Midfrontal theta power as response to social-evaluative feedback from predominantly positive or negative peers in individuals with fear of negative evaluation.

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Midfrontal theta power as response to social-evaluative feedback from predominantly positive or negative peers in individuals with fear of negative evaluation.

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Abstract

Midfrontal EEG oscillations in the theta (4-8 Hz) band reflect a threat-detection mechanism, which might work differently in individuals with fear of negative evaluation (FNE) due to attentional biases. This study aimed to examine FM theta reactivity to social-evaluation in a probabilistic feedback learning experiment, and possible biased learning processes in individuals with FNE, a hallmark feature in social anxiety. Additionally, the current study explored the possible mediating role of FM theta power in the relationship between FNE and emotion regulation. Fifty-nine undergraduate students (mean age = 20.5 years) participated in the newly developed SELF-profile paradigm. The participants received social rejection or acceptance feedback by (predominantly positive and negative) peers, which was either congruent or incongruent with prior expectations. Results revealed that unexpected peer feedback, regardless of the valence (acceptance or rejection), elicited a significant increase in FM theta power, as did feedback from the most negative peer. No association between FM theta power and FNE was found, and FM theta power did not mediate the relationship between FNE and emotion regulation (positive reappraisal or rumination). Behaviourally, participants had more difficulties in learning the probability of acceptance feedback for the negative peer than the positive peer. Individuals with FNE were slower in predicting acceptance feedback for the most positive peer, and felt more rejected after the experiment. Together, the results provided evidence that individuals with higher FNE seemed to display increased negative affect after receiving feedback and an attention bias towards threat. Furthermore, FM theta power seemed to reflect uncertainty-driven exploration.

Keywords: EEG, Emotion regulation, Fear of negative evaluation, Social-evaluative feedback, Theta power.

Layman's abstract

In this study, we wanted to learn more about how people with fear of negative evaluation (FNE) learn from, and how their brain responds to, social rejection or acceptance feedback. We studied this by measuring frontal-midline (FM) theta (4-8 Hz) power, a specific frequency range of brain activity that can be measured with an electroencephalogram (EEG). FNE is a characteristic of social anxiety, and by investigating this, we wanted to understand more about how social anxiety is maintained. We also looked at whether FM theta power is necessary to regulate emotions in a helpful way. Fifty-nine university students (mean age = 20.5 years) took part in our newly developed experiment, called SELF-profile. The students predicted whether they would receive acceptance or rejection feedback from (mostly positive and negative) peers, and then received their feedback. Feedback could therefore either be expected or unexpected. Our results showed that unexpected peer feedback (both unexpected acceptance or rejection), and feedback from the most negative peer led to an increase in FM theta power. These results did not differ for people with FNE, and we did not find that FM theta power was needed to regulate emotions (by using rumination or positive reappraisal as regulation strategy). Participants found it more difficult to learn the odds of receiving acceptance feedback from the most negative peer than the positive peer. We also found that people with higher FNE felt more rejected after the experiment and were more focused on social threat, which might maintain social anxiety. Together, these results show that FM theta power was highest when social feedback led to uncertainty, and therefore people had to explore more.

Midfrontal theta power as response to social-evaluative feedback from predominantly positive or negative peers in individuals with fear of negative evaluation.

Navigating our social environment successfully depends on learning from positive and negative experiences with others and shaping future behaviour adequately towards those individuals (Jones et al., 2011). It has been postulated that people have evolved a neural alarm system to detect signs of social rejection, so that individuals can adapt their behaviour to protect from disconnection (Eisenberger, 2012; Eisenberger & Lieberman, 2004; MacDonald & Leary, 2005). Recent evidence suggests that this alarm system is mainly rooted in the dorsal anterior cingulate cortex (dACC), insula, frontal pole, inferior frontal gyrus, and supplementary motor area (SMA) (Van der Molen et al., 2017). Additionally, van der Molen and colleagues (2017) found that frontal-midline (FM) theta (4–8 Hz) power originated in these brain regions is elevated during unexpected social rejection feedback, which is seen as a social threat. Thus, FM theta power seems to be a threat-detection mechanism. This threat-detection mechanism might work differently in individuals who fear negative social evaluation, which is a core component of social anxiety (Mattick & Clarke, 1998). In the current study, we were interested in investigating how this neural alarm system works in people with different levels of fear of negative evaluation (FNE), by examining the relationship between FNE and FM theta reactivity to social-evaluation in a probabilistic feedback learning experiment.

Two different attentional biases may play a role in social anxiety, and therefore in FNE, which limit the ability to learn from social encounters: self-focused attention and increased focus on threat. The existence of an attentional bias towards threat in both anxious patients and high-trait anxious individuals is well established (Bar-Haim et al., 2007 & Frewen et al., 2008). Likewise, the social-evaluative threat principle (Wong & Rapee, 2016) suggests that socially anxious individuals should show increased reactivity to social-evaluative feedback, as this feedback appears to be a threat to the individual's well-being (Baumeister & Leary, 1995; Eisenberger & Lieberman, 2004). In contrast, the cognitive-behavioural model on social anxiety of Clark and Wells (1995) indicates that the processing of external social-evaluative threat signals is reduced, presumably because of heightened self-focused attention in socially anxious individuals (Bögels & Mansell, 2004). It is argued that this self-focused attention to internal stimuli (such as own thoughts or bodily arousal) results in decreased attention to external signals, and thus restricts the processing of external social-evaluative threats (Clark & Wells, 1995; Rapee & Heimberg, 1997, Terasawa et al., 2013). This limited processing of external social-evaluative threat could lead to less accuracy in interpretations, leaving more room for (biased) interpretation, which could maintain social anxiety.

Since these theories contradict each other, neural reactivity as a result of social-evaluative feedback might offer an objective measurement to determine whether individuals with a high level of FNE show heightened or lower sensitivity to social-evaluative threat (van der Molen et al., 2018). Additionally, neural deficits may emerge before behavioural symptoms (Kujawa & Burkhouse, 2017), and can therefore be used for prevention and intervention efforts. A small number of studies have contributed to this topic, and results are ambiguous. Van der Molen and colleagues (2014) used the Social Judgement paradigm (SJP; Somerville et al., 2006), in which participants are shown portrait photographs of peers that supposedly provided social evaluative (like/dislike) feedback about these participants. Social rejection or acceptance feedback is provided, which is either congruent or incongruent with participants' prior predictions. They investigated the association between FNE and neural sensitivity to the processing of this social-evaluative feedback, as indexed by the feedback related negativity (FRN) and P3. The FRN component reflects response to negative feedback (Rappaport & Barch, 2020), and the P3 component seems responsive to expected social acceptance feedback, indicating reward sensitivity (van der Veen, 2014). They found that the FRN was more sensitive to unexpected feedback, but this failed to reach significant levels. Since time frequency components, such as feedback-related theta power, give better insights in the specific contribution of each frequency to the event-related potential (ERP, such as the FRN), we examined whether FNE levels are significantly associated with oscillations in the theta frequency band.

