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**Authors**

Morelli, Sylvia A
Torre, Jared B
Eisenberger, Naomi I

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# The neural bases of feeling understood and not understood

Sylvia A. Morelli,[1] Jared B. Torre,[2] and Naomi I. Eisenberger[2]

[1]Department of Psychology, Stanford University, Stanford, CA 94305, USA and [2]Department of Psychology, University of California Los Angeles, Los Angeles, CA 90095-1563, USA

Past research suggests that feeling understood enhances both personal and social well-being. However, little research has examined the neurobiological bases of feeling understood and not understood. We addressed these gaps by experimentally inducing felt understanding and not understanding as participants underwent functional magnetic resonance imaging. The results demonstrated that feeling understood activated neural regions previously associated with reward and social connection (i.e. ventral striatum and middle insula), while not feeling understood activated neural regions previously associated with negative affect (i.e. anterior insula). Both feeling understood and not feeling understood activated different components of the mentalizing system (feeling understood: precuneus and temporoparietal junction; not feeling understood: dorsomedial prefrontal cortex). Neural responses were associated with subsequent feelings of social connection and disconnection and were modulated by individual differences in rejection sensitivity. Thus, this study provides insight into the psychological processes underlying feeling understood (or not) and may suggest new avenues for targeted interventions that amplify the benefits of feeling understood or buffer individuals from the harmful consequences of not feeling understood.

## INTRODUCTION

Every day, thousands of individuals visit the website 'Experience Project' to share their personal experiences. The nodes of this social network are organized by life experiences (e.g. surviving a divorce or fighting cancer), and members can share their stories with others who have encountered similar events. The slogan for the website is 'Find people who understand you,' and this goal seems to appeal to many, as the website reports that over 35 million experiences have been shared. But why is feeling understood so appealing? One possibility is that feeling understood provides us with the sense that we are socially connected and not alone, whereas not feeling understood may make us feel socially rejected and isolated.

Indeed, much of human behavior is driven by the need to belong and the desire to connect with others (Baumeister and Leary, 1995; Cacioppo and Patrick, 2008; Lieberman and Eisenberger, 2008). Findings across social psychology, neuroscience, and health psychology all suggest that social connection is rewarding and salubrious (Cohen, 2004; Eisenberger, 2013; Inagaki and Eisenberger, 2011, 2013), while social disconnection is aversive and detrimental to mental and physical health (Whisman et al., 2000; Hawkley et al., 2003; Cacioppo and Patrick, 2008). Although these studies have consistently demonstrated that interpersonal connections bolster happiness and health, it is unclear what specific social interactions produce these robust effects.

Past research suggests that feeling understood by others may be a critical component of social connection, enhancing both personal and social well-being (Reis and Shaver, 1988; Cahn, 1990; Swann, 1990; Reis et al., 2000, 2004; Oishi et al., 2010). For example, on days participants felt more understood during social interactions, they also felt more closely connected with others and more satisfied with their life (Reis et al., 2000; Lun et al., 2008). In interactions between strangers,

felt understanding enhanced interaction satisfaction and partner liking (Cross et al., 2000) and decreased negative affect (Seehausen et al., 2012) and perceived pain (Oishi et al., 2013). In close relationships, felt understanding has been shown to foster intimacy, trust, and relationship satisfaction, in addition to diminishing stress and boosting positive affect and life satisfaction (Laurenceau et al., 1998; Lippert and Prager, 2001; Gable et al., 2004, 2006; Reis et al., 2004; Oishi et al., 2008). In contrast, not feeling understood degrades social relationships and personal well-being, leading to reduced liking, relationship breakups, negative affect, and less satisfaction with life (Butler et al., 2003; Gable et al., 2006; Lun et al., 2008; Oishi et al., 2010).

Given the importance of felt understanding for well-being, it is critical to establish the neural bases of feeling understood and not understood and link these neural signatures to interpersonal and intrapersonal outcomes. However, to our knowledge, no studies have examined these critical questions. Further, although studies have shown that individual and cultural differences impact felt understanding (Cross et al., 2000; Lun et al., 2008; Oishi et al., 2010), it is unclear how these individual differences are instantiated in the brain when feeling understood and not understood. This study addressed these gaps by experimentally inducing felt understanding and not understanding as participants underwent functional magnetic resonance imaging (fMRI). Critically, our analyses examined neural regions that track with participants' subjective ratings of felt understanding. Further, we tested whether these subjective ratings of felt understanding were associated with subsequent interpersonal closeness with interaction partners (i.e. liking). Finally, we examined whether individual differences in rejection sensitivity (RS) altered neural responses to understanding and non-understanding feedback from others.

Because of the paucity of neural work on feeling understood and not understood, it is difficult to make precise predictions. However, a large body of work on neural responses to various forms of social connection and disconnection suggest several candidate regions. For example, when individuals receive positive feedback from others (Izuma et al., 2008) or receive loving messages from close others (Inagaki and Eisenberger, 2013), reward-related regions (e.g. ventral striatum [VS]) are activated. In addition, some research suggests that

experiencing physical and emotional closeness with others or viewing close others activates the middle insula (Olausson *et al.*, 2002; Bartels and Zeki, 2004; Eisenberger *et al.*, 2011; Inagaki and Eisenberger, 2013). Thus, we predicted that felt understanding may boost feelings of social closeness and activate VS and middle insula. In contrast, we predicted that not feeling understood may create social distance and activate neural regions previously associated with social disconnection. More specifically, past research demonstrates that social rejection and negative social feedback activate the dorsal anterior cingulate cortex (dACC) and anterior insula (AI) (Eisenberger *et al.*, 2003, 2011; Kross *et al.*, 2007). Therefore, not feeling understood may activate the dACC and AI, with trait differences in RS amplifying neural responses in these regions.

