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Learning biases underlying individual differences in sensitivity to social rejection

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Abstract

People vary greatly in their dispositions to anxiously expect, readily perceive, and strongly react to social rejection (rejection sensitivity, RS) with implications for social functioning and health. Here, we examined how RS influences learning about social threat. Using a classical fear conditioning task, we established that high as compared to low (HRS vs. LRS) individuals displayed a resistance to extinction of the conditioned response to angry faces, but not to neutral faces or non-social stimuli. Our findings suggest that RS biases the flexible updating of acquired expectations for threat, which helps to explain how RS operates as a self-fulfilling prophecy.

Keywords

Fear conditioning; Rejection sensitivity; Social threat; Extinction; Skin conductance response

Humans depend on others for their survival and well-being. Yet, efforts to connect with others and enlist their help and approval hold the potential for rejection. Because the prospect and reality of rejection is highly aversive, it can powerfully shape our social behavior (Baumeister & Leary, 1995; Eisenberger et al., 2003; Panksepp, 1998; Seymour, Singer & Dolan, 2007). People vary greatly, however, in the extent to which they identify cues of social threat as personally threatening and in how they respond to them, with profound implications for their social functioning and well-being (Downey & Feldman, 1996; Mogg, Philippot, & Bradley, 2004). This variability can be described in individual differences in rejection sensitivity (RS), which Downey and Feldman (1986) characterized in social-cognitive terms as the disposition to anxiously expect, readily perceive, and strongly react to social rejection (Downey & Feldman, 1996; London, Downey, Bonica, & Paltin, 2007). There is considerable evidence linking rejection sensitivity with a number distinct relationship difficulties, including reactive hostility, overaccommodation to the needs of others, and avoidance of situations that entail a risk of rejection or criticism. In

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extreme forms these patterns are symptomatic of Borderline, Dependent and Avoidant Personality Disorders, respectively.

Efforts to understand how rejection sensitivity is developed and maintained and has its pernicious effects have yielded evidence that RS operates as a self-fulfilling prophecy with anxious expectations of rejection creating a readiness to perceive and react to it in ways that elicit the feared rejection, which confirms and reinforces rejection expectations (Downey, Freitas, Michaelis, & Khouri, 1998). Given the high personal and interpersonal costs of this vicious circle, understanding with greater precision the underlying learning mechanisms is an important goal.

Here we examined whether RS might influence two kinds of processes involved in learning to associate others with an aversive outcome. First, we hypothesized that RS might influence social learning processes, such that HRS individuals more effectively learn to fear a given social target. Second, we hypothesized that once a HRS individual has learned to expect negative outcomes associated with a specific social target, he or she may tend to retain that expectation even if circumstances change and the potential for threat has passed. Addressing these two distinct, hypotheses will provide a better understanding of the mechanisms responsible for the behavioral outcomes of RS, thereby opening the possibility of identifying potential targets of intervention. A major advantage of this multi-process approach is that it can establish how these processes in isolation or in combination may contribute to the operation and maintenance of RS in particular and social hypersensitivity more generally. Extending previous work, this approach can better capture the heterogeneity of biased information processes that underlie variability in self-reported sensitivity to social rejection.

With these goals in mind, we compared HRS and LRS individuals on a two-phase fear conditioning and extinction paradigm to tap processes supporting learning and updating threat responses to social targets. In the Acquisition stage, images of potentially threatening/rejection-relevant (angry faces) and non-threatening/rejection-irrelevant social stimuli (neutral faces) and non-social stimuli (geometric figures) served as conditioned stimuli, CS, and were paired with an aversive outcome (a mild shock to the wrist), serving as the unconditioned stimulus (US). This task was designed to model real-life situations in which social stimuli signaling threat or rejection acquire negative values through direct aversive experiences or expectancies of such, which might feed into a vicious circle of increasingly sensitized responses to a growing range of social cues and contexts perceived as threatening (Mineka & Oehlberg, 2008). Previous studies have supported the use of conditioning protocols to model socially and culturally acquired fears (Olsson & Phelps, 2004) and how such fears can contribute to the emergence and maintenance of dysfunctional affective responses (Delgado, Olsson, & Phelps, 2007; Lissek et al., 2008; McCabe, Miller, Laugsen, Antony, & Young, 2010; Mineka & Oehlberg, 2008).

