. There was a sex difference in this relationship with a positive relationship for males, but not for females.

The finding of a positive relationship between FNE and emotion lateralisation (particularly for angry, happy, and sad emotional expressions) is consistent with the previous research examining the relationship between trait or generalised anxiety and strength of lateralisation (e.g., Bourne & Vladeanu, 2011; Monk et al., 2006; O'Hare & Dien, 2008). The previous research regarding social anxiety is somewhat less consistent, and this may be the consequence of social anxiety being multi-faceted (Moscovitch, 2009), and the different components may be differently associated with emotion lateralisation. FNE reflects an individual's fear of the negative consequences of social interactions, and these findings suggest that stronger patterns of lateralisation are associated with this aspect of social anxiety. However, there is evidence that FNE may also be further subdivided into implicit and explicit facets. Interestingly, implicit and explicit measures of FNE are not correlated (Teachman & Allen, 2007), and therefore each might be differently correlated with emotion lateralisation. In our study we used an explicit measure of FNE, and therefore a positive relationship would be predicted. However, it is unclear how implicit FNE might be associated with emotion lateralisation.

Emotion regulation relates to a specific element of social anxiety involving fear related safety behaviours. When considering the relationship between emotion regulation and emotion lateralisation, positive relationships were found between negative emotion lateralisation and the use of negative emotion regulation strategies for males only. Within our sample there was no evidence of any sex differences in either of the factored emotion regulation scales, and only one positive emotion scale (positive refocusing) showed that females scored significantly higher. Therefore, it seems unlikely that this could explain the sex difference in our findings. However, previous research has tended to report sex differences in emotion regulation strategies. Using the same emotion regulation scale as in our study, Martin and Dahlen (2005) found no sex differences in the scales of self blame, acceptance and positive reappraisal, males scored significantly higher on the blaming others scale, and women scored higher on all of the remaining scales (rumination, catastrophizing, positive refocusing, refocusing on planning, positive reappraising). As such, our only finding of a sex difference (in positive refocusing), is consistent with the findings of Martin and Dahlen, however they reported far more significant sex differences. One explanation for this might be sample size and the power behind the analyses, as Martin and Dahlen had 362 participants, although their sample was unbalanced with only 76 male participants and 286 female participants. Although our sample was smaller (175 participants), and may therefore lack power, our sample was more balanced (75 males and 100 females).

The lack of finding for females when examining the relationship between emotion regulation and lateralisation may, at least in part, be explained hormonally. It is now relatively well established that, in females, functional lateralisation fluctuates across the menstrual cycle (e.g., Hwang, Wu, Chen, Yeh, & Hsieh, 2009). This is likely to add random noise to the data and make it more difficult to detect an effect in females. Additionally, it has been shown that levels of subjective stress and cortisol levels change across the menstrual cycle, and it has been suggested that fluctuations in the cortisol stress response across the menstrual cycle may modulate emotion regulation in women (Duchesne & Pruessner, 2013). As such, there may indeed be a relationship between emotion regulation and emotion lateralisation in females, but this relationship may only be apparent after controlling for possible menstrual cycle effects,

For both FNE and emotion regulation, positive relationships were found between the measures and strength of right hemisphere lateralisation. However, there were some differences in the findings. First, emotion regulation was associated with lateralisation across all four of the negative emotions, whereas FNE was associated with both positive (happiness) and negative (anger and sadness). The differences may reflect the ways in which FNE and emotion regulation are distinct and/or overlap. Looking at the zero order correlations, only lateralisation for anger and sadness were associated with both measures. It is possible that the processing of these two facial expressions of emotion are those most highly relevant to social and emotional interactions with others. A number of studies have shown that individuals with social anxiety are more sensitive to angry faces (e.g., Mohlman, Carmin & Price, 2007), possibly due to their threatening expression (Staugaard, 2010). Others have shown that individuals with social anxiety show atypical processing of other emotional expressions, including fear (Garner, Baldwin, Bradley & Mogg, 2009) and anger, sadness, and fear (Leber et al., 2009). It is therefore possible that variability in the patterns of emotional face processing ability may be associated with the variability in patterns of emotion lateralisation. This possibility is supported by studies of emotion lateralisation in children which have shown that stronger patterns of lateralisation are associated with better processing of emotional stimuli (Watling & Bourne, 2007; Workman et al., 2006).

The second way in which the findings differ between the two studies is in relation to the interactions with sex. For FNE, sex was only an interacting variable for the processing of facial expressions of fear, with a positive relationship for females only. In contrast, for emotion regulation, the use of negative strategies was only associated with emotion lateralisation for males. Without knowing the relationship between FNE and emotion regulation, and further whether there is a sex difference in this relationship, it is difficult to clearly interpret these contrasting patterns of findings.