## METHODS

### Participants

Informed consent was obtained from 35 healthy University of California Los Angeles (UCLA) undergraduates during an initial behavioral session. Twenty-one of these students met criteria for the fMRI scanning session (i.e. right-handed, no metal, no psychoactive medications) and were scanned approximately 1 week later. One student was excluded from analyses due to a brain abnormality; a second student was excluded due to severe problems with normalization. Of the remaining 19 students, 9 were male and 10 were female (mean age =18.9 years, SD = 1.15). The sample was 37% Caucasian, 47% Asian American and 16% Latino/a.

### Initial behavioral session

Before arriving at the lab, participants were asked to write a paragraph on SurveyMonkey about each of the six most positive and six most negative events in their life that they were willing to discuss in a lab setting and while being videotaped (following the procedure used by Zaki *et al.* [2008]). In addition, they gave each event a short title and rated its emotional intensity on a 9-point likert scale. Before the lab session, the experimenter selected the four most intense positive and four most intense negative events and pseudorandomized the order of events, such that no more than two positive or two negative events occurred in a row.

Once participants arrived at the laboratory, they were asked to videotape themselves while describing the details and emotions they experienced during each of the eight pre-selected events. Critically, participants were told that no one would see these videos, but the participants themselves. For each event, participants were asked to read their own paragraph about the event, spend one minute reliving the event, self-record a video approximately 2-min long describing the event, and then rate how emotionally intense they felt while talking about the event. Some example positive events were acceptance into UCLA, a surprise birthday party, and winning a scholarship; some example negative events were failing a class, getting bullied, and a romantic breakup.

As the experimenter prepared the videos for playback, participants completed the Sensitivity to Rejection Scale (Mehrabian, 1970). Participants then watched each of their videos and continuously rated the affective valence they felt while discussing the event, using a digital sliding scale ranging from *very negative* (1) to *very positive* (9). Finally, participants were asked for their permission to have other UCLA students watch their videos in the upcoming week. In reality, no UCLA students ever watched their videos.

In the week between the behavioral session and fMRI scanning session, the experimenters used the participants' videos and continuous ratings to create short, emotionally intense video clips with a significant upshift or downshift in self-reported valence for positive and negative events, respectively. More specifically, a clip was selected from a positive event if the continuous ratings were above the midpoint and showed an increase of two points or more in a 20-s time period (e.g. ratings from 5 → 7 or 6 → 9). In contrast, a clip was selected from a negative event if the ratings were below the midpoint and showed a decrease of two points or more in the 20-s time period (e.g. ratings from 5 → 2 or 3 → 1). Using iMovie, we then spliced these time periods from the full-length videos. For each participant, all video clips were reviewed by two independent judges and assessed for perceived emotional intensity (i.e. strong facial and verbal expressions of emotion) and comprehensibility. After discussing and resolving discrepancies, judges then selected two positive and two negative clips (each from a separate full-length video) to include in the fMRI task. Participants who did not have enough clips that met these criteria were not invited to participate in the fMRI scanning session.

### fMRI task

Before entering the scanner, participants were told that several UCLA students had come into the lab over the past week and that each student had randomly viewed one of the participant's eight videos. The experimenter then told participants that they would see how different students responded to each of their videos, that two responses per video would be shown, and that these students' responses were intentionally selected due to their different reactions to the same video. Next, participants were shown photos of the supposed UCLA students and told that each student responded to their video by choosing three sentences from a list of provided sentences. Finally, participants were familiarized with the structure of the experiment and given instructions about how to make responses in the scanner.

During the fMRI task, participants believed they were seeing how other UCLA students (i.e. responders) responded to two of their positive videos and two of their negative videos. For each of these four videos, participants saw responses from two different students that were intended to make the participant feel either understood or not understood. Participants saw a total of four 'Understood' blocks and four 'Not Understood' blocks. Each participant saw these blocks in one of five pseudorandomized orders.

In each block for the Understood and Not Understood conditions (Figure 1), participants saw the following: (1) the title of their event for 2 s; (2) a short video clip of their event for 20 s cued in on a moment of high emotionality; (3) a cue that they were about to see a student's response (e.g. 'Student 1') for 1 s; (4) the three sentences the responder supposedly chose in response to the participant's video (each shown for 5 s with a 0.5 second transition between sentences); (5) a scale for rating how understood they felt for 4 s; and (6) a fixation cross for 12 s.

As described previously, the title of the event and video clip were drawn from each participant's initial behavioral session. The responders' three sentences for each of the 'understood' or 'not understood' blocks were generated by the authors and behaviorally piloted to verify that participants did indeed feel understood or not understood (Reis *et al.*, 2000, 2004; Gable *et al.*, 2004). Some examples of understanding sentences included the following: 'I know exactly how you felt,' 'I understand why that affected you a lot,' and 'I get why you responded like that.' Some examples of not understanding sentences included the following: 'I don't get why you reacted like that,' 'I would feel differently in that same situation,' and 'I don't understand why you felt that strongly.' After viewing the three sentences from the responder, participants then rated how understood they felt on a scale from *not at all* (1) to *quite a bit* (4).