Although the relationship between RS and learning has not been investigated, previous research has attempted to tie social anxiety disorder, a condition that is associated with high levels of rejection sensitivity, to hyperconditionability to social stimuli. Unfortunately, these studies are inconclusive because they either have not separated patients with social and other anxiety related problems (Pitman & Orr, 1986) or have used non-threatening social

conditioned stimuli, such as neutral faces paired with a non-social US, such as unpleasant odors (Hermann C, Ziegler S, Birbaumer N, & Flor, 2002; Schneider et al., 1999). Only few studies have used socially relevant aversive stimuli (Lissek et al., 2008; Peijic, Hermann, Vaitl, & Stark, 2011). For example, Lissek and colleagues (2008) studied conditionability to threatening social stimuli in patients with social anxiety disorder relative to healthy controls. In their study, pictures of three neutral faces served as CSs. Each face was paired with one of three audiovisual US; a negative insult with an angry expression (US [neg]), a positive compliment with a happy face (US[pos]), or a neutral comment with a neutral face (US[neu]). Supporting an effect of social anxiety on conditionability, the results showed that only social anxiety patients displayed a conditioned response to negative as compared to positive and neutral stimuli.

In the present study, the conditioning phase was followed by an extinction phase during which the aversive outcome (shock) was omitted to examine how the updating and adjustment of the conditioned fear response (CR) depended on stimulus type and level of RS. This extinction phase was designed to model naturally occurring changes in the contingency between social cues and feared outcomes that are especially problematic for HRS individuals. Indeed, a resistance to extinguish conditioned responses to certain kinds of potentially threatening stimuli, including snakes, spiders and angry faces is known to be associated with maladaptive emotional responses such as anxiety and phobia (Carlsson et al., 2004; Ohman & Mineka, 2001; Milad, Rauch, Pitman, & Quirk, 2006; Myers & Davis, 2002), whereas successful extinction may mediate the effectiveness of exposure-based therapies (Rothbaum & Davis, 2003). Accordingly, we expected that CRs to angry faces would be more resistant to extinction in HRS than in LRS individuals. Based on previous findings (Downey, Mougios, Ayduk, London, & Shoda, 2004), we did not expect any RS-related differences in extinction for the non-threatening/rejection-irrelevant stimuli.

METHOD

Participants

Forty-three volunteers (21 female, mean age = 23 yrs) were recruited from the Columbia University community in accordance with the regulations of the Columbia University IRB. Participants were recruited both through advertisement on campus and through contacting pre-screened individuals with high and low scores (75^{th} and 25^{th} percentiles, respectively) relative to the normative sample for the Rejection Sensitivity Questionnaire (RSQ, Downey & Feldman, 1996). The pre-screening procedure was used to oversample high and low RS individuals. Importantly, after the conditioning session, all participants completed the RSQ and this score was then used to classify each individual as LRS or HRS. The exclusion of participants showing virtually no measurable skin conductance response (HRS, n = 4; LRS, n = 4) or lacked a CR to all three classes of stimuli (HRS, n = 5; LRS, n = 3) yielded a final sample of 27 participants (15 female, mean age = 22 yrs). The proportion of participants excluded due to lacking measurable SCR or CR is similar to earlier studies investigating conditioning and extinction (e.g. Olsson et al., 2005). Based on a median split of the final sample, 13 participants were classified as LRS (mean RS score = 7.8; SE= 0.6) and 14 as HRS (mean RS score = 15.4; SE=1.4).

Stimuli and Procedures

This task was modeled on a previously established within-participants differential conditioning paradigm (Olsson et al., 2005). Black and white images of two neutral male faces, two angry male faces, and two geometrical figures (a star and a triangle) served as conditioned stimuli and were presented in a pseudo-randomized order on a black background. Face stimuli were drawn from the Ekman and Friesen face set (1976). The electric shocks were delivered to the right wrist through a stimulator (STM 200, BIOPAC Systems Inc., CA) charged by a stabilized current. The conditioned fear response was assessed by the skin conductance response (SCR) measured through disposable Ag-AgCl electrodes attached to the distal phalanges of the second and third digits of the left hand. The SCR signal was amplified and recorded with a BIOPAC Systems SRC module connected to a PC and continuously recorded at a rate of 200 samples per second. Off-line analysis of the analogue SCR waveforms was conducted with AcqKnowledge software (BIOPAC Systems Inc., CA).

