The Role of Self-Esteem in Social Feedback: An fMRI study

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ABSTRACT

In this study we investigated the role of trait self-esteem in social feedback in 53 women, using questionnaires and functional magnetic resonance imaging (fMRI). Results showed that women with higher trait self-esteem did not feel worse after social feedback and showed brain activity during negative feedback in areas involved in emotion regulation. Women with lower trait self-esteem did feel worse after social feedback and showed more brain activity during positive feedback compared to negative and neutral feedback. We concluded that women with lower trait self-esteem display a preference for positive feedback and do not cope effectively with negative feedback.

Keywords

Self-esteem, social feedback, fMRI.

INTRODUCTION

Feelings of low self-esteem are common. This feeling can be a short-term or long-term feeling. Our long-term or global self-esteem is called our trait self-esteem [1]. Our short-term self-esteem is at a particular moment in time, and is called state self-esteem [2]. People with high trait self-esteem are happier and low trait self-esteem is linked to unfavorable outcomes such as depression [3]. An important influence on people's self-esteem is social feedback. Social feedback can affect our state self-esteem. Previous research demonstrated that a feeling of acceptance resulted in high state self-esteem, whereas a feeling of rejection resulted in low state self-esteem [1,4]. Trait self-esteem is also related to how you cope with feedback. Individuals with low trait self-esteem feel worse after negative feedback than individuals with high self-esteem, but not after positive feedback [5]. Trait self-esteem is thus important in dealing with negative feedback [5]. One study investigating the neural correlates of self-esteem found that people who reported lower state self-esteem after social feedback showed enhanced activity in the dorsal anterior cingulate cortex (dACC) and the bilateral anterior insula, areas involved in social distress [2]. Another study investigating trait self-esteem found that people with low trait self-esteem felt worse after rejection and had more activation in the dACC and the ventral ACC (vACC) than people with high trait self-esteem [6]. Additionally, individuals with low trait self-esteem also showed enhanced activity when viewing positive compared to negative feedback words in the vACC and medial prefrontal cortex (mPFC) [7].

However, it remains unclear how trait self-esteem plays a role in dealing with negative social feedback. Furthermore, trait and state self-esteem are not yet investigated together in a neuroimaging study. Therefore, we examined the influence of negative, neutral and positive social feedback on state self-esteem and neural activity in a lower trait self-esteem group (insecure) and a higher trait self-esteem group (control). Previous studies used a median split on their subject pool to divide participants in low and high self-esteem, but in this first study individuals with clinically defined low self-esteem were recruited [8]. Two hypotheses were posited. First, we hypothesized that subjects with lower trait self-esteem feel worse after feedback (and in particular negative feedback) compared to subjects with higher trait self-esteem, as measured by a decrease in state self-esteem. Second, we predicted different brain activation during negative (and negative compared to positive) social feedback in subjects with higher trait self-esteem compared to subjects with lower trait self-esteem.

METHOD

Subjects. A total of 53 female subjects participated. Only female subjects were recruited because they were, as part of a larger study, matched with patients with borderline personality disorder, who were only female. A sample of 18 insecure subjects (Mean age = 30.7, SD = 8.4) were compared to 35 controls (Mean age = 28.1, SD = 9.3). Subjects were recruited through online advertising and leaflets, requesting for low self-esteem in part of the adverts. Exclusion criteria were severe mental illnesses or a history of neurological disorders. All participants provided written informed consent.

Measures & questionnaires. Trait self-esteem was measured with the Rosenberg Self-Esteem Scale (RSES) [9]. When participants scored below 18 points (on a scale of 0 to 30), they had clinically defined low self-esteem and were assigned to the lower trait self-esteem group [8]. The Mini International Neuropsychological Interview (MINI) was administered to assess AXIS I psychiatric diagnoses [10].