### Post scanner ratings

After exiting the scanner, participants were asked to provide additional ratings about their experiences in the scanner. Participants were
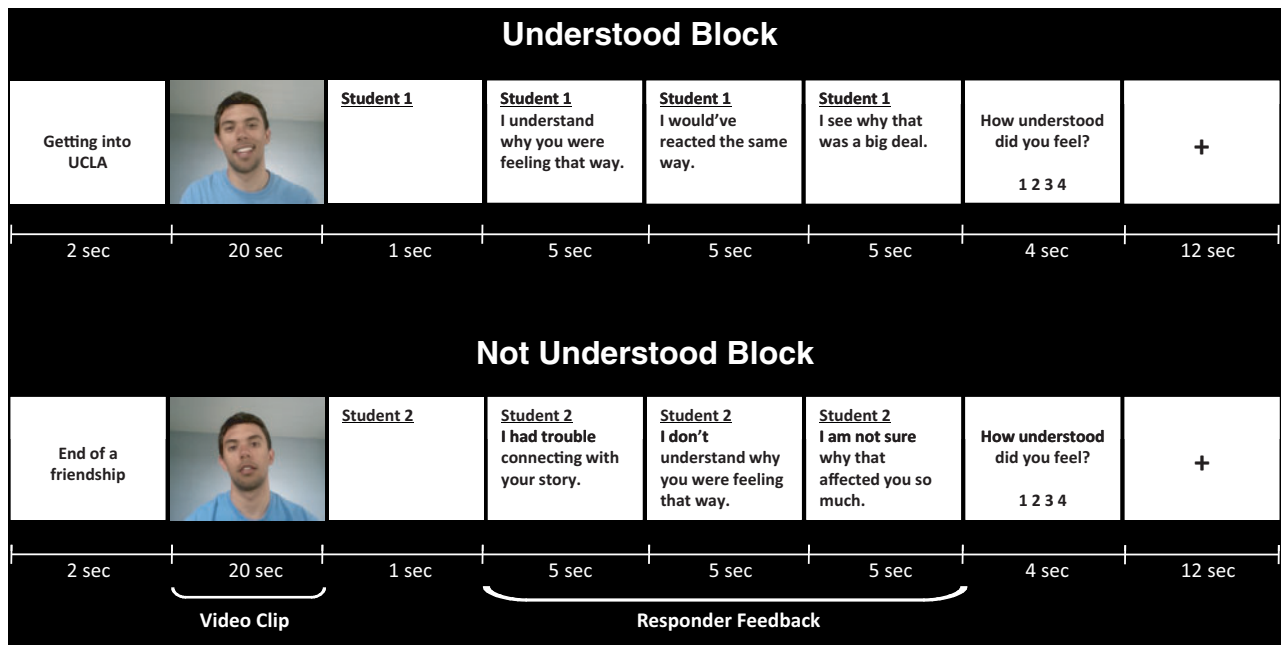
**Fig. 1** The experimental design for the fMRI task, depicting an example of an Understood block and a Not Understood block.

re-shown the title of each event followed by the responders' three sentences for both the Understood and Not Understood conditions. After each block, participants were asked to rate how they felt in response to seeing the feedback on a scale from *very negative* (1) to *very positive* (9). To assess how much the participant liked the responder, we asked participants to rate (1) how much they liked the responder, (2) how warmly they felt towards the responder and (3) whether they would want to spend time with the responder.

### fMRI acquisition and data analysis

Scanning was performed on a Siemens Trio 3T at the UCLA Ahmanson-Lovelace Brain Mapping Center. The MATLAB Psychophysics Toolbox version 7.4 (Brainard, 1997) was used to present the task to participants and record their responses. Participants viewed the task through MR compatible LCD goggles and responded to the task with a MR compatible button response box in their right hand. For each participant, 278 functional T2*-weighted echo planar image volumes were acquired in one run (slice thickness = 3 mm, gap = 1 mm, 36 slices, TR = 2000 ms, TE = 25 ms, flip angle = 90°, matrix = 64 × 64, FOV = 200 mm). A T2-weighted, matched-bandwidth anatomical scan (slice thickness = 3 mm, gap = 1 mm, 36 slices, TR = 5000 ms, TE = 34 ms, flip angle = 90°, matrix = 128 × 128, FOV = 200 mm) and a T1-weighted, magnetization-prepared, rapid-acquisition, gradient echo (MPRAGE) anatomical scan (slice thickness = 1 mm, 192 slices, TR = 2170 ms, TE = 4.33 ms, flip angle = 7°, matrix = 256 × 256, FOV = 256 mm) were also acquired.

In SPM8 (Wellcome Department of Imaging Neuroscience, London), all functional and anatomical images were manually reoriented, realigned, co-registered to the MPRAGE, and normalized using the DARTEL procedure. First-level effects were estimated using the general linear model. 16-s blocks (i.e. three sentences of feedback from the responder for 5 s each with 0.5 s in between sentences) were modeled and convolved with the canonical (double-gamma) hemodynamic response function. The model included four regressors of interest: Positive Event-Understood, Negative Event-Understood, Positive Event-Not Understood, and Negative Event-Not Understood. The title for the event, the video clips, the rating scales and the standard

six motion parameters were included as nuisance regressors. Based on a custom tool for assessing how different high-pass filters affect the estimation efficiency of an SPM design matrix, the time series was high-pass filtered using a cutoff period of 140 s. Serial autocorrelations were modeled as an AR(1) process.

Random effects analyses of the group were computed using the contrast images generated for each participant (Friston *et al.*, 1999). Because our study is the first paradigm to examine the neural correlates of feeling understood and not understood, whole-brain group-level analyses were performed using an uncorrected *P* value of <0.005 with a cluster threshold of 25. For visualization of results, group contrasts were overlaid on a surface representation of the Montreal Neurological Institute (MNI) canonical brain using MRIcron (Rorden *et al.*, 2007).

### RESULTS
#### Behavioral results
##### Manipulation check

To assess participants' affective response in each condition, we examined in-scanner ratings of how understood participants felt, as well as post-scanner ratings of how positive/negative they felt in response to seeing the responders' feedback. Using a hierarchical linear model, we found that felt understanding was positively associated with positive affect over the eight different blocks (*B* = 1.54, SE *B* = 0.12, *P* < 0.001). Therefore, we computed a 'felt understanding' composite that averaged these two ratings together. We then conducted a repeated measures 2 × 2 analysis of variance with emotional event (positive, negative) and feedback type (understanding, not understanding) as the two independent variables. The main effect of emotional event ($F(1,18) = 2.76$, *ns*) and the interaction ($F(1,18) = 0.02$, *ns*) were not significant. However, the main effect of feedback type was significant, $F(1,18) = 216.71$, *P* < 0.001. Participants felt more understood in the 'Understood' condition (*M* = 5.42, SD = 0.62) compared with the 'Not Understood' condition (*M* = 2.04, SD = 0.59). Thus, the participants' subjective ratings of felt understanding confirm that the experimental manipulation was effective.