Before the start of the experiment, and following an established procedure (Olsson et al., 2005), the shock magnitude was individually adjusted for each participant to be perceived as “uncomfortable, but not painful”. The subsequent conditioning task consisted of three continuous stages: During the initial Habituation stage, participants viewed 3 unreinforced presentations of each CS. During the following Acquisition stage (5 presentations of each CS), one stimulus (CS+) from each stimulus category (angry, neutral, and figure) was always paired with a shock (the unconditioned stimulus, US). The other stimulus from each category (CS−) served as a control and was never paired with a shock. The particular stimulus from each category serving as the CS+ or CS− was counterbalanced across participants. Each presentation of a CS lasted six seconds and the shock co-terminated with each presentation of a CS+ during the Acquisition stage. The inter-trial-interval was 12–15 seconds.

Finally, during the Extinction stage (5 presentations of each CS), no shocks were administered. SCR was measured during all three stages. The category-specific arousal response during the Habituation stage was assessed as the mean SCR across both CS’s (i.e., the to-become CS+ and CS−) from each category. For the Acquisition and Extinction stages, mean SCRs were calculated separately for CS+ and CS− presentations. In addition, the conditioned fear response (CR) was assessed as the mean differential SCR (CS+ minus CS −) from the same stimulus category to control for any between category differences in the emotional salience of stimuli.

Background Measures—After the conditioning task, all participants completed paper and pencil versions of the *Rejection Sensitivity Questionnaire (RSQ*, Downey & Feldman, 1996*)*. The RSQ assessed anxious expectations of social rejection by measuring responses to 17 hypothetical interpersonal interactions in which rejection is a possibility (e.g., “You ask your friend to do you a big favor”). For each hypothetical interaction, the respondent indicated his or her degree of concern or anxiety about the outcome, as well as the perceived likelihood that the interactant (or interactants) would respond with rejection. RS scores (range: 1 – 24) were calculated by first weighting the expected likelihood of rejection for

each situation by the degree of anxiety and then averaging these weighted scores across all situations. The measure was intended to capture the level of threat experienced in situations where people seek support from important others. In the original validation study, the scores on the anxiety and expectations questions were unrelated (Downey & Feldman, 1996). This composite RS score has been shown to have unique predictive utility with conceptually and empirically related personality constructs, including introversion, neuroticism, adult attachment style, social anxiety, fear of negative evaluation, social avoidance, and self-esteem (Downey & Feldman, 1996; Romero-Canyas, Downey, Berenson, Ayduk, & Kang, 2010). All participants also completed the *State – Trait Anxiety Index (STAI*, Spielberger et al., 1983) and the *Symptom Checklist – Anxiety (SCL-Anx.*, Derogatis, 1983), assessing current (state) and enduring (trait) anxiety levels. The STAI and SCL-Anx. were included in the analyses to control for anxiety that was not specific to social threat.

RESULTS

The results are shown in Figure 1.

Data analysis

SCR was measured for each trial as the largest peak-to-peak (initial deflection to the peak) amplitude difference in skin conductance (in microsiemens, μS) starting in the 0.5 to 4.5 second window following CS onset. The minimal response criterion was 0.02 μS. The raw SCR scores were square root transformed to normalize the distributions and scaled based on each participant's mean square-root-transformed unconditioned response. The habituation means included the SCR to the first three presentations of each CS. To examine the effect of time, the acquisition SCR means were divided up into an early phase (the first 3 presentations of each CS following the first CS+ paired with a shock) and a late phase (the subsequent 2 trials of each CS). Similarly, the Extinction SCR means were divided up into an early phase (the first 3 presentations of each CS following the first omission of the US) and a late phase (the subsequent 2 trials of each CS).

Habituation

The HRS group showed an overall greater arousal responses than the LRS group, $F(1, 25)=6,78$, $p < .05$, but group belonging did not interact with type of stimuli. There were no other significant effects during the Habituation stage. Importantly, these effects held when controlling for individual differences in self-reported state and trait anxiety, indicating that they were specific to anxiety about social threats and not anxiety about threats in general.

Acquisition

A main effect of Time, $F(1,25)= 14$, $p<.01$, indicated that the SCR decreased in both groups from early to late Acquisition across all three types of CS, and a main effect of Group, $F(1, 25)= 12.3$, $p <.01$, revealed an overall larger SCR for the HRS as compared to the LRS group (see fig. 1). An interaction between Group and CS (CS+ vs. CS−) indicated that the HRS displayed a stronger differential CR as compared to the LRS group, $F(1, 25)=5,2$, $p<.05$. Importantly, this effect did not interact with type of stimuli, indicating that HRS individuals conditioned better than LRS regardless of type of CS. An explorative analysis