Subsequent studies examined the sensitivity of FM theta power to the processing of social-evaluative feedback (Harrewijn et al., 2017; van der Molen et al, 2017; van der Molen et al, 2018). FM theta oscillations reflect a generic mechanism involved in adaptive cognitive control efforts, such as dealing with uncertain outcomes or optimal behavioural adjustment after errors, also during situations that elicit anxiety (Cavanagh & Frank, 2014; Cavanagh & Shackman, 2015). FM theta reactivity to social-evaluative feedback may form a neural mechanism of the processing of social-evaluative threat in socially anxious individuals (van der Molen et al., 2018). Using the SJP, van der Molen et al. (2018) found that socially anxious females displayed decreased midfrontal theta reactivity to unexpected social rejection feedback, whereas non-socially anxious females showed significantly higher reactivity. This suggests increased self-focused attention in socially anxious individuals (Clark & Wells, 1995), or an expectation bias towards rejection, resulting in less surprising rejection feedback (Clark & McManus, 2002; Wong & Rapee, 2016). In contrast, Harrewijn and colleagues (2017) used the SJP and found that individuals with social anxiety disorder (SAD) showed increased theta power to unexpected rejection feedback compared to other conditions, suggesting a selective bias for negative evaluation (Clark & McManus, 2002). Since the samples of these studies differed in multiple aspects (e.g., sample size and clinical status), comparing these results is difficult, and the effect of unexpected rejection feedback on FM theta reactivity in socially anxious individuals remains elusive. Additionally, these studies using the SJP solely focus on the reactivity to social-evaluative feedback. The current study employed a novel paradigm to additionally assess how individuals integrate this feedback to form impressions about a person and learn from the provided feedback.

Previous studies posit that social anxiety involves difficulties with emotion regulation, or emotion dysregulation (Clark & Wells, 1995; Hofmann, 2007). Emotion regulation refers to efforts to regulate the intensity or duration of the emotional response (Gross, 1998, 2013), and plays an important role in adapting to stressful life events (Eisenberg et al., 2000; Gross, 1998). Anxiety disorders are associated with impaired top-down emotion regulation (such as reappraisal) prior to and during anxiety-evoking scenarios (Brühl et al., 2013). Learning adaptive emotion regulation strategies might therefore be a protective mechanism. The cognitive way of dealing with emotionally arousing information is particularly powerful (Thompson, 1991; Ochsner & Gross, 2005). Cognitive strategies such as rumination and reduced positive reappraisal have been associated with higher levels of stress and anxiety (Martin & Dahlen, 2005). Therefore, it is expected that these emotion regulation strategies are related to FNE, which is associated with both social anxiety and stress. Assessing the relationship between rumination or positive reappraisal and levels of FNE, might give further insights in adaptive emotion regulation strategies, and enable to examine the role of FM theta power within this association.

Since FM theta power is associated with adaptive cognitive control operations (Cavanagh & Frank, 2014), it is suspected that emotion regulation strategies that require cognitive control might be mediated by FM theta power. Oscillations in the theta frequency band are found in brain areas which are usually reported when the saliency network is activated (i.e. the dACC, insula, frontal pole, inferior frontal gyrus, and supplementary motor area (SMA)) (Van der Molen et al., 2017; Ham et al., 2013; Menon & Uddin, 2010). Menon and Uddin (2010) suggest that this saliency network distinguishes the most relevant internal and external stimuli. The saliency network engages top-down, cognitive control processes (Seeley, 2019; Dosenbach et al., 2008). These top-down processes can be used to detect and filter salient stimuli, thereby having the ability to generate and regulate emotions by controlling which stimuli have access to emotions generated by bottom-up processes (Ochsner & Gross, 2007). Since FM theta power is found in brain regions associated with the saliency network, and the saliency network triggers top-down processes which are present when regulating emotions, it is expected that FM theta power is required to adaptively regulate emotions.

Indeed, Ertl and colleagues (2013) found that FM theta reactivity is associated with successful usage of cognitive reappraisal in order to decrease negative emotions. With respect to rumination, Andersen and colleagues (2009) found that increased scalp-wide theta power was associated with rumination regarding subjectively important goals. Their hypothesis regarding FM theta specifically, however, was not supported by their results. Suggesting that the dACC and other regions involved in top-down cognitive control are not activated during rumination. These studies provide support for the notion that FM theta power as cognitive control mechanism is necessary to use positive reappraisal, but not rumination. The current study specifically focused on the role of FM theta power as threat detection mechanism and its possible mediating role leading to everyday use of positive reappraisal or rumination.

In the current study, we used the Social Evaluative Learning through Feedback (SELF-) Profile paradigm to examine electrocortical responses to social-evaluative feedback processing in individuals with different levels of FNE. The SELF-Profile paradigm is a newly developed paradigm (inspired by paradigms of Jones et al., 2011; Will et al., 2017 and the Social Judgement Paradigm; Gunther Moor et al., 2010, Somerville et al., 2006, Van der Molen et al., 2014). In this paradigm, participants were asked to create a profile with a photo and 60 answered questions about themselves. The participants were allegedly given social rejection or acceptance feedback based on their answers to the 60 questions by their chosen top 4 peers, which was either congruent or incongruent with prior expectations. Unbeknown to the participant, the peers differed in the probability of providing social-evaluative acceptance feedback (85%, 70%, 30%, or 15%, of which the most positive and negative were used in this study). This set-up allowed for examining probabilistic learning, as well as possible biased social-evaluative learning processes, and reactivity to social-evaluative feedback in individuals with different levels of FNE. Additionally, the current study explored the possible mediating role of FM theta power in the relationship between FNE and emotion regulation.

Based on evidence by van der Molen and colleagues (2017; 2018), we expected higher FM theta reactivity to unexpected social rejection compared to expected social rejection and (un)expected social acceptance. With respect to the learning effect, we hypothesized that unexpected rejection from the most positive peer (Peer 1) lead to higher theta reactivity than unexpected rejection from the most negative peer (Peer 4). Following van der Molen and colleagues (2018), we tested two competing hypotheses regarding FNE: If participants with higher levels of FNE displayed reduced processing of social-evaluative threat (Clark & Wells, 1995), FM theta reactivity to unexpected social rejection feedback would be lower. However, if these participants perceived social rejection feedback as a threat (Wong & Rapee, 2016), FM theta power would be higher in these participants. We expected that this effect would be more apparent in peer 1 than peer 4. With respect to emotion regulation, we expected that FNE was positively associated with rumination, and negatively associated with positive reappraisal, since rumination and reduced positive reappraisal have been associated with anxiety and stress (Martin & Dahlen, 2005). Finally, we exploratively examined the mediating role of FM theta reactivity to unexpected social rejection in the relationship between FNE and positive reappraisal and rumination.

Method

Design

This study was part of the Changing Minds project, a larger project that aimed to analyze which distinctive symptom-profiles are sensitive to diverse social-stressful situations, and their ability to cope with social stress by testing how people adjust their behaviour after receiving social feedback. The current study had a within-subjects design, and focused on one of the three paradigms that were administered in the Changing Minds Project, namely the SELF-Profile paradigm.

Participants

Undergraduate students aged between 18-26 within the proximity of Leiden University were recruited to participate in this study. Participants were excluded when they had participated in an earlier edition of this study or had knowledge of Japanese/ Chinese symbols (relevant for one of the other tasks that was administered). Furthermore, participants were excluded when they used medication that could influence cognitive performance, or had a (history of) head trauma or psychiatric disorders, including clinical levels of social anxiety and/or depression. After participation, some participants were excluded due to data recording failures (n = 4), and disbelief in the cover story (n = 4). This resulted in a total sample of 59 participants. All participants signed informed consent prior to the experiment and received (course credits and) a monetary reward afterwards. The study's protocol was reviewed and approved by the medical ethical review committee of the Leiden University Medical Center. The sociodemographic characteristics of the participants are presented in Table 1.

Table 1

Characteristics of the sample.

	n	*M*	*SD*	Range
Age		20.5	2.0	18.2 - 26.3
Gender				
Male	6			
Female	53			
Student				
Dutch	26			
International	33			
Completed Educational level				
High school	47			
HBO first year	4			
HBO Bachelor	1			
University Bachelor	5			
University Master	2			

Note. HBO = university of applied sciences in the Netherlands. After finishing the first year (propaedeutic year), students can start with an academic bachelor at the university.