### Consequences of feeling understood

To test our hypothesis that feeling understood would increase liking for the responder, we examined this relationship within each participant across the eight blocks. For each of the eight blocks, a composite measure of liking was created by averaging together participants' ratings of liking, warmth, and willingness to spend time with each responder. Then, using a hierarchical linear model, we examined whether felt understanding would covary with liking over the eight different blocks. In the within-subjects analyses, felt understanding showed a significant positive relationship with liking ($B = 0.89$, SE $B = 0.08$, $P < 0.001$). Taken together, these analyses suggest that feeling understood by someone may increase interpersonal closeness, while not feeling understood may create social distance.

### Individual differences and felt understanding

To test whether trait RS would impact felt understanding, we conducted several correlational analyses. First, averages for the felt understanding composite in the Understood and Not Understood condition were computed. Analyses then focused on whether RS would correlate with felt understanding in each condition. RS showed a marginal negative correlation with felt understanding in the Not Understood condition ($r = -0.42$, $P = 0.07$), suggesting that participants who are sensitive to rejection felt less understood when receiving the same negative feedback as other participants. However, RS was not significantly correlated with felt understanding in the Understood condition ($r = 0.15$, ns). Overall, RS seems to amplify decreases in felt understanding after non-understanding feedback.

### fMRI Results

#### Neural responses to feeling understood

Our first aim was to examine whether feeling understood would activate regions previously associated with processing monetary and social rewards (such as VS or middle insula). These analyses collapsed across positive and negative events because the behavioral data (see above) did not show an interaction between emotional event (positive vs. negative) and feedback type (understanding vs. not understanding) on felt understanding ratings. Further, in whole-brain analyses, the same interaction contrasts yielded no significant clusters in areas of interest. Hence, the 'Understood condition' was created by averaging the Positive Event-Understood condition and the Negative Event-Understood condition together. The 'Not Understood condition' was created by averaging the Positive Event-Not Understood condition and the Negative Event-Not Understood condition together. Then, a contrast was created to examine neural regions that were more active during the Understood condition compared with the Not Understood condition. Results revealed significant clusters of activation in the VS and middle insula (Table 1 and Figure 2), suggesting that feeling understood activates regions related to reward and social connection. In addition, this contrast showed increased activation in regions related to mentalizing such as the precuneus and temporoparietal junction (TPJ) (Table 1).

Next, a parametric analysis was conducted to identify what neural regions would show parametric increases as a function of felt understanding. More specifically, a parametric felt understanding regressor (i.e. felt understanding composite) was entered to scale the hemodynamic responses during the feedback sentences for all 8 blocks. As expected, parametric increases occurred in the VS as a function of felt understanding (Table 2). Additional mentalizing-related regions such as the precuneus and TPJ (Table 2) were also activated. Because of the strong associations between the felt understanding composite and liking, we do not discuss additional parametric analyses with these

**Table 1** Neural regions that were more active during the understood condition compared with the not understood condition

| Region | BA | Hemisphere | k | Coordinates | | | t |
|---|---|---|---|---|---|---|---|
| | | | | x | y | z | |
| Understood > not understood | | | | | | | |
| VS | — | — | 35 | 0 | 18 | −3 | 5.06 |
| Middle insula | 6/44/13 | L | 126 | −42 | −3 | 9 | 4.64 |
| | 13 | R | 47 | 39 | 6 | 15 | 4.85 |
| Precuneus/paracentral lobule | 5/3 | L | 127 | −12 | −24 | 51 | 4.77 |
| | | R | 115 | 9 | −36 | 45 | 3.61 |
| TPJ/inferior parietal lobule | 40/4 | L | 404 | −51 | −27 | 27 | 4.69 |
| Ventrolateral prefrontal cortex | 46 | L | 37 | −48 | 33 | 9 | 4.75 |
| Middle cingulate/supplementary motor area | 24 | L | 42 | −9 | −6 | 48 | 3.97 |
| Hippocampus | — | L | 36 | −33 | −21 | −12 | 5.16 |
| | | L | 26 | −24 | −33 | 0 | 3.79 |
| Fusiform | 36/37 | R | 54 | 33 | −36 | −18 | 6.14 |
| Supplementary motor area | 6 | R | 73 | 15 | −12 | 60 | 4.22 |
| Occipital lobe/cerebellum | 18/19 | R | 62 | 24 | −66 | −18 | 3.84 |
| Not understood > understood | | | | | | | |
| AI/IFG | 13/47 | L | 52 | −30 | 21 | 18 | 4.01 |
| DMPFC | 9 | R | 37 | 3 | 54 | 33 | 3.58 |

variables to avoid redundancy. However, these analyses revealed very similar patterns.

#### Neural responses to not feeling understood

Our second aim was to explore what regions would be activated when participants did not feel understood. Therefore, we conducted a whole brain analysis comparing the Not Understood condition to the Understood condition. This contrast showed increased activation in AI/inferior frontal gyrus (IFG) (Table 1 and Figure 2), suggesting that not feeling understood activates a region previously associated with negative affect—including negative affective experiences arising from feeling rejected, being negatively evaluated, or being treated unfairly (Eisenberger et al., 2003, 2011; Sanfey et al., 2003). We also found an additional cluster in the dorsomedial prefrontal cortex (DMPFC) (Table 1 and Figure 2), suggesting that not feeling understood may activate a mentalizing-related region previously associated with thinking about dissimilar others (Mitchell et al., 2006).

In addition, a parametric analysis was conducted to identify what neural regions would show parametric increases as a function of not feeling understood. Parametric increases in not feeling understood occurred in AI/IFG and DMPFC (Table 2), suggesting that not feeling understood may be tracked in regions related to negative emotion and thinking about others.