showed that a greater proportion of HRS as compared to LRS participants displayed a CR to angry faces (100% and 54%, respectively, chi square (1)= 6.6, p < .01). However, the proportion conditioners in the two groups did not differ for neutral faces (53.8% and 64.3%, respectively) and geometrical figures (71.4% and 53.8%, respectively). This confirmed that LRS participants indeed were able to acquire a CR, and making it less likely that extraneous variables, such as inattention during the task, could explain the greater CR displayed by the HRS group. Anxious traits have previously been linked to an enhanced conditionability (Lissek et al., 2008), but trait anxiety was not significantly related to the conditionability in our sample. However, a regression analysis revealed that higher reported state anxiety predicted an increased CR (CS+ > CS−) to angry faces, B=.5, t=2,6, p<.05, but not to neutral faces and geometric figures (all p's >.1), during the Acquisition stage. Level of RS was not related to CR to any CS type during the Acquisition stage.

Extinction

Similar to the Acquisition stage, HRS participants showed an overall larger SCR as compared to LRS participants as reflected in a main effect of Group, F(1, 25)=5,3, p<.03). As expected, and as revealed by a Group×Stimulus type×CS interaction, F(2, 25)=4.7, p = . 01, the HRS group showed a resistance to extinction of the CR to angry faces, but not to neutral faces or geometric figures (see fig. 1). These effects remained unchanged after controlling for state and trait anxiety. The resistance to extinction to angry faces in the HRS group could not be explained by any differences in the strength of the conditioned responses during Acquisition, as the CR did not interact with CS type during the Acquisition stage. Interestingly, the LRS individuals that indeed acquired a CR to angry faces during the Acquisition stage (n=7) showed a complete extinction of these responses during the Extinction stage, making their responses during this stage similar to the LRS individuals that failed to acquire a CR in the first place.

Confirming the relationship between RS and the CR to angry faces during the Extinction, a regression analysis revealed that RS score predicted the strength of the CR to angry faces (B = .51, t =2,6, p< .05), but not to neutral faces and geometric figures (p's >.1). Unlike the CR during acquisition, anxiety measures were not related to the CR during extinction (p's >.1). Taken together, these results suggest that whereas state anxiety was related to conditionability across types of CS, RS was specifically related to a resistance to extinguish conditioned responses to potentially threatening social stimuli (angry faces) after they have become predictive of an aversive outcome.

DISCUSSION

Sensitivity to rejection is presumed to be partly learned and maintained via rejection experiences. To date, support for this claim is limited to correlational data from longitudinal field studies (London et al., 2007). The learning processes that support the operation of RS as a self-fulfilling prophecy have not been experimentally studied. Here, we used a conditioning task to test the hypotheses that RS could influence the learning and/or updating of the threat value associated with social cues.

The conditioning task showed HRS vs. LRS differences during all three stages of the experiment. During the initial Habituation stage before any shock was administered, we found that HRS individuals showed a larger arousal responses across all types of stimuli. This might indicate a general anxious apprehension in a situation characterized by an ambiguous threat (knowing that shocks would be administered at some point). Indeed, HRS individuals might be prepared physiologically for the worst to happen. This finding also validates self-reports of anxious-expectations of rejection even before anything aversive has happened that were assessed in the Rejection Sensitivity Questionnaire and are viewed as assessing the phenomenon at the heart of the disposition. During the Acquisition stage, expectation for shock was learned. Our results showed that the HRS group displayed higher mean level of CR to all kinds of CS regardless of type. The fact that the CR during the Acquisition stage was related to state anxiety, but not to RS score, suggests that the greater conditionability in the HRS group primarily reflected anxiety that was not specific to RS. When combined with Lissek et al.'s (2008), and Pejic et al.'s (2011) finding of hyperconditionability to social stimuli in patients with social anxiety disorders (and thus likely very high in RS), our result underscore the importance of continuing to attend to the role of hyperconditionability to social threat in vulnerability to relational difficulties of the type associated with RS. During the Extinction stage, HRS individuals fully extinguished their CR to neutral faces and geometric figures, but continued to display a CR to angry faces.

One reason that HRS individuals might maintain enduring expectations for rejection in social situations is that they fail to flexibly regulate social fears if they have been realized. This interpretation is consistent with the hypothesis that RS individuals adhere to the old maxim, "once burned, twice shy". These results are also in line with the commonly reported resistance in extinction to phobic stimuli (Ohman & Mineka, 2001), as well as suggestions of a dysfunctional regulatory ability in high RS (Kross et al., 2007), and social anxious (Pejic et al., 2011), individuals. Our results are also compatible with an earlier study reporting a resistance to extinction to angry, but not neutral faces, in a heterogeneous group of anxiety patients (Pitman & Orr, 1986).