Procedure and Materials

Prior to the lab visit, the online prescreening was filled out via Qualtrics. This took around 10 minutes. Initially, the information letter was shown and informed consent was asked. The prescreening itself consisted of inclusion/exclusion criteria questions, contact information questions, and a questionnaire. During the first testing day, lasting 2,5 to 3 hours approximately, participants first filled out numerous questionnaires, including the Brief Fear of Negative Evaluation Scale (BFNE-R; Bögels & Reith, 1999). This took 50 minutes in total, whereafter they engaged in Paradigm 1. EEG and ECG were registered during this paradigm. At the end of this day participants received information about the cover story for paradigm 2.

During the second testing day participants filled out the remaining questionnaires, including the Cognitive Emotion Regulation Questionnaire, (CERQ; Garnefski et al., 2001; Garnefski & Kraaij, 2006). This took approximately 35 minutes in total. Thereafter paradigm 2, the SELF-Profile task, started. First a 5-minute baseline (resting-state) physiological (ECG/EEG) measurement started, which was followed by the SELF-Profile task. Afterwards another baseline physiological (ECG/EEG) recording was administered. Before and after both baseline measurements, participants were asked to indicate how anxious they felt on a visual analogue scale (VAS-scale). Prior to and after the SELF-Profile paradigm participants were asked (a) to estimate the amount of acceptance feedback they expect to receive/have received overall and from each peer, (b) to indicate how likeable they find each peer and to what extent they believe they could be friends with them, and (c) how accepted/rejected they feel by the peers and in general (only after the task). Answers were given on a VAS-scale, and these questions were used to measure explicit (conscious) learning. The duration of this paradigm was approximately 60 minutes. Afterwards, the participants took part in paradigm 3, which likewise lasted around 60 minutes. EEG and ECG were also registered during this paradigm. At the end of this testing day, participants were debriefed to reveal the cover-story and the true purpose of the study. This day lasted 3,5 hours. The total time for the participants was 6,5 hours.

SELF-Profile paradigm

For the experiment we used the newly developed Social Evaluative Learning through Feedback (SELF-) Profile paradigm (inspired by paradigms of Jones et al., 2011; Will et al., 2017 and the Social Judgement Paradigm; Gunther Moor et al., 2010, Somerville et al., 2006, van der Molen et al., 2014). The SELF-Profile paradigm allowed for examining FM theta activity elicited by social-evaluative feedback.

Via a cover story (see appendix A), participants were led to believe that they were enrolled in a study on first impressions about appearance and personal content. All participants created their own profile via Qualtrics by uploading a profile-picture of themselves and answering 60 2-choice questions that characterize their interests, personality, and behaviour in social situations (e.g. ‘I usually approach others’ or ‘I usually wait for others to approach me’). Participants were asked to choose the statement that characterizes them most (see appendix B for an example of the profile). Prior to creating this profile, participants viewed profiles of peers who allegedly also participated in the study. To decrease the likelihood of socially desirable answers, we ensured that previously viewed peer-profiles contained a broad diversity of answers.

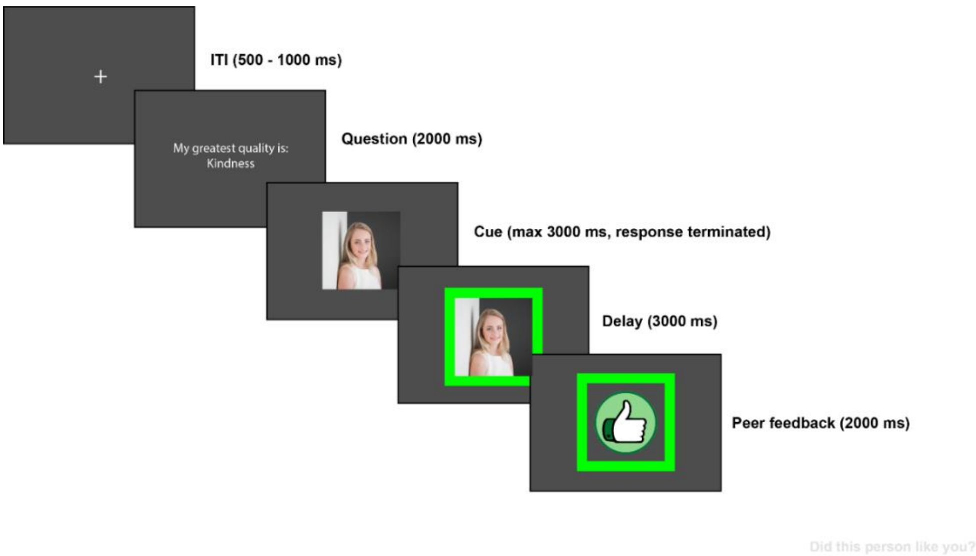
First, participants rated profile-pictures of 24 gender-matched peers using VAS-scales. Thereafter, they selected 4 peers from their alleged top 12 peers’ content-profiles (without photos). The picture-ratings were used to select 4 peer-pictures that were matched on the extent they believed they could be friends/ likeability. These pictures were used during the lab visit to represent the peers that the participant allegedly selected. This preparation for the second testing day took place during the first day and at least one week prior to testing day 2, and lasted around 20 minutes to complete.

During the second testing day, participants were shown their own profile again. They were asked to indicate for each of their 60 answers to what extent they felt that answer is characteristic of them (using a VAS scale). While viewing the photos of the four peers they allegedly selected two weeks earlier, they were told that the four peers had evaluated the participant’s profile and that they would shortly receive feedback on their profile from them. Additionally, they were told that each of the peers previously indicated per answer to each of the 60 profile-questions, whether they liked the participant or not based on the answer the participant had given. In reality, this feedback was generated by a computer.

In a reinforcement-learning task environment, participants then predicted on a trial-to-trial basis for each of the 60 evaluative items per peer (thus 60 items x 4 peers = 240 trials) whether the peer liked or disliked the participant based on the answer to this social-evaluative item (see appendix C for the visual explanation about social-evaluative feedback). The reaction times (RT) from cue onset until their prediction were measured, which is a measure of implicit (subconscious) associations (Greenwald et al., 1998). Participants were unaware that the four peers differed in their probability of giving acceptance feedback (i.e., 85%, 70%, 30%, 15%, as generated by the computer). All participants received an equal amount of positive and negative feedback. An outline of a trial of the SELF-Profile paradigm is presented in Figure 1.

Figure 1

Example of a single trial of the SELF-Profile paradigm.



Note. The photo of the peer who provided the social-evaluative feedback is shown. The green square shows that the participant expected acceptance feedback, and the thumbs-up shows that the participant guessed correctly.

Signal recording and processing

EEG data were acquired online between 0.01–100 Hz at a 2048 Hz sampling rate with a Biosemi Active Two system (Biosemi, Amsterdam, the Netherlands) from 64 active scalp electrodes placed in an electrode cap, using the 10/20 system. Two electrodes placed below and above the left eye were used to measure vertical eye-movements (VEOG). Horizontal eye-movements (HEOG) were measured from two electrodes placed at the right and left lateral canthi. For offline reference, two electrodes were placed at the mastoids. As online reference, the common mode sense and driven right leg electrodes, which are part of a feedback loop to replace the conventional ground electrode, were used.

