Neural Systems Underlying Successful Emotion Regulation via Social Buffering

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Introduction

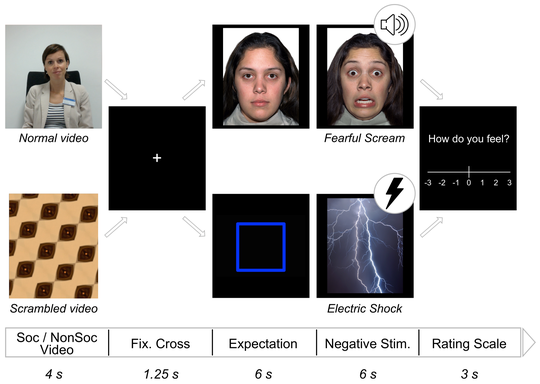
Across the mammalian world, the presence of a trusting conspecific is known to have a calming emotional and physiological effect, called social buffering (Hostinar, 2014). Reduction of negative feelings and associated physiological responses due to social buffering are also consistently observed in humans (Eisenberger, 2013; Krahé, 2013). However, beyond imaging studies priming social buffering via pictures or handholding with romantic partners (e.g. Coan, 2006; Eisenberger, 2011), we still know little about the neural systems involved in and affected by social buffering.

The current study aimed to delineate a process model of the neural underpinnings of social buffering.

Which neural systems mediate the effect of social buffering on aversive emotional feelings?

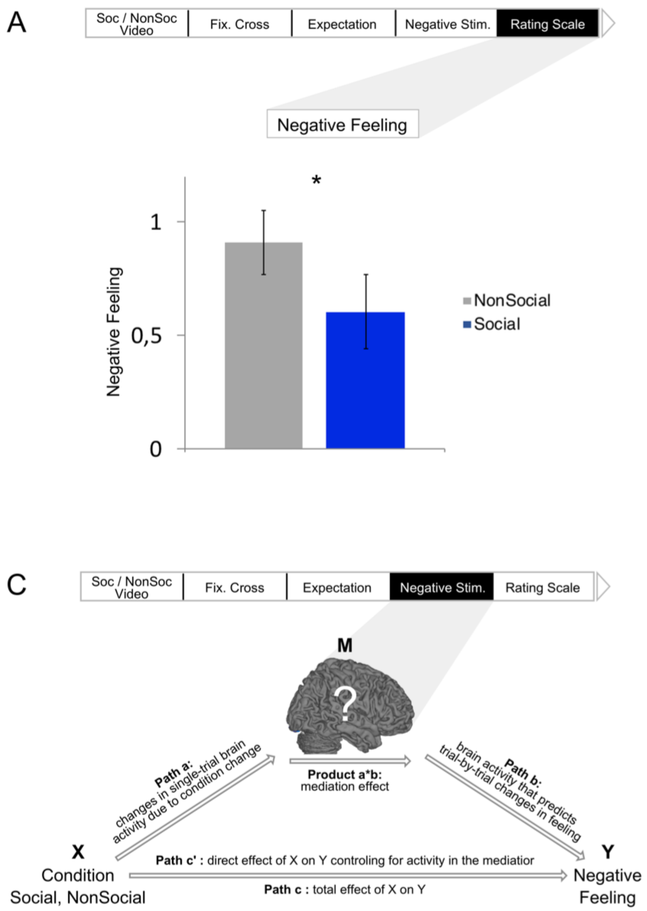
Methods

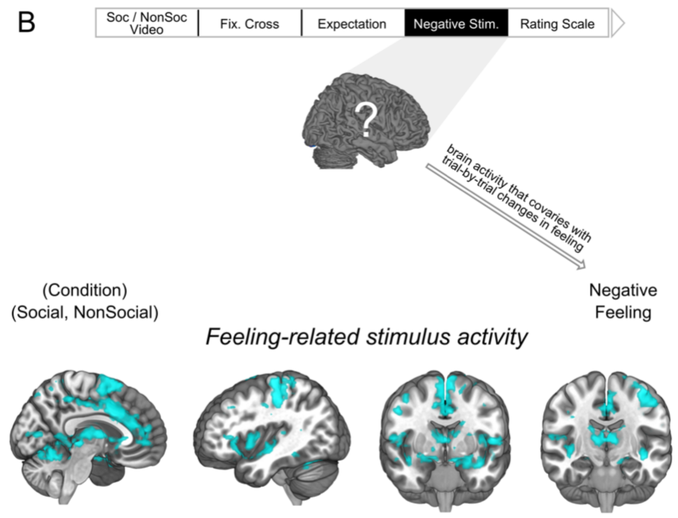
In a 2x2 design (social buffering x aversive stimulation type), 27 participants underwent fMRI while being exposed to aversive stimuli, including painful electrical stimulation and fearful screams. In the Social condition, a psychotherapist communicated with participants at the start of every trial; she signaled her supportive presence with sentences such as “Don’t worry, I am here.” In reality, videos were used. In the NonSocial condition, participants viewed scrambled versions of the social videos.