#### Rejection sensitivity and neural responses to feeling understood and not understood

In our last set of analyses, we examined whether RS would impact neural responses when feeling understood and not understood. A regression analysis was conducted using the contrast Understood > Not Understood with RS entered as a regressor. Analyses showed that heightened RS was associated with greater neural activity in AI during Not Understood vs. Understood blocks (Table 3 and Figure 3). To examine what might be driving this effect, post-hoc analyses were conducted. A functional region of interest (ROI) from the AI cluster was created, and parameter estimates were extracted for the contrasts Understood > Fixation and Not Understood > Fixation. Parameter estimates from AI for each contrast were then correlated
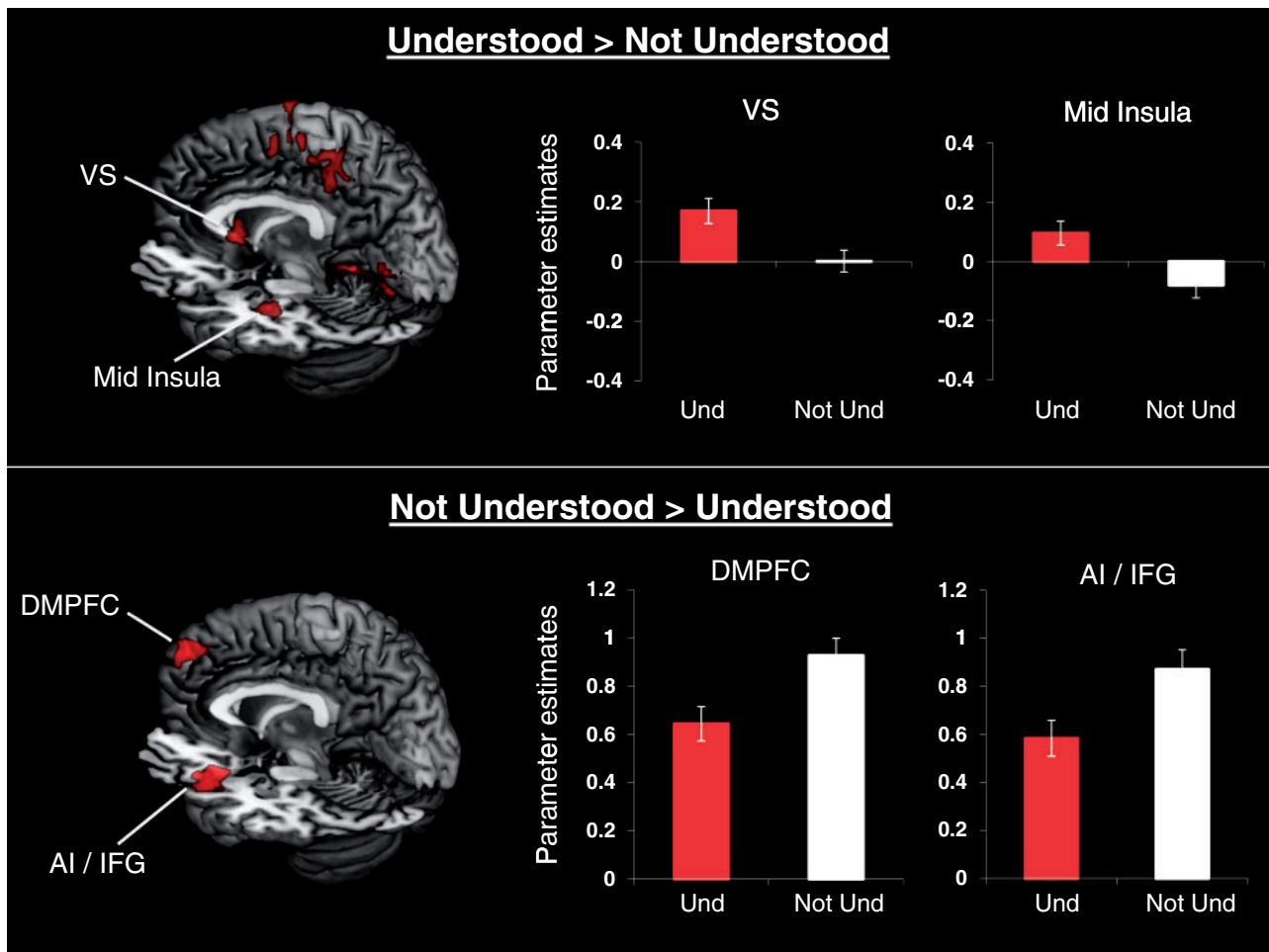
**Fig. 2** Neural activations for the contrast Understood > Not Understood and Not Understood > Understood, in addition to the parameter estimates for each region for Understood > Fixation and Not Understood > Fixation.

**Table 2** Neural regions that show parametric increases as a function of feeling understood and not understood

| Region | BA | Hemisphere | k | Coordinates | | | t |
|---|---|---|---|---|---|---|---|
| | | | | x | y | z | |
| Parametric increases in feeling understood | | | | | | | |
| VS | — | — | 27 | 0 | 18 | −3 | 5.06 |
| Precuneus | 7 | L | 27 | −18 | −60 | 48 | 3.13 |
| TPJ/inferior parietal lobule | 40 | L | 52 | −48 | −30 | 24 | 5.32 |
| Ventrolateral prefrontal cortex | 46 | L | 34 | −48 | 36 | 21 | 3.84 |
| Fusiform | 36/37 | R | 46 | 33 | −33 | −18 | 5.63 |
| Superior parietal lobule | 3/5/2 | L | 74 | −15 | −48 | 66 | 3.32 |
| Precentral gyrus | 4 | L | 112 | −36 | −27 | 63 | 3.95 |
| Parametric increases in not feeling understood | | | | | | | |
| AI/IFG | 13/47 | L | 96 | −27 | 15 | −15 | 4.05 |
| DMPFC | 9/10 | R | 146 | 6 | 54 | 33 | 3.79 |