EEG time-series data were offline analyzed using Brain Vision Analyzer (BVA 2.2.1; Brain Products GmbH, Munich, Germany), down-sampled to 512 Hz, and re-referenced to the average of the left and right mastoid electrodes. A 0.01-70 Hz band-pass filter (including a 50 Hz notch filter) was applied. Afterwards, a linear derivation method was used to create a single HEOG and VEOG channel based on the existing EOG channels. Time-series were epoched from -250 to 12000ms surrounding the onset of the peer cue type. After these epochs were baseline corrected from -200 to 0 using a linear subtraction method, the epochs were manually screened for noisy channels that demonstrated clipping, excessive drift or high frequency noise throughout the recordings, and removed to be interpolated later. Thereafter, artifacts with a maximum voltage step of 50 μV, a maximum allowed difference of 150 μV in the epoch, as well as activity below 0.5 μV, were marked by an automatic artifact rejection method. These epochs were manually inspected, and marked artifacts other than eye blinks (e.g., clipping, muscular activity, and movement artifacts) were removed from the data, except for noisy channels. Electrodes were considered noisy, and thus interpolated by a spherical spline interpolation method, when at least five epochs had to be discarded after the abovementioned steps. On average, 1.05 (*SD* = 1.04) channels were interpolated per participant. Eye blinks or movements were automatically removed from the data with the Ocular Independent Component Analysis method, as implemented in BVA.

Time-frequency analyses

Data was analyzed from peer 1 and 4 only, by creating epochs from -250 to 12000ms around the peer. Afterwards, the data was segmented per condition (valence and congruency) in epochs of 8s (-4 to +4s) surrounding the onset of the feedback stimulus. To extract time-frequency characteristics from the EEG time series per condition, the single trials were convolved with a family of complex Morlet wavelets, which can be defined as Gaussian-windowed sine waves (van der Molen et al., 2017). Time-frequency data was normalized on a single trial level through decibel normalization with a 2300-2800ms post-feedback reference interval. Convolution was performed from 1 to 70 Hz in 60 logarithmically spaced steps (wavelet length = 95.27 ms). The Morlet parameter was set to 5 to obtain an adequate trade-off between time and frequency precision. The Gabor normalization method as implemented in Brain Vision Analyzer was used, which gives the amplitude of the signal at each frequency layer. Afterwards, segmentations from -500 to +2000ms surrounding the onset of the feedback stimulus were created, and electrodes Fz and FCz were a priori selected, since previous research showed a pronounced burst in theta power in these electrodes (van der Molen et al., 2017; van der Molen et al., 2018). These electrodes were averaged per condition, and by collapsing over the conditions we observed that theta power reached its peak at Fz during a 200-400ms post-feedback time-window, which was extracted for further analyses.

Self-report questionnaires

Fear of negative evaluation.

The Brief Fear of Negative Evaluation Scale, revised (BFNE-R; Bögels & Reith, 1999; Carleton et al., 2006) was used to measure fear of negative evaluation in the participants. This questionnaire consists of 12 items rated on a five-point Likert scale (1 =

Not at all characteristic of me, 2 = Slightly characteristic of me, 3 = Moderately characteristic of me, 4 = Very characteristic of me, 5 = Extremely characteristic of me). The scores were recoded into 0-4, to compare them to recent norm scores. The total of the scores (ranging from 0 to 48) on these items were used to determine the FNE levels. A cutoff score of greater than 38 may be indicative of clinically significant social anxiety (Carleton et al., 2011).[1] The test-retest reliability and internal consistency of the BFNE-R is excellent, and it is a frequently used measure of social anxiety (Carleton et al., 2011; Collins et al., 2005). In addition, analysis showed that the BFNE-R had a high internal reliability for this dataset (Cronbach's alpha = .90).

Emotion regulation.

The short version of the Cognitive Emotion Regulation Questionnaire (CERQ- short; Garnefski & Kraaij, 2006; Garnefski et al., 2001) was used to identify the cognitive emotion regulation strategies (or cognitive coping strategies) the participants use after having experienced negative events or situations. This questionnaire consists of 18 items rated on a five-point Likert scale (1 = (almost) never, 2 = sometimes, 3 = regularly, 4 = often, 5 = (almost) always). It consists of nine subscales, of which two are used in this study: Rumination and Positive Reappraisal. The totals of the scores on these subscales (ranging from 2 to 10) were used to determine the emotion regulation strategy used by the participants. The reliability of the CERQ-short is high, and the internal consistency of the subscales are good (Garnefski & Kraaij, 2006), which suggests that the CERQ-short is a valid instrument to measure emotion regulation strategies. The Rumination subscale had an acceptable internal

[1] We measured social anxiety (Liebowitz Social Anxiety Scale (LSAS); Liebowitz, 1987), and rejection sensitivity (Rejection Sensitivity Questionnaire (RSQ); Downey & Feldman, 1996) to compare FNE levels with other studies on social anxiety and constructs associated with social anxiety. These data are presented in Table 2.

reliability in the current sample (Cronbach's alpha = .60), and the Positive Reappraisal scale a high internal reliability (Cronbach's alpha = .79)

Statistical approach

In order to investigate whether there is a difference in theta reactivity to unexpected rejection, compared to expected rejection and (un)expected acceptance for peer 1 and peer 4, a within-subject repeated measures analysis of variance (ANOVA) test was run in IBM SPSS statistics (version 24): The within subject independent variable was the Feedback Valence (2 levels: Positive, Negative), Feedback Congruency (2 levels: Congruent, Incongruent) and Peer (2 levels: Peer 1, Peer 4). The dependent variable was FM theta power.[2] To test the relationship between FNE and FM theta reactivity to unexpected social rejection, Pearson r correlation tests were run for peer 1 and peer 4 separately. Thereafter, Fisher's r-to-Z transformation calculator was used to compare the correlation coefficients from peer 1 and peer 4. To assess the association between FNE and rumination/ positive reappraisal, a Pearson r correlation test was run.[3] Last, to further investigate whether FM theta reactivity to unexpected social rejection mediated this relationship between the level of FNE and rumination/ positive reappraisal, and whether this differed for peer 1 and peer 4, four separate mediation analyses were performed in SPSS. All variables met assumptions of normality (skewness and kurtosis were < 1.96). EEG measures were log-transformed to minimize the outliers.

[2] For the repeated measures ANOVA, 34 participants were included because of missing data due to the fixed probabilities of the peers and the learning effect. Since participants learned which peer was more positive and more negative, some participants (*n* = 25) did not choose options that were less likely to occur, which resulted in missing data.
[3] For analyses including emotion regulation, 54 participants were included. The CERQ-short was included in the study after the first participants (*n* = 5) were already tested. All other analyses included 59 participants.

Results

The results on the self-report questionnaires are presented in Table 2.

Table 2

Self-report characteristics of the sample.

	M	*SD*	Range
Fear of negative evaluation (FNE)	23.1	8.9	8 – 43
Social anxiety	35.7	18.6	4 – 86
Rejection sensitivity	8.0	3.2	1.7 – 17.1
Positive reappraisal	7.8	1.8	4 – 10
Rumination	6.6	1.7	3 – 10

Note. n = 59 for all variables, except positive reappraisal and rumination (n = 54).

Behavioural results

To test the learning effect, a paired sample t-test was applied to check the pre- and post-test differences in social-evaluative feedback predictions between peers. The results are presented in Table 3. Pre-test, participants' prediction to receive social acceptance feedback was not significantly different between peer 1 and peer 4. Post-test, however, participants predicted significantly more acceptance feedback from peer 1 than peer 4, indicating that participants explicitly learned that peer 1 was the more positive peer and peer 4 more negative.

Table 3

Pre- and post-test feedback predictions

		Peer 1		Peer 4		*p*	*d*
		M	*SD*	*M*	*SD*		
Pre	Prediction social acceptance	59.8	13.7	60.3	14.5	.831	0.03
Post	Prediction social acceptance	77.5	14.4	27.2	20.1	<.001	1.94

Note. The estimated social acceptance feedback prior to and after the experiment were indicated on a VAS scale. *P* = p-value, *d* = Cohen's d.