Taken together, these data connect the study of RS to the body of research on the mechanisms of threat detection and fear learning, which provides a framework for understanding the vicious circle of increasingly sensitized responses to a growing range of social cues and contexts perceived as threatening that is experienced by the HRS individual. Consideration of the data in light of the following facts appears particularly relevant: First, both the tendency to perceive a face as threatening and the process of fear conditioning are associated with the amygdala (Ohman et al., 2001; Phelps & LeDoux, 2005), and these processes are affected by level of anxiety (Indovina, Robbins, Núñez-Elizalde, Dunn, & Bishop, 2011; Lissek et al., 2005). Second, the ability to regulate social evaluative judgments and affective responses – including the extinction of conditioned fear – is associated with prefrontal regions implicated in cognitive control (Ochsner & Gross, 2008; Ochsner et al., 2002; Phelps & LeDoux, 2005). Thus, HRS individuals may fail to effectively use prefrontal control systems to down-regulate activity in brain systems that trigger threat responses. This hypothesis is consistent with emerging work showing potentiated startle responses, heightened activation of core affective regions like the

amygdala and relative underactivation of prefrontal regions when HRS (Burklund et al., 2007; Downey, et al. 2004; Kross et al., 2007) and socially anxious (Peijic et al., 2011) individuals view rejection-themed stimuli. It is also consistent with both laboratory and field studies showing that the negative social consequences of RS are moderated by the ability to cognitively "cool" or down-regulate affective responses (Ayduk et al. 2002, 2008; Guyrak & Ayduk, 2007). The current findings extend this research by identifying specific learning processes that may be influenced by HRS and may potentially underlie these behavioral and neural effects. Second, they point the way towards future studies that could determine whether biases in different kinds of prefrontal-amygdala interactions underlie the striking failure to regulate learned fear responses to social threat cues as shown here. Together with the growing body of research addressing the neural bases of emotional perception, learning and extinction, our results provide a window into mechanisms that potentially sheds light on how the self-fulfilling prophecy of RS operates.

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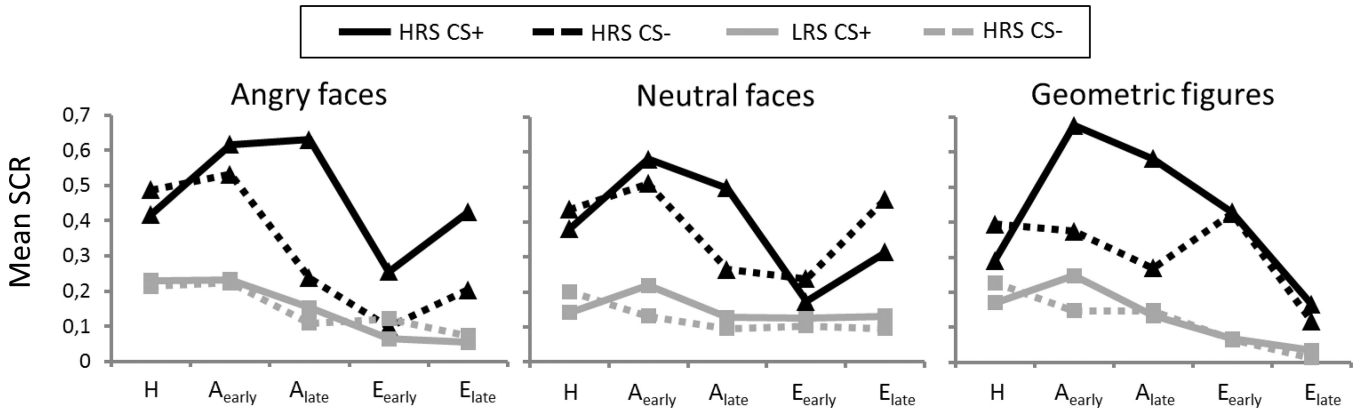

Figure 1.

Mean square root transformed and scaled skin conductance responses (SCR) to angry faces, neutral faces, and geometric figures serving as CS+ and CS− in high and low Rejection sensitivity individuals (HRS and LRS). SCRs are presented as a function of experimental phase and time; Habituation (H), early and late Acquisition (A_{early} and A_{late}), and early and late Extinction (E_{early} and E_{late}). The HRS group shows larger SCRs during all phases. Importantly, this group does not extinguish its conditioned response to angry faces, but well to neutral faces and geometric figures.