**Table 3** For the contrast not understood compared with understood, neural regions that show increased activation as rejection sensitivity increases

| Region | BA | Hemisphere | k | Coordinates | | | t |
|---|---|---|---|---|---|---|---|
| | | | | x | y | z | |
| Not understood > understood with rejection sensitivity regressor | | | | | | | |
| AI | 13 | L | 51 | −36 | 9 | −6 | 4.11 |
| TPJ | 40 | R | 45 | 63 | −39 | 24 | 4.09 |
| Precuneus/paracentral lobule | 5 | R | 152 | 12 | −30 | 54 | 5.67 |
| Dorsolateral prefrontal cortex | 10/46 | L | 56 | −36 | 36 | 15 | 6.72 |
| Superior/IFG | 22 | R | 69 | 66 | −3 | −6 | 4.82 |
| Dorsal striatum | — | L | 40 | −18 | 18 | 9 | 3.88 |
| Occipital lobe | 19 | L | 49 | −12 | −87 | 42 | 3.81 |
| | | R | 64 | 36 | −75 | −18 | 4.17 |

with RS. RS was positively correlated with AI activity for Not Understood > Fixation ($r = 0.61$, $P < 0.01$), (Figure 3, bottom left). However, RS was not significantly correlated with AI activity for Understood > Fixation ($r = -0.01$, *ns*) (Figure 3, bottom right). Similar to our behavioral findings, these analyses suggest that RS may amplify neural responses in regions previously associated with negative affect and social rejection, when not feeling understood.

## DISCUSSION

Our results begin to shed light on the neural bases of feeling understood and not understood. Feeling understood is tracked in neural regions previously associated with reward and social connection (i.e. VS and middle insula), as well as those associated with mentalizing (i.e. precuneus and TPJ). In contrast, not feeling understood is tracked in regions related to negative affect and social pain (i.e. AI), as well as regions previously associated with mentalizing and thinking about
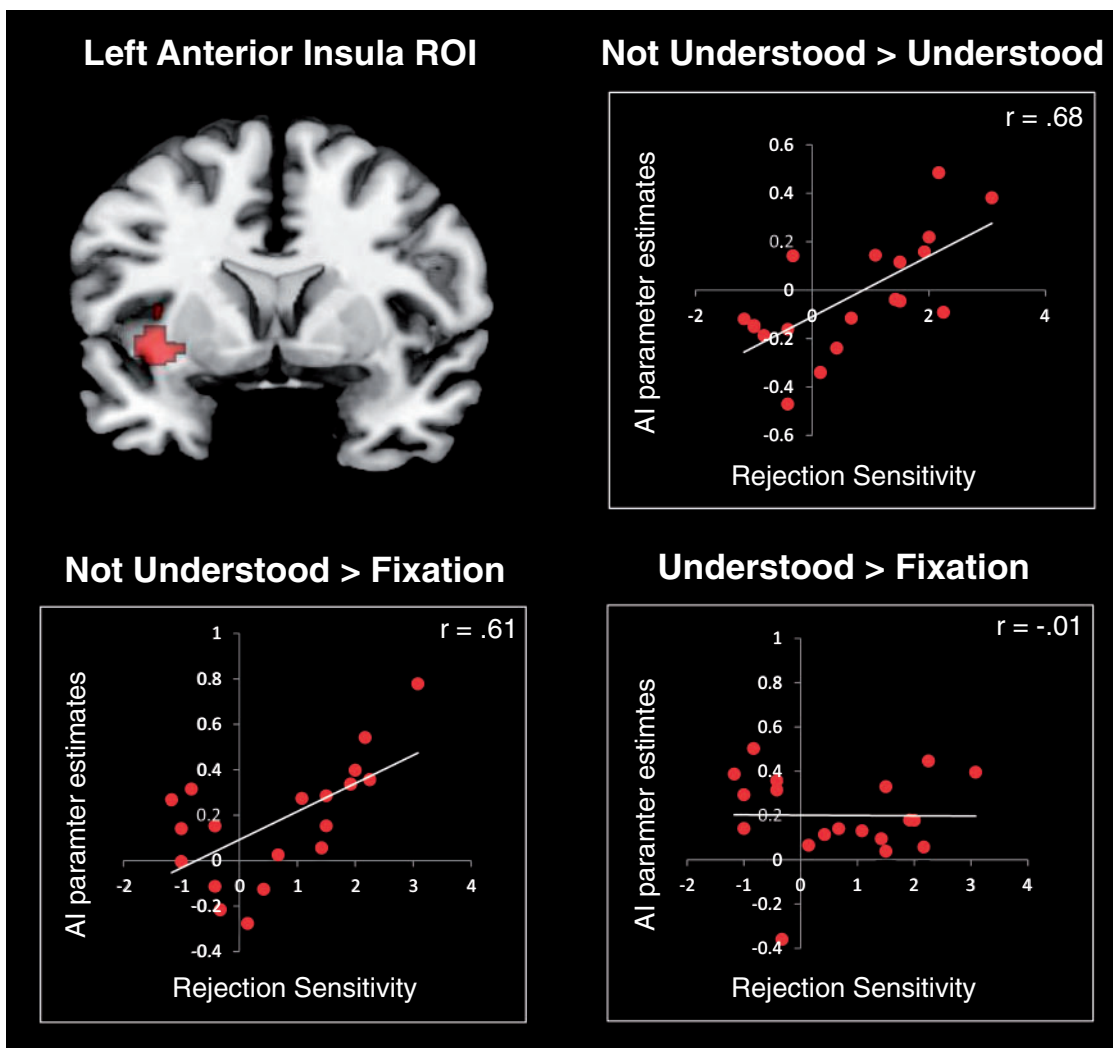
**Fig. 3** For the Not Understood condition compared with the Understood condition, left AI activation increased with increasing levels of trait RS (top left). For visualization purposes, only AI activation is shown. The scatter plots depict the correlation between trait RS and parameter estimates from this left AI ROI for (1) Not Understood > Understood (top right), (2) Not Understood > Fixation (bottom left) and (3) Understood > Fixation (bottom right).

dissimilar others (i.e. DMPFC). Behavioral ratings paralleled the neural findings: feeling more understood predicted increased interpersonal closeness, while not feeling understood was associated with feeling socially distant from others. Further, when getting feedback that was not understanding, rejection-sensitive individuals felt less understood and showed amplified neural responses in regions related to negative affect (i.e. AI).