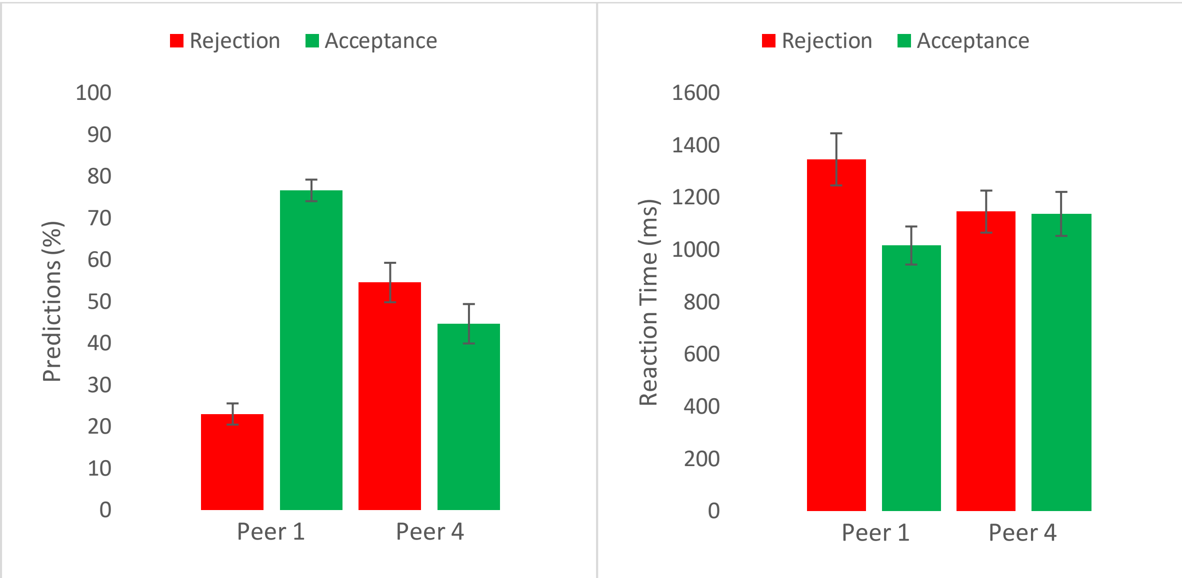
Differences in feedback predictions during the experiment were tested using a two-way repeated measures ANOVA, with Peer (Peer 1, Peer 4), and Prediction (Acceptance, Rejection), which revealed a main effect of Peer $F(1,58) = 5.76$, $p = .020$, $\eta_p^2 = .09$. The amount of predictions per peer were fixed, however, sometimes participants were too late, resulting in absent responses. There were more absent responses for peer 4 than peer 1. Additionally, a main effect of Prediction was found, $F(1,58) = 79.68$, $p < .001$, $\eta_p^2 = .58$. More acceptance than rejection predictions were made. Furthermore, the repeated measures ANOVA yielded an interaction effect between Peer x Prediction, $F(1,58) = 119.70$, $p < .001$, $\eta_p^2 = .67$. For peer 1, more acceptance predictions were made, $F(1,58) = 438.38$, $p < .001$, $\eta_p^2 = .88$, and peer 4 more rejection predictions, $F(1,58) = 4.39$, $p = .041$, $\eta_p^2 = .07$, as visible in figure 2.

To test the differences in RT while making feedback predictions, another two-way repeated measures ANOVA was performed, with Peer (Peer 1, Peer 4), and Prediction (Acceptance, Rejection), which revealed a main effect of Peer $F(1,58) = 4.79$, $p = .033$, $\eta_p^2 = .08$, and a main effect of Prediction, $F(1,58) = 85.79$, $p < .001$, $\eta_p^2 = .60$, which were included in a significant interaction effect between Peer x Prediction, $F(1,58) = 54.97$, $p < .001$, $\eta_p^2 = .49$. For peer 1, participants were significantly faster in predicting acceptance feedback than rejection feedback, $F(1,58) = 111.73$, $p < .001$, $\eta_p^2 = .66$. For peer 4, no significant differences were found between prediction types, $F(1,58) = 0.12$, $p = .730$, $\eta_p^2 = .00$. These results are shown in figure 2, and indicate that participants implicitly learned that peer 1 was more positive than peer 4.

Figure 2

Average feedback predictions and reaction time per condition.

A. Average predictions per condition **B. Average reaction time per condition**



Note. Panel A depicts the average feedback predictions made by the participants per condition. More acceptance predictions were made for peer 1 and more rejection predictions for peer 4. Panel B depicts the average time it took for participants to make the prediction per condition. For peer 1, participants were quicker to predict acceptance than rejection feedback. For peer 4, no statistically significant differences were found. Error bars are shown with a 95% confidence interval.

Association between FNE and behavioural data

Correlation analyses were applied to explore relationships between FNE and RT or predictions. FNE positively correlated with the RT for acceptance feedback from peer 1, r (59) = .35, p = .006, such that higher FNE correlated with a longer RT. No significant correlations were found between FNE and predictions prior to, during or after the experiment (all ps > .05).

Feelings towards the peer.

Participants indicated how they felt towards the peer pre- and post-test. The results are presented in Table 4. Pre-test, no significant differences were found between peer 1 and 4, indicating that the participants had no preference before the test started. Post-test, participants found peer 1 significantly more likeable than peer 4, and indicated they would be friends with peer 1 more than peer 4. Additionally, participants felt significantly more rejected by peer 4 than peer 1, and vice versa significantly more accepted by peer 1 than peer 4. Showing that participants explicitly learned that peer 1 was the more positive peer, and peer 4 the more negative one.

Table 4

Feelings towards the peer.

		Peer 1		Peer 4		*p*	*d*
		M	*SD*	*M*	*SD*		
Pre	Friends	74.8	13.7	70.5	16.8	.060	0.28
	Likability	76.6	12.2	73.7	14.9	.126	0.21
Post	Friends	84.9	16.9	33.2	27.4	<.001	2.27
	Likability	83.8	13.8	39.4	24.3	<.001	2.25
	Feelings of acceptance	82.9	16.9	31.0	15.2	<.001	3.23
	Feelings of rejection	15.9	23.6	64.0	26.5	<.001	1.92

Note. For all variables, n = 59. Friends= “Do you think you could be friends with this person?” Likeability= “How likeable do you find this person?”. The answers were indicated on a VAS scale. p = p-value, d = Cohen’s d.

Association between FNE and self-report data

Correlation analyses were applied to explore relationships between FNE and the feelings towards the peer. Results are shown in Table 5. Pre-test, FNE was positively associated with the VAS questions “do you think you could be friends with this person” and “how likeable do you find this person?” for both peers. Post-test, FNE only correlated significantly with the question “how likeable do you find this person” for peer 1. Furthermore, FNE correlated with feelings of rejection and acceptance after the experiment, in such a way that individuals with higher FNE felt more rejected and less accepted in general. Feelings of rejection or acceptance from a specific peer, however, were not significantly associated with FNE (*p*s > .05).

Table 5

Correlations between FNE and self-report data

		FNE	
		Pre	Post
Peer 1	Friends	.39**	.21
	Likability	.41**	.36**
Peer 4	Friends	.33*	-.03
	Likability	.28*	.04
General	Feelings of acceptance		-.29*
	Feelings of rejection		.42**

Note. For all variables, N = 59. Friends= “Do you think you could be friends with this person?” Likeability= “How likeable do you find this person?”.