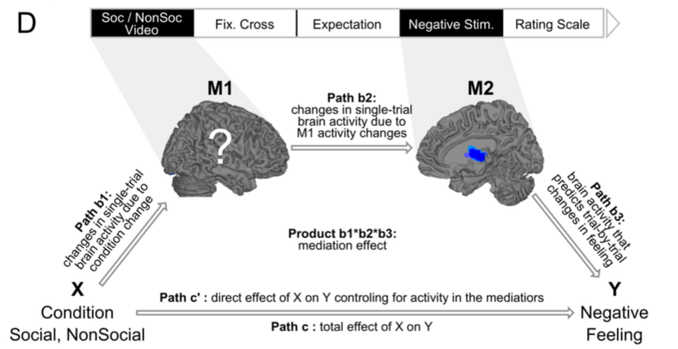


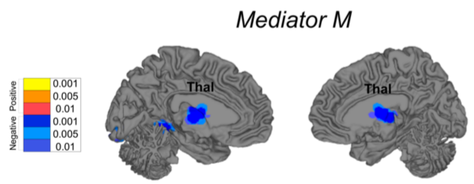
Trial structure. First, a video was shown – the psychotherapist (Social condition), or a scrambled social video (NonSocial condition). After a subsequent fixation cross, participants either saw a face or a shape (signalling the type of upcoming aversive stimulation). Then followed either a fearful face together with a scream, or a lighting paired with painful electrical stimulation. Finally, participants rated their feeling on a 7-point rating scale.

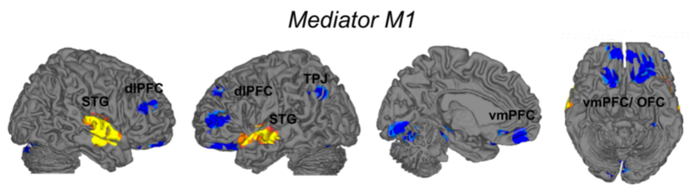
Results











A. *Presence of the psychotherapist lowered participants’ negative feelings induced by the aversive stimuli via social buffering. Main effect of social buffering for both types of stimulation is shown. Error bars indicate standard error. * p < 0.05.*

B. *Activation analysis of negative stimulus-related activity, parametrically modulated with trial-wise aversive feeling scores. Negative stimulus-related activity covarying with feeling was found in an extensive emotion-pain network, including the thalamus, anterior insula, amygdala and anterior cingulate. Results are thresholded at 0.05 FWE cluster-corrected, based on a height threshold of 0.001.*

C. *Two-path single-trial (i.e., multilevel) whole-brain mediation analysis. This analysis examined which brain regions mediate the effect of social buffering on negative emotional feelings, focusing on stimulus-related brain activity. It revealed thalamus to be the mediator between social buffering-induced changes in aversive feelings. Results are thresholded at 0.05 FWE cluster-corrected. For visualisation, three height thresholds of 0.001, 0.005 and 0.01 are used.*

D. *Three-path multilevel whole-brain mediation analysis. Using the result of A as mediator 2 in an extended three-path mediation, we here looked for a neural mediator 1 (mediating the effect of social buffering on stimulus-related brain activity). Analysis revealed several such mediators, including ventromedial prefrontal cortex, orbitofrontal cortex, and temporoparietal junction. Results are thresholded at 0.05 FWE cluster-corrected. For visualisation, three height thresholds of 0.001, 0.005 and 0.01 are used.*

Conclusion

- Using mediation analysis, we constructed a process model of social buffering effects on aversive feelings. Two brain systems support the soothing effect of social buffering: first, the ventral and dorsal prefrontal cortex during active social buffering, and secondly the thalamus during aversive stimulus presentation.
- Both brain systems reduce their activity with social buffering, mirroring its soothing/calming effect and perhaps signifying a general reduction of vigilance and stress in the individual.

References

- Coan, J.A. (2006), Psychological Science, 17(12), pp. 1032-1039.
- Eisenberger, N.I. (2011), PNAS, 108(28), pp. 11721-11726.
- Eisenberger, N.I. (2013), Psychosomatic Medicine 75(6), pp. 545-556.
- Hostinar, C.E. (2014), Psychological Bulletin, 140(1), pp. 256-282.
- Krahé, C. (2013), Frontiers in Human Neuroscience, 7(386), pp. 1-21.

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