Procedure. Participants filled in an online screening, including the RSES. Afterwards they were screened for psychological disorders. A meeting was organized to fill in a demographic form and to sign the informed consent, followed by the actual experiment. The participant arrived at the scanning room along with a confederate. The confederate would give the participant social feedback based on a recorded personal interview with the participant. In reality, each participant received the same preprogrammed feedback during the MRI scan. After the interview, the MRI scan was conducted while the participants performed the social feedback task. Afterwards, there was a debriefing in which the real experiment was explained and the participant received a monetary reward and a travel allowance.

fMRI task. Before and after the social feedback task, participants were asked to indicate their state self-esteem on a scale of 1 to 100 (1= really good; 100= really bad). During the social feedback task, the participants viewed a total of 45 randomized words, of which 15 were negative (e.g. 'selfish'), 15 positive (e.g. 'kind') and 15 neutral (e.g. 'critical'), in a way that no stimuli of the same valence were consecutive. Each trial started with a fixation cross for 500 ms, then the word appeared on the screen for 2500 ms, followed by a black screen for ± 1000 ms, then a question, which was self-paced, and another black screen for ± 2000 ms. The question after each word asked the participants to indicate how they felt about themselves on a scale of 1 to 4 (1= very bad; 4= very good), to measure state self-esteem [2].

Imaging data acquisition. All imaging data was acquired using a 3 Tesla Philips MRI scanner. First a calibration, reference head and rest scan were made, followed by the social feedback scan (repetition time (TR) = 2200 ms, 3mm cubic voxel size, echo time (TE) = 30 ms, field of view (FOV) = 220 mm). The amount of volumes collected depended on the time the participants took to answer the questions and varied between 122 and 248. Finally, a T1 scan and a high resolution scan were made.

Analysis. Data from questionnaires and self-report measures were analyzed in IBM SPSS Statistics 22 using repeated measures ANOVAs and a T-test. Imaging data was pre-processed and analyzed using FMRIB Software Library 5.0.4 (FSL; http://www.fmrib.ox.ac.uk/fsl). Pre-processing consisted of brain extraction, motion correction, a high-pass filter cut off of 120 s, spatial smoothing of 8 mm to increase the signal-to-noise ratio and normalization into standard space using the brain map of the Montreal Neurological Institute (MNI). The feedback task was modelled as an event-related design based on duration of the feedback words and reaction time to the questions. Contrasts were applied for the valence of the feedback words: negative-positive, positive-negative, negative-neutral, neutral-negative, positive-neutral and neutral-positive and also for each individual word (negative, neutral, positive). A General Linear Model was created and applied to the data. All participants were first individually analyzed using the FMRI Expert Analysis Tool (FEAT) before completing a higher level analysis where levels of trait self-esteem (as measured by RSES) were entered as a covariate. A whole brain analysis was used to find activation above the threshold of $z = 2.3$, cluster threshold was set at $p = .05$.

RESULTS

Considering the behavioral data, the results are consistent for between-groups and one group analysis. Therefore, only the between-group analysis is shown for clarity.

Behavioral results. The average level of trait self-esteem, as measured by RSES, was 19.87, SE= 0.83. The insecure group (N= 18) had a significantly lower RSES score (M= 12.67, SE= 0.66) than the control group (N= 35, M= 23.57, SE= 0.53), $t(51) = 12.46$, $p < .001$. The insecure group rated their average state self-esteem significantly lower (M= 53.42, SE= 3.12) than the control group (M= 71.50, SE= 2.24, $F(1,51) = 22.18$, $p < .001$) (see Figure 1). A significant difference in state self-esteem before and after the feedback task was found, $F(1,51) = 8.99$, $p = .004$. The interaction effect between state self-esteem and experimental group, $F(1,51) = 6.90$, $p = .011$, showed that this was due to a difference in state self-esteem of the insecure group. Post hoc tests using the Bonferroni correction revealed that the insecure group felt better before the task (M= 56.67, SE= 3.39) than after the task (M= 50.17, SE= 3.12, $p < .001$). There was no difference in state self-esteem in the control group ($p = .752$).

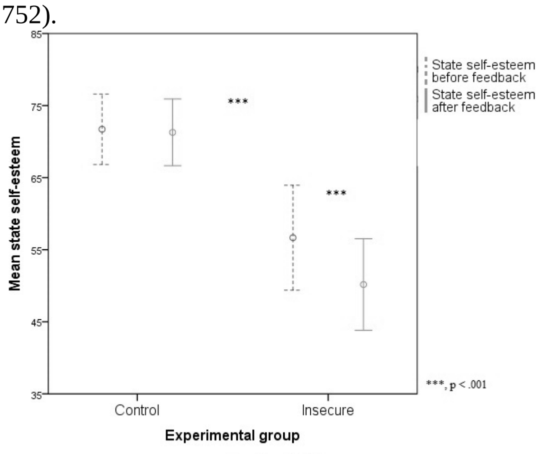

Figure 1. State self-esteem before and after the social feedback.