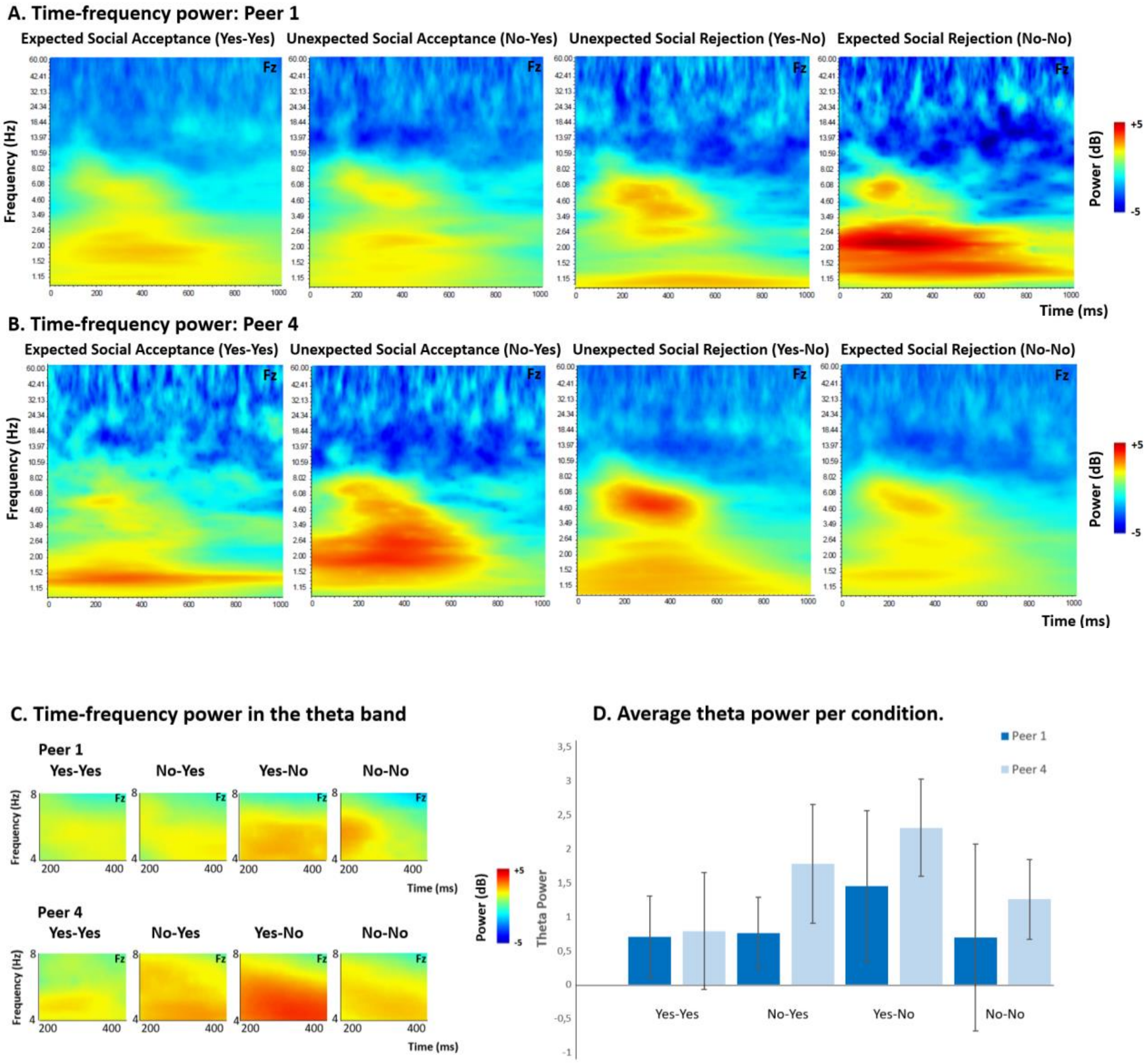
*p < .05., two-tailed. **p < .01., two-tailed.

Time-frequency theta power

The effect of social-evaluative feedback on FM theta power was tested using a three-way repeated measures ANOVA, with Feedback Valence (Acceptance, Rejection), Feedback Congruency (Expected, Unexpected) and Peer (Peer 1, Peer 4). The repeated measures ANOVA revealed a main effect of Feedback Congruency, $F(1,33) = 6.44$, $p = .016$, $\eta_p^2 = .16$. Theta power was significantly higher when social-evaluative feedback was unexpected compared to expected. Additionally, it revealed a main effect of Peer, $F(1,33) = 6.65$, $p = .015$, $\eta_p^2 = .17$. FM theta power was significantly higher when it was provided by peer 4 compared to peer 1. No other main or interaction effects were found (all *p*s > .05). Results are depicted in Figure 3.

Figure 3

Average theta power per condition.



Note. Panel A shows feedback-related time-frequency power results from Fz for peer 1, and Panel B for peer 4. Panel C and D show the specific 200-400 post-feedback time window averages in the theta power frequency band per condition, which was extracted for analysis. Theta power was higher for peer 4 and incongruency. Error bars are shown with a 95% confidence interval.

Association between FNE and FM theta power.

Correlation analyses were applied to assess the relationship between FNE and FM theta reactivity to unexpected social rejection from peer 1 or peer 4. Pearson's correlation coefficient revealed no significant relationship between FNE and FM theta reactivity to unexpected rejection from peer 1, *r* (59) = 0.08, *p* = .577, or peer 4, *r* (59) = 0.02, *p* = .870.

Emotion regulation

Association between FNE and positive reappraisal or rumination.

Correlation analyses were applied to assess relations between FNE and rumination or positive reappraisal. Pearson's correlation coefficient revealed a relationship between FNE and rumination, *r* (54) = .25, *p* = .034. The correlation between FNE and positive reappraisal just failed to reach significant levels, *r* (54) = .22, *p* = .061. Revealing a positive association between FNE and rumination, and none with use of positive reappraisal.

Mediation analysis

Four simple mediation analyses were performed using PROCESS (Hayes, 2017).

Rumination. The outcome variable for analysis was Rumination, FNE was the predictor variable, and FM theta reactivity to unexpected rejection from peer 1 was the mediator variable. The indirect effect of FNE on Rumination was not found to be statistically significant, effect = -.0029, 95% CI (-.0156, .0073). The same was true for peer 4, effect = .0065, 95% CI (-.0031, .0310).

Positive reappraisal. Positive reappraisal was the outcome variable, FNE the predictor variable, and FM theta reactivity to unexpected rejection from peer 1 the mediator variable. No significant indirect effect of FNE on Positive reappraisal was found, effect = -.0009, 95% CI (-.0096, .0090). The same was true for peer 4, effect = .0038, 95% CI (-.0063, .0255).

These results show that FM theta reactivity to unexpected social rejection was not found to mediate the relationship between FNE and both emotion regulation strategies.

Discussion

This study aimed to examine probabilistic learning, as well as possible biased social-evaluative learning processes, and reactivity to social-evaluative feedback in individuals with different levels of FNE. Additionally, the current study explored the possible mediating role of FM theta power in the relationship between FNE and emotion regulation. Regarding behaviour, we observed that participants explicitly (i.e. consciously, as self-reported) and implicitly (i.e. subconsciously, as seen in behaviour) learned that peer 1 was predominantly positive, and peer 4 negative. However, the probability from peer 4 appeared to be more challenging to discover. At the neural level, FM theta reactivity to social evaluative feedback was significantly higher for peer 4 than peer 1, and for incongruent (unexpected) than congruent (expected) feedback. Contrary to our expectation, no association was found between FM theta reactivity to unexpected social rejection and FNE, and FM theta power was not found to mediate the relationship between FNE and emotion regulation (rumination or positive reappraisal).