In this paper, two studies were presented in which variability in emotion lateralisation was examined in relation to distinct aspects of social anxiety. We found that individuals with greater fear of negative evaluation from others are more strongly lateralised to the right hemisphere for the processing of anger, happiness, and sadness, and that for fear this relationship was only evident for females. With regards to the use of emotion regulation strategies when coping with negative experiences, individuals are likely to be more strongly lateralised to the right hemisphere; this is especially true for males when processing disgust, fear, and sadness. Although these studies were correlational, and therefore conclusions cannot be drawn regarding the direction of the relationship, they do show that variability in the neuropsychological processing of emotion is associated with feelings about and responses to being in social situations. Taken together, these two findings suggest that individuals who have difficulties processing emotional information that arises from social interactions may be over reliant on the right hemisphere for the processing of emotional facial expressions.

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Table One: Descriptive statistics of laterality quotients, fear of negative evaluation (FNE; Study One) and emotion regulation (Study Two).

Study One:	All participants (N = 110)	Males (N = 55)	Females (N = 55)	Sex differences analysis		
	Mean (SD)	Mean (SD)	Mean (SD)	t	p	d
Anger	.24 (.52)	.28 (.47)	.21 (.57)	.7	.459	.14
Disgust	.16 (.52)	.14 (.49)	.18 (.55)	-.4	.660	.08
Fear	.23 (.49)	.22 (.49)	.23 (.51)	-.2	.873	.04
Happiness	.28 (.49)	.27 (.46)	.30 (.51)	-.3	.733	.06
Sadness	.24 (.49)	.22 (.47)	.26 (.51)	-.4	.710	.08
Surprise	.32 (.50)	.33 (.48)	.31 (.53)	.2	.851	.04
FNE	37.90 (9.05)	35.44 (7.97)	40.36	-3.0	.004	.58
Study Two:	All participants (N = 175)	Males (N = 75)	Females (N = 100)	Sex differences analysis		
	Mean (SD)	Mean (SD)	Mean (SD)	t	p	d
Anger	.23 (.48)	.26 (.44)	.21 (.51)	.65	.514	.10
Disgust	.18 (.49)	.21 (.49)	.16 (.49)	.72	.474	.11
Fear	.28 (.49)	.34 (.50)	.23 (.48)	1.40	.163	.21
Happiness	.27 (.51)	.31 (.46)	.24 (.54)	1.00	.318	.15
Sadness	.21 (.43)	.23 (.47)	.20 (.40)	.57	.569	.09
Surprise	.26 (.54)	.30 (.51)	.24 (.56)	.72	.475	.11
Positive factor score	.01 (1.01)	-.05 (.97)	.06 (1.03)	-.70	.487	.11
Negative factor score	.00 (1.01)	-.05 (1.05)	.04 (.98)	-.57	.568	.09

Note, for all sex difference analyses: df = 108 for Study One, and df = 173 for Study Two.

Table Two: Summary of the zero order correlations and regression analyses for each emotion separately and fear of negative evaluation (FNE).

		Anger			Disgust			Fear			Happiness			Sadness			Surprise		
Zero order correlations		All	M	F	All	M	F	All	M	F	All	M	F	All	M	F	All	M	F
	r	***.190***	.109	***.293***	.172	.164	.169	.181	-.053	***.376***	***.233***	.242	.227	***.233***	.211	.248	.162	.134	.204
	p	***.047***	.428	***.030***	.073	.230	.218	.059	.703	***.005***	***.014***	.075	.096	***.014***	.122	.067	.090	.328	.135
Model statistics		R^2	F	p	R^2	F	p	R^2	F	p	R^2	F	p	R^2	F	p	R^2	F	p
Overall (ANOVA)		.061	2.30	.082	.030	1.08	.362	***.075***	***2.86***	***.040***	.056	2.08	.107	.055	2.06	.109	.031	1.15	.334
Block 1 (change statistics)		.052	3.00	.056	.030	1.63	.201	.034	1.88	.157	***.055***	***3.13***	***.048***	***.055***	***3.12***	***.048***	.031	1.69	.190
Block 2 (change statistics)		.009	.98	.324	.000	.01	.979	***.041***	***4.7***	***.032***	.000	.02	.878	.000	.01	.915	.001	.09	.760
Predictor statistics		β	t	p	β	t	p	B	t	p	B	t	p	β	t	p	β	t	p
Block 1:	Sex	-.074	-.76	.449	.044	.44	.658	.015	.162	.872	.032	.359	.727	.035	.38	.705	-.018	-.19	.848
	FNE	***.013***	***2.31***	***.023***	.010	1.75	.083	.010	1.93	.056	***.013***	***2.48***	***.015***	***.013***	***2.47***	***.015***	.010	1.82	.070
Block 2:	Sex	-.074	-.76	.449	.044	.44	.659	.015	.165	.870	.032	.348	.729	.035	.38	.706	-.018	-.19	.849
	FNE	-.005	-.26	.795	.010	.54	.589	-.026	-1.49	.140	.016	.88	.381	.011	.63	.532	.005	.25	.805
	Interaction	.011	.99	.324	.000	-.03	.979	***.023***	***2.17***	***.032***	-.002	-.15	.878	.001	.11	.915	.003	.31	.760

Significant findings are presented in bold and italicised.

Table Three: Descriptive statistics for the emotion regulation (ER) scales in Study Two (Note, df = 173 for all sex difference analyses). Also, correlations and factor loadings for the nine emotion regulation scales and the two emotion regulation factor scores.