We also found a significant effect of type of feedback word (positive, neutral or negative) on the participants' state self-esteem, $F(1.35, 68.66) = 258.16$, $p < .001$, see Figure 2. Post hoc tests using the Bonferroni correction revealed that participants rated lower state self-esteem after a neutral word (M= 2.79, SD= 0.46) compared to a positive word (M= 3.52, SD= 0.34, $p < .001$), and after a negative word (M= 1.94, SD= 0.60) compared to a positive ($p < .001$) or a neutral word ($p < .001$). There was a significant interaction effect between feedback word and experimental group, $F(1.35,68.66) = 6.52$, $p = .007$. Post-hoc tests showed that the insecure and control group differed in their rated state self-esteem for neutral (M= 2.56, SE= 0.10 vs M= 2.91, SE= 0.07 respectively, $p = .008$) and negative words (M=1.62, SE= 0.13 vs M= 2.11, SE= 0.09, respectively, $p = .004$) but not for positive words (M= 3.54, SE= 0.82 vs M= 3.51, SE= 0.06 respectively, p = .822).

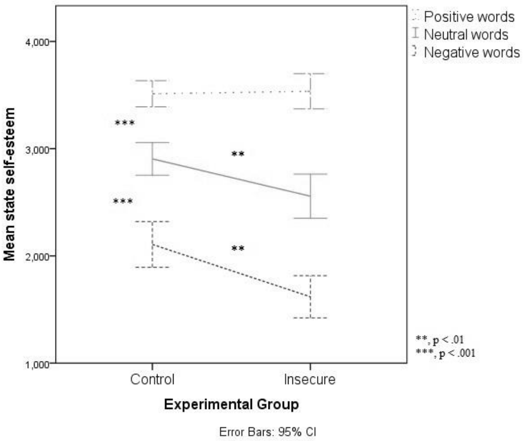

Figure 2. Reported state self-esteem after the feedback words.

Imaging results. Four participants were excluded due to a lot of movement (N= 2) and scanner artefacts (N= 2).

Positive correlations with trait self-esteem

Higher levels of trait self-esteem were associated with more activity in the anterior cingulate gyrus, frontal orbital cortex, hippocampus, paracingulate gyrus and the insula when viewing negative words. Figure 3 shows the whole-brain activation map of this contrast.

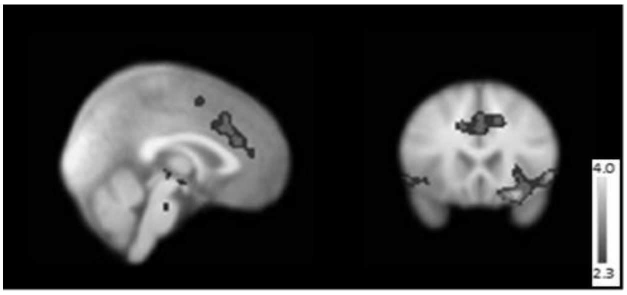

Figure 3. Higher levels of trait self-esteem were correlated positively with activation in the anterior cingulate gyrus, hippocampus and insula when viewing negative words (left is x= 0, right is y= 22). Color maps represent the group averaged Z-statistic values.

Higher levels of trait self-esteem were also associated with more activity when viewing neutral words in the frontal orbital cortex, temporal pole and insula. During positive words activity was found in the frontal orbital cortex, hippocampus and insula. When viewing negative words compared to positive words, more activity was found in the anterior and posterior cingulate gyrus, frontal pole and precuneus cortex (see Figure 4).

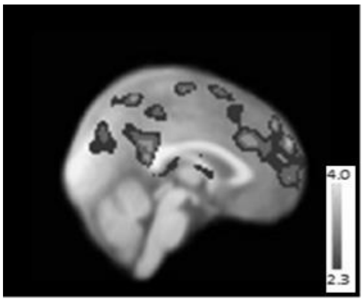

Figure 4. Higher levels of trait self-esteem were correlated positively with activation in the anterior and posterior cingulate gyrus, precuneus cortex and frontal pole when viewing negative compared to positive words (x= 0). Color maps represent the group averaged Z-statistic values.

When viewing neutral words compared to positive words there was significant activity in the posterior cingulate gyrus, cuneal cortex, middle frontal gyrus and precuneus cortex with higher levels of trait self-esteem, see Figure 5.