To be able to interpret the theta-related results in peer 1 and 4, we examined whether the manipulation succeeded and participants (explicitly and implicitly) learned which peer was more positive and which one more negative. We observed that the participants had no preference in peer before the experiment started. After the experiment, however, participants found peer 1 more likeable and indicated that they would want to be friends with peer 1 more than peer 4. Participants also felt more accepted by peer 1, and rejected by peer 4. Moreover, we observed that participants recalled significantly more acceptance feedback from peer 1 (77.5%) than peer 4 (27.2%) after the experiment. Together, these findings show that participants explicitly learned that peer 1 was more positive and peer 4 more negative.

When further exploring the behavioural prediction and RT results, we found that the average of acceptance predictions during the experiment for peer 1 (76.6%) were closer to the actual probability (85%) than for peer 4 (44.6%, 15% respectively). Besides, participants were significantly faster in predicting acceptance than rejection feedback from peer 1, but no significant differences were found in peer 4. Additionally, more absent responses due to surpassing the RT-window occurred for peer 4 than peer 1. These results indicate that participants implicitly learned that peer 1 was predominantly positive, whereas they had more difficulty and uncertainty in learning the probability for the negative peer. In general, participants made more acceptance than rejection predictions, and were faster in predicting acceptance feedback. Together, these findings indicate that participants had a subconscious focus towards the positive, which is in accordance with the Pollyanna Principle positing that people recognize and recall pleasant stimuli more accurately and frequently than unpleasant stimuli (Matlin & Gawron, 1979). Therefore, an optimistic self-evaluation bias may be at play, which is consistent with findings by van der Molen and colleagues (2014) that showed a significantly larger amount of acceptance predictions compared to rejection predictions.

We exploratively examined the association of RT and feedback predictions with FNE. No associations were found with feedback predictions. For RT, we found that individuals with higher FNE took longer with their trial-by-trial predictions of acceptance feedback, but only for peer 1. These results were partly in accordance with findings by van der Molen and colleagues (2014), who found that females with higher levels of FNE took longer in predicting the social-evaluative feedback. This was interpreted as individuals with high levels of FNE having increased uncertainty about the outcome of the social-evaluative feedback. The results for peer 4, however, were in line with van der Molen and colleagues (2018), as they found no difference in behaviour for the socially anxious and the non-socially anxious group. In general, we found that individuals were faster in predicting acceptance feedback from peer 1, compared to the other conditions. As such, the other conditions might lead to uncertainty for all individuals, whereas predicting acceptance feedback from the predominantly positive peer might only lead to uncertainty in individuals with FNE, due to their increased focus on threat (Bar-Haim et al., 2007; Frewen et al., 2008; Wong & Rapee, 2016).

Likewise, we exploratively examined the relationship between FNE and feelings about the peer. Before the experiment started, FNE in individuals was positively associated with indication of likability and friendship with peer 1 and 4. This could be explained by the social belongingness theory (Baumeister and Leary, 1995), stating that positive social relationships are a fundamental human need. Since socially anxious individuals are often more socially impaired and interpersonally dependent (Davila & Beck, 2002), they might feel more need to actively form connections than non-socially anxious individuals. After receiving the social-evaluative feedback, only the positive association with likability of peer 1 remained. No association was found with indication of friendship in peer 1, possibly due to the small sample size, or distribution in FNE levels. Additionally, we found a positive association between FNE and feelings of rejection, and negative association with feelings of acceptance, which is in agreement with the notion that socially anxious individuals show increased negative affect following social rejection, and reduced positive affect in response to social acceptance (Caouette & Guyer, 2016)

Regarding EEG data, we expected FM theta to increase the most in response to unexpected rejection feedback (van der Molen et al., 2017; 2018). Our results indicated that FM theta power was significantly higher when social-evaluative feedback was unexpected compared to expected, regardless of valence. We found no interaction between congruency and valence. Therefore, unexpected rejection failed to elicit the highest theta response. These results indicate that FM theta power was higher when the social-evaluative feedback resulted in uncertainty. This is consistent with studies associating theta activity with conflict monitoring and error processing, positing theta to be involved in increased cognitive control after making an error (Trujillo & Allen, 2007; Cavanagh & Shackman, 2015). However, figure 3 shows that FM theta power was highest in unexpected rejection, for both peer 1 and peer 4. This failed to reach significant levels, possibly due to our limited sample size. Future studies should replicate this paradigm with a larger sample size to verify these results.

Besides FM theta reactivity, figure 3 shows increased power in the delta frequency band. Increased delta activity after receiving feedback is commonly seen as reward related (Bernat et al., 2015; Jin et al., 2019). As can be seen in figure 3, delta power is higher after correctly predicting feedback that is less likely to occur (rejection feedback for peer 1 and acceptance feedback for peer 4), leading to a higher intrinsic reward for being correct (Jin et al., 2019). Besides this, delta is high in unexpected acceptance feedback from the most negative peer, as this might be the biggest reward when receiving positive feedback (Jin et al., 2019). These interpretations are speculative, since no statistical tests were performed for the delta oscillations. According to Jin and colleagues (2019), higher social anxiety levels are associated with increased sensitivity to predicting feedback correctly, regardless of the valence of the feedback. Future research including delta reactivity to social-evaluative feedback might help to further elucidate the biased learning processes in social anxiety.

With respect to the learning effect, we hypothesized that unexpected rejection from the most positive peer (Peer 1) would lead to higher theta reactivity than unexpected rejection from the most negative peer (Peer 4). Contrary to our hypothesis, we found that social evaluative feedback from peer 4 resulted in higher FM theta power. Behavioural results indicate that participants more easily learned that peer 1 was predominantly positive. As mentioned above, the probability for peer 1 was possibly easier to discover due to an optimistic self-evaluation bias, making it easier to recognize and recall pleasant stimuli than unpleasant stimuli (Matlin & Gawron, 1979). This results in unexpected rejection to be more salient for threat-detection. For peer 4, the probability was more challenging to discover, leading to more exploration. Our results are in accordance with Cavanagh and colleagues (2012), who posit that heightened FM theta power relates to uncertainty-driven exploration in reinforcement learning, thereby reflecting the decision to commit to a prediction after exploring options.

Following van der Molen and colleagues (2018), we tested two competing hypotheses regarding FNE: we expected FM theta reactivity to unexpected social rejection feedback to be lower if participants with higher levels of FNE displayed reduced processing of social-evaluative threat (Clark & Wells, 1995). However, we expected FM theta power to be higher, if these participants perceived social rejection feedback as a threat (Wong & Rapee, 2016). Contrary to both hypotheses, no relation was found between the participants own report of their FNE and FM theta reactivity to unexpected social rejection. Van der Molen and colleagues (2018) compared subclinical socially anxious (60 and above on LSAS) with non-socially anxious individuals (below 30 on LSAS). From the 34 participants that were included in our analysis, only 14 participants had scores below 30 and 4 participants of 60 and above. Future studies should therefore include participants with more divergent FNE/ social anxiety scores to verify these results.

With respect to emotion regulation, we expected that FNE was positively associated with rumination, and negatively associated with positive reappraisal, since rumination and reduced positive reappraisal have been associated with anxiety and stress (Martin & Dahlen, 2005). We found a small positive association between FNE and rumination. The small negative association between FNE and positive reappraisal just failed to reach significant levels, thereby showing an indication that positive reappraisal is associated with less social anxiety, and therefore adaptive, and rumination is associated with more social anxiety, and therefore maladaptive.