	All participants (N = 175)		Males (N = 75)		Females (N = 100)		Sex differences analysis			Zero order correlations		Factor loadings	
	Mean	SD	Mean	SD	Mean	SD	t	p	d	Factor 1: Positive ER	Factor 2: Negative ER	Factor 1: Positive ER	Factor 2: Negative ER
Self blame	9.83	2.77	9.81	3.04	9.84	2.57	-.06	.950	.01	-.036	***.668******	-	.686
Acceptance	12.62	3.18	12.24	3.44	12.91	2.95	-1.38	.168	.21	***.447******	***.386******	.466	-
Rumination	11.81	3.27	11.49	3.42	12.05	3.15	-1.12	.266	.17	***.153****	***.791******	-	.799
Positive refocusing	10.95	3.29	10.37	3.07	11.38	3.40	***-2.02***	***.045***	***.30***	***.643******	.052	.642	-
Refocus on planning	14.02	3.42	14.37	3.46	13.75	3.38	1.20	.233	.18	***.777******	-.077	.773	-
Positive reappraisal	14.47	3.61	14.57	3.39	14.40	3.78	.31	.754	.05	***.830******	-.139	.822	-
Putting into perspective	13.85	3.70	13.52	3.62	14.09	3.76	-1.01	.315	.15	***.692******	-.109	.684	-
Catastrophising	7.98	2.86	8.04	2.94	7.93	2.82	.25	.802	.04	-.111	***.813******	-	.813
Other blame	8.17	2.65	8.19	2.51	8.15	2.76	.09	.928	.01	-.087	***.602******	-	.574

* p < .050, ** p < .010, *** p < .001. Significant correlations are presented in bold and italicised.

Table Four: Summary of the zero order correlations and regression analyses for each emotion separately and for the mean laterality quotient.

		Anger			Disgust			Fear			Happiness			Sadness			Surprise		
Zero order correlations		All	M	F	All	M	F	All	M	F	All	M	F	All	M	F	All	M	F
Positive strategies	r	.128	-.045	***.238***	***.171***	.052	***.261***	.094	-.038	***.203***	.103	-.073	***.216***	.125	.056	.187	.091	.050	.122
	p	.091	.703	***.017***	***.023***	.656	***.009***	.214	.745	***.043***	.173	.532	***.031***	.100	.631	.062	.231	.669	.226
Negative strategies	r	.131	***.291***	.025	.068	***.261***	-.084	.096	***.273***	-.043	.094	.197	.031	.003	.186	-.167	-.011	.076	-.072
	p	.085	***.011***	.807	.373	***.024***	.407	.206	***.018***	.670	.215	.091	.759	.969	.109	.097	.880	.517	.478
Model statistics		R^2	F	p	R^2	F	p	R^2	F	p	R^2	F	p	R^2	F	p	R^2	F	p
Overall (ANOVA)		***.043***	***2.56***	***.029***	***.048***	***2.77***	***.020***	***.041***	***2.50***	***.033***	.024	1.86	.103	.024	1.85	.106	.011	.64	.673
Block 1 (change statistics)		.037	2.17	.093	.038	2.24	.085	.031	1.83	.144	.026	1.55	.203	.018	1.05	.373	.012	.69	.562
Block 2 (change statistics)		***.034***	***3.06***	***.050***	***.038***	***3.47***	***.033***	***.038***	***3.42***	***.035***	.026	2.30	.103	.034	3.01	.052	.01	.56	.571
Predictor statistics		β	t	p	β	t	p	β	t	p	β	t	p	β	t	p	β	t	p
Block 1	Sex	-.06	-.83	.410	-.07	-.89	.377	-.11	-.153	.128	-.09	-1.13	.259	-.04	-.66	.510	-.06	-.77	.441
	Positive	.06	1.72	.088	***.084***	***2.31***	***.022***	.05	1.31	.193	.05	1.40	.163	.05	1.68	.095	.05	1.24	.217
	Negative	.062	1.74	.083	.033	.90	.372	.05	1.32	.190	.05	1.27	.206	.01	.03	.973	-.01	-.14	.887
Block 2	Sex	-.06	-.85	.399	-.07	-.92	.360	-.12	-1.57	.119	-.09	-1.14	.254	-.04	-.69	.490	-.06	-.78	.437
	Positive	-.17	-1.37	.172	-.08	-.65	.519	-.14	-1.15	.251	-.19	-1.46	.147	-.02	-.22	.826	-.02	-.12	.908
	Negative	***.23***	***2.03***	***.044***	***.28***	***2.45***	***.015***	***.28***	***2.42***	***.017***	.16	1.29	.198	***.23***	***2.25***	***.026***	.11	.86	.390
	Positive * Sex	.14	1.96	.052	.10	1.38	.169	.12	1.60	.111	.15	1.95	.053	.05	.74	.461	.04	.49	.622
	Negative * Sex	-.11	-1.55	.122	***-.16***	***-2.27***	***.024***	***-.15***	***-2.10***	***.037***	-.07	-.93	.352	***-.15***	***-2.35***	***.020***	-.08	-.95	.344

Significant findings are presented in bold and italicised.