On the surface, the term 'feeling understood' seems to emphasize the importance of *cognitive* processes, such as recognizing that others have listened attentively and have accurately understood 'the facts' about a personal event (Reis and Patrick, 1996). To the extent that feeling understood results primarily from knowing that others understand one's actions or intentions, feeling understood (or not) should activate neural regions known to be involved in processing social cognitive information about the self and others (Lieberman, 2007; Mitchell, 2009). Indeed, our findings are partially consistent with this idea: feeling understood led to increased activation in the precuneus and TPJ, whereas not feeling understood led to increased activation in DMPFC. However, our findings also suggest that feeling understood (or not) is an emotional process as well, as evidenced by increased activity in regions known to correlate with positive affective states (VS, middle insula) in response to feeling understood and increased activity

in regions associated with negative affective states (AI) in response to not feeling understood. Although past research has examined felt understanding in live social interactions, this study minimized emotional cues from others (i.e. no facial expressions, body language, or vocal tone) and simply had participants read sentences from a stranger. Therefore, one might expect that feeling understood (or not) would not evoke a strong emotional response. However, these minimal interactions were powerful enough to activate neural systems related to social reward and pain (Lieberman and Eisenberger, 2008). This is consistent with prior work showing that feeling understood makes individuals feel valued, respected and validated (Reis and Patrick, 1996). Thus, even though feeling understood sounds like primarily a cognitive process, these results support the idea that feeling understood leads to important changes in affective experience and feelings of social connection as well.

By understanding the underlying neural mechanisms of feeling understood and not understood, we have begun to identify why feeling understood (or not) is such a powerful driver of social behavior, as well as a critical component of positive social relationships. More specifically, the anticipated reward of feeling understood may motivate individuals to seek out positive interaction partners, much like individuals seek out primary and secondary rewards such as food or money

(Young, 1959). Further, feeling understood may then act as a social reward, reinforcing and strengthening the social relationship. In contrast, the anticipated social pain of not feeling understood may cause individuals to avoid negative interaction partners, much like individuals avoid physical pain and threats (Lieberman and Eisenberger, 2008). Furthermore, if individuals who do not feel understood experience social pain, it may explain why they also show increases in sensitivity to physical pain (Eisenberger, 2012; Oishi et al., 2013). Finally, our results provide insight into how individual differences may impact these different psychological experiences. Individual differences in RS altered emotional, but not cognitive, processing during others' nonunderstanding feedback.

Our study, however, also had limitations that should be addressed in future research. First, the felt understanding task partially conflates understanding (i.e. getting the facts right; e.g. 'I understand why you were feeling that way') with validation (i.e. acceptance, respect, or support for the other's perspective; e.g. 'It makes sense you felt that way') (Reis and Patrick, 1996). Although these concepts are difficult to disentangle, testing these separate components may help clarify whether neural regions associated with cognitive processes are primarily involved in understanding, whereas neural regions associated with affective processes are primarily involved in validation. A second limitation is that our study did not include a trait measure that parallels RS on the positive end, such as a measure of 'social' reward sensitivity. Therefore, future studies should examine whether individuals high in trait social reward sensitivity show greater VS activity in response to feeling understood. Finally, future research is needed to better understand why certain mentalizing-related regions were responsive to feeling understood (TPJ, precuneus), whereas others were responsive to not feeling understood (DMPFC).

Taken together, these findings inform psychological theory by demonstrating that feeling understood is supported by different emotional and cognitive processes than not feeling understood. Further, by understanding how individual differences alter these emotional and/or cognitive processes, we may be able to more accurately target interventions and tailor therapy to buffer individuals from the harmful consequences of not feeling understood or to amplify the benefits of feeling understood. Although this study begins to elucidate the neural bases of feeling understood and not understood, future studies are needed to replicate these findings and explore additional topics such as neural responses to felt understanding in individuals with altered social functioning and individuals in close relationships.

## REFERENCES

Bartels, A., Zeki, S. (2004). The neural correlates of maternal and romantic love. Neuroimage, 21(3), 1155–66.

Baumeister, R.F., Leary, M.R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. Psychological Bulletin, 117, 497–529.

Brainard, D.H. (1997). The psychophysics toolbox. Spatial Vision, 10(4), 433–6.

Butler, E.A., Egloff, B., Wlhelm, F.H., Smith, N.C., Erickson, E.A., Gross, J.J. (2003). The social consequences of expressive suppression. Emotion, 3(1), 48.

Cacioppo, J.T., Patrick, W. (2008). Loneliness: Human Nature and the Need for Social Connection. New York, NY: WW Norton & Company.

Cahn, D.D. (1990). Perceived understanding and interpersonal relationships. Journal of Social and Personal Relationships, 7(2), 231–44.

Cohen, S. (2004). Social relationships and health. American Psychologist, 59(8), 676–84.

Cross, S.E., Bacon, P.L., Morris, M.L. (2000). The relational-interdependent self-construal and relationships. Journal of Personality and Social Psychology, 78(4), 791.

Eisenberger, N.I. (2012). The pain of social disconnection: Examining the shared neural underpinnings of physical and social pain. Nature Reviews Neuroscience, 13(6), 421–34.

Eisenberger, N.I. (2013). An empirical review of the neural underpinnings of receiving and giving social support: implications for health. Psychosomatic Medicine, 75, 545–56.

Eisenberger, N.I., Inagaki, T.K., Muscatell, K.A., Haltom, K.B., Leary, M.R. (2011). The neural sociometer: brain mechanisms underlying state self-esteem. Journal of Cognitive Neuroscience, 23(11), 3448–55.

Eisenberger, N.I., Lieberman, M.D., Williams, K.D. (2003). Does rejection hurt? An FMRI study of social exclusion. Science, 302(5643), 290–2.

Friston, K.J., Holmes, A.P., Price, C.J., Büchel, C., Worsley, K.J. (1999). Multisubject fMRI studies and conjunction analyses. Neuroimage, 10(4), 385–96.