We exploratively examined the mediating role of FM theta reactivity to unexpected social rejection in the relationship between FNE and positive reappraisal and rumination. No relationships were found, which is in disagreement with the findings of Ertl and colleagues (2013), that FM theta reactivity is associated with successful usage of cognitive reappraisal in order to decrease negative emotions. To verify whether FM theta reactivity to unexpected social rejection is a mediator in the relationship between FNE and positive reappraisal, future studies should consider actively asking participants to use positive reappraisal during the task, as was done by Ertl and colleagues (2013). Moreover, Ertl and colleagues (2013) looked into the 0-7000ms timeframe after cue onset, whereas we merely looked into the 200-400ms cue onset. Therefore future studies could look at longer time intervals to measure FM theta reactivity. Additionally, to ensure participants use emotion regulation strategies, the paradigm could be adjusted by first providing social acceptance feedback before switching to rejection feedback. This has previously been done in a paradigm called ‘Cyberball’ (Eisenberger et al., 2003), where they first included participants when throwing a ball, and later excluded them. Our results were in accordance with Anderson and colleagues (2009), as they found no support for the notion that FM theta was associated with rumination regarding subjectively important goals. Based on the current findings in this regard, we found no support for the notion that FM theta power as cognitive control mechanism is necessary to adaptively regulate emotions (positive reappraisal, but not rumination).

Certain limitations should be acknowledged while considering the results of this study. First, the number of participants was less than indicated by a priori power analysis (minimum of 67 participants; G*Power; Faul et al., 2009). Future studies should therefore replicate these findings with a larger sample size to verify the results. Second, FNE, positive reappraisal and rumination were measured by self-report questionnaires. Therefore, it should be taken into account that biased responses (such as social desirability), or misinterpretations by participants might have played a role. Third, the sample consisted of predominantly female university students, limiting the generalizability of the findings. To reflect the general population, future studies could include more diverse participants, and likewise, include factors such as gender and ethnicity to differentiate between these groups. Last, only three participants in the current sample met criteria for clinical levels of social anxiety (Carleton et al., 2011), whereas the majority had intermediate FNE levels. This could explain why, against our expectations, associations with FNE were often non-significant. Future studies should therefore examine whether a clinical SAD sample displays different or exaggerated behavioural and electrocortical results.

In conclusion, this study offered insights into the probabilistic, biased social-learning in individuals with FNE, and reactivity to social-evaluative feedback. In general, participants had more difficulty learning the probability for the negative peer, possibly due to an optimistic self-evaluation bias, recognizing and recalling pleasant stimuli more accurately and frequently than unpleasant stimuli. At the neural level, we found that FM theta power was higher for unexpected feedback, and feedback from the most negative peer, independent of valence, or levels of FNE. Together, these results indicate that FM theta power reflects uncertainty-driven exploration. Individuals with higher FNE showed increased negative affect after receiving social-evaluative feedback, independent of peer type. They additionally appeared to have an attention bias towards threat, as these individuals were more uncertain when predicting acceptance feedback from the predominantly positive peer. Ultimately, this study showed novel insights by differentiating between peers with different probabilities, and thereby contributed to the available literature on biased learning from, and responsivity to social-evaluative feedback in non-clinical social anxiety. Implications for future research regarding FM theta power as mediator between FNE and emotion regulation were made.

Future studies should examine the (biased) behavioural and electrocortical responses to social-evaluative feedback in clinical social anxiety.

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Appendix A: Cover story paradigm 2 (SELF-Profile)

This cover story is derived from Will et al. (2017; E-life) and adjusted to fit the purposes of this study.

Thank you for participating in this study. Part of the preparations for the second testing day is to provide some information about yourself. This info can be submitted via this online platform. Based on the info you provide of yourself, a profile will be created of you. Your profile will be made up of your answers to 60 personal multiple-choice questions and a personal profile picture of you. Together they will give others an idea about who you are.

Before you start creating your own profile, you will be shown some profiles of other participants in the study. We would like you to evaluate these profiles first. This will be done in a 'step-wise' manner: first, you will view the profile-pictures of 24 other {male/female} participants that are roughly the same age as you. You are asked to rank how likeable you find the person on each picture and whether you think you could be friends with him/her. Based on your rankings, the computer will calculate your 'top 12' pictures of the people that you liked the most. Only for these 12 people will you be shown the content of their profile (i.e., their answers to personal multiple-choice questions that together reflect their personality and behavior in social situations). Purely based on this content, we ask you to select the 4 peers that you like most and would like to meet in real life. The pictures and content of the profiles will deliberately not be shown together, to delineate your impressions about appearance from impressions about personal content. We are interested in examining how people form impressions about these processes separately. This selection-process enables us to examine these processes separately, whilst still ensuring that you select peers based on both appearance and personal content.

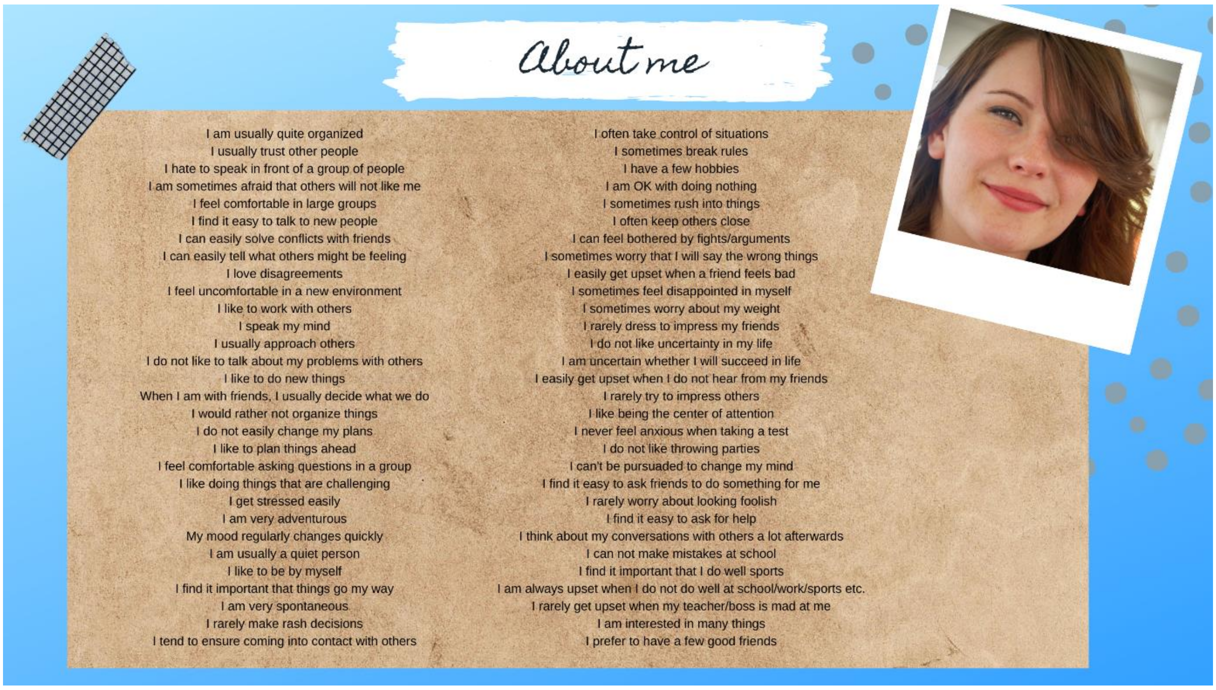
{------------------------------------ rate peer photos/profiles --}

Now that you have selected 4 peers you like most, it is time to create your own profile. Please upload a personal picture of yourself first. Make sure that the picture is in colour, only includes you, that your face and eyes are clearly visible and that you are facing the lens. Then, for each of the 60 questions, pick the statement that you feel characterizes you MOST. Answer each question honestly.

{---------------------- create own profile + show overview of profile -----------------------------}

Thank you!

Appendix B: SELF-profile



Appendix C: Instruction slides of the SELF-Profile task presented to the participants