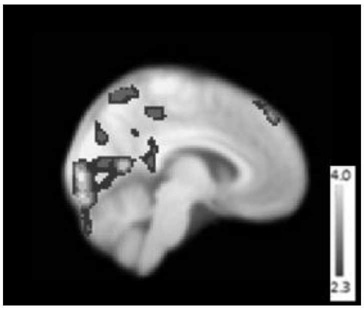

Figure 5. Higher levels of trait self-esteem were associated with more activity in the posterior cingulate gyrus, cuneal cortex and precuneus when viewing neutral compared to positive words (x= 6). Color maps represent the group averaged Z-statistic values.

Negative correlations with trait self-esteem

Lower levels of trait self-esteem correlated with activity in the positive-negative and positive-neutral contrast, as opposite to the contrasts of subjects with higher levels of trait self-esteem. They showed exactly the same pattern of activation in the same areas. However, no significant difference in activity was found during the negative, neutral or positive words on its own.

CONCLUSION

The current study aimed to investigate the role of self-esteem in receiving social feedback. As hypothesized, subjects with lower trait self-esteem felt worse after social feedback and in particular after negative and neutral feedback compared to subjects with higher trait self-esteem. This is in line with previous results [4,5]. We conclude that negative and neutral feedback affects women with lower trait self-esteem in a negative way.

The imaging results showed that subjects with higher trait self-esteem had activity during negative words in the ACC, paracingulate gyrus and hippocampus. Phillips et al. mention an emotion regulation network including these areas [11]. Therefore, we speculate that the activation we found in women with higher trait self-esteem could be an emotion regulation process. Subjects with higher trait self-esteem also had activity in the negative-positive contrast and the neutral-positive contrast in areas such as the posterior cingulate gyrus, precuneus cortex and superior frontal gyrus which are involved in self-reflection and mentalizing [12-13]. Remarkably, lower trait self-esteem was not related to increased activity during the words on their own. Subjects with lower trait self-esteem did show exactly the same pattern as the subjects with higher self-esteem in the same areas but in the opposite contrasts: when viewing positive words compared to negative or positive compared to neutral words. Somerville et al. also found that individuals with lower trait self-esteem had more activity in the vACC/mPFC during positive versus negative feedback [7]. In conclusion, the activation we found during the negative words in women with higher trait self-esteem might be part of an emotion regulation network. Women with higher trait self-esteem also had activity in areas involved in self-reflection or mentalizing, while the lower trait self-esteem women had this activity during the opposite word contrasts. Women with lower trait self-esteem seem to display a preference for positive feedback, but this does not help to prevent them from feeling worse after the feedback.

There were some limitations of this study. First, it is not known how representative feedback words are while lying in the scanner, compared to social feedback in daily life. However, we hope to give insight into the basic processes of receiving social feedback. Second, we used a paradigm with feedback words, but there are no studies with the exact same paradigm. General conclusions compared to the current literature about people with low self-esteem are therefore difficult to make.

Future research could try to implement more natural forms of social feedback in the paradigm. Furthermore, it was found that neutral feedback is usually interpreted as rejecting [14]. Since only few studies investigated neutral feedback, the effect of it on brain activation could be further investigated. A further investigation could also elaborate on our findings and investigate if subjects with lower trait self-esteem indeed feel worse because they attend too much to the positive feedback and find out if the lack of increased activation during negative feedback has an origin in less emotion regulation.

In summary, our study showed that women with higher trait self-esteem had activity during negative feedback words which could perhaps indicate an underlying emotion regulation process. Furthermore, they showed activation in areas involved in mentalizing and self-reflection during negative versus positive and neutral versus positive words and it seemed that this protected them from feeling worse. Women with lower trait self-esteem did not show significant activity during negative feedback words but showed the same activation pattern as women with higher trait self-esteem during positive versus negative and positive versus neutral words. Since they did feel worse after the feedback, they seem to display a preference for positive feedback and do not cope effectively with the negative feedback. Together, these results provide a further step into the understanding of the role of self-esteem in receiving social feedback.

ROLE OF THE STUDENT

The research presented was carried out during a 4-month internship. Consultation with the supervisor took place at least three times a week. Data collection was already started a year before the internship by the supervisor and continued during the internship. Most of the imaging and behavioral data was provided by the supervisor. Formulation of the research question, literature research, analysis, processing of the results and the writing were done by the student. The internship was finished with a thesis of which this paper is a shorter version.

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