Gable, S.L., Gonzaga, G.C., Strachman, A. (2006). Will you be there for me when things go right? Supportive responses to positive event disclosures. Journal of Personality and Social Psychology, 91(5), 904–17.

Gable, S.L., Reis, H.T., Impett, E.A., Asher, E.R. (2004). What do you do when things go right? The intrapersonal and interpersonal benefits of sharing positive events. Journal of Personality and Social Psychology, 87(2), 228.

Hawkley, L.C., Burleson, M.H., Berntson, G.G., Cacioppo, J.T. (2003). Loneliness in everyday life: Cardiovascular activity, psychosocial context, and health behaviors. Journal of Personality and Social Psychology, 85(1), 105.

Inagaki, T.K., Eisenberger, N.I. (2011). Neural correlates of giving support to a loved one. Psychosomatic Medicine, 74, 3–7.

Inagaki, T.K., Eisenberger, N.I. (2013). Shared neural mechanisms underlying "social warmth" and physical warmth. Psychological Science, 24, 2272–80.

Izuma, K., Saito, D.N., Sadato, N. (2008). Processing of social and monetary rewards in the human striatum. Neuron, 58, 284–94.

Kross, E., Egner, T., Ochsner, K., Hirsch, J., Downey, G. (2007). Neural dynamics of rejection sensitivity. Journal of Cognitive Neuroscience, 19(6), 945–56.

Laurenceau, J.P., Barrett, L.F., Pietromonaco, P.R. (1998). Intimacy as an interpersonal process: the importance of self-disclosure, partner disclosure, and perceived partner responsiveness in interpersonal exchanges. Journal of Personality and Social Psychology, 74(5), 1238.

Lieberman, M.D. (2007). Social cognitive neuroscience: a review of core processes. Annual Review of Psychology, 58, 259–89.

Lieberman, M.D., Eisenberger, N.I. (2008). The pains and pleasures of social life: a social cognitive neuroscience approach. NeuroLeadership Journal, 1, 1–9.

Lippert, T., Prager, K.J. (2001). Daily experiences of intimacy: A study of couples. Personal Relationships, 8(3), 283–98.

Lun, J., Kesebir, S., Oishi, S. (2008). On feeling understood and feeling well: The role of interdependence. Journal of Research in Personality, 42(6), 1623–8.

Mehrabian, A. (1970). The development and validation of measures of affiliative tendency and sensitivity to rejection. Educational and Psychological Measurement, 30, 417–28.

Mitchell, J.P. (2009). Inferences about mental states. Philosophical Transantions of the Royal Society B Biological Sciences, 364(1521), 1309–16.

Mitchell, J.P., Macrae, C.N., Banaji, M.R. (2006). Dissociable medial prefrontal contributions to judgments of similar and dissimilar others. Neuron, 50(4), 655–63.

Oishi, S., Koo, M., Akimoto, S. (2008). Culture, interpersonal perceptions, and happiness in social interactions. Personality and Social Psychology Bulletin, 34(3), 307–20.

Oishi, S., Krochik, M., Akimoto, S. (2010). Felt understanding as a bridge between close relationships and subjective well-being: antecedents and consequences across individuals and cultures. Social and Personality Psychology Compass, 4(6), 403–16.

Oishi, S., Schiller, J., Gross, E.B. (2013). Felt understanding and misunderstanding affect the perception of pain, slant, and distance. Social Psychological and Personality Science, 4(3), 259–66.

Olausson, H., Lamarre, Y., Backlund, H., et al. (2002). Unmyelinated tactile afferents signal touch and project to insular cortex. Nature Neuroscience, 5(9), 900–4.

Reis, H.T., Clark, M.S., Holmes, J.G. (2004). Perceived partner responsiveness as an organizing construct in the study of intimacy and closeness. In: Mashek, D.J., Aron, A., editors. Handbook of Closeness and Intimacy. Mahwah, NJ: Lawrence Erlbaum Associates Publishers, pp. 201–25.

Reis, H.T., Patrick, B.C. (1996). Attachment and intimacy: component processes. In: Higgins, E.T., Kruglanski, A.W., editors. Social Psychology: Handbook of Basic Principles. New York, NY: Guilford Press, pp. 523–63.

Reis, H.T., Shaver, P. (1988). Intimacy as an interpersonal process. In: Duck, S., editor. Handbook of Personal Relationships. Chichester, UK: Wiley, pp. 367–389.

Reis, H.T., Sheldon, K.M., Gable, S.L., Roscoe, J., Ryan, R.M. (2000). Daily well-being: The role of autonomy, competence, and relatedness. Personality and Social Psychology Bulletin, 26(4), 419–35.

Rorden, C., Karnath, H.O., Bonilha, L. (2007). Improving lesion-symptom mapping. Journal of Cognitive Neuroscience, 19(7), 1081–8.

Sanfey, A.G., Rilling, J.K., Aronson, J.A., Nystrom, L.E., Cohen, J.D. (2003). The neural basis of economic decision-making in the ultimatum game. Science, 300(5626), 1755–8.

Seehausen, M., Kazzer, P., Bajbouj, M., Prehn, K. (2012). Effects of empathic paraphrasing–extrinsic emotion regulation in social conflict. Frontiers in Psychology, 3, 482.

Swann, W.B. (1990). To be adored or to be known: The interplay of self-enhancement and self-verification. In: Sorrentino, R.M., Higgins, E.T., editors. Handbook of Motivation and Cognition, Vol. 2, New York: Guilford, pp. 408–48.

Whisman, M.A., Sheldon, C.T., Goering, P. (2000). Psychiatric disorders and dissatisfaction with social relationships: does type of relationship matter? Journal of Abnormal Psychology, 109(4), 803–8.

Young, P.T. (1959). The role of affective processes in learning and motivation. Psychological Review, 66(2), 104–25.

Zaki, J., Bolger, N., Ochsner, K. (2008). It takes two the interpersonal nature of empathic accuracy. Psychological Science, 19(4), 399–404.