

Neural underpinnings of individual differences in emotion regulation

Carmen Morawetz¹ & Ulrike Basten²

¹ Institute of Psychology, University of Innsbruck, Austria

² Department of Psychology, University of Koblenz-Landau, Germany

Introduction Previous meta-analyses have integrated a large number of functional magnetic resonance imaging (fMRI) studies to find robust brain networks underlying emotion regulation. However, findings on individual differences in neural processes underlying emotion regulation have not yet been integrated across studies. This is an important next step to improve our understanding of individual differences in emotion regulation, which are considered a transdiagnostic dimension of psychopathology and possible target for individualized interventions. In this meta-analysis, we integrate findings from studies relating brain activation during emotion regulation to (1) offline questionnaire, (2) online behavioural, (3) demographic, and (4) physiological measures. We synthesize findings of individual differences analyses in terms of region-of-interest correlational analyses (hypothesis-driven approach) and whole-brain regression analyses (exploratory approach).

Methods Literature research was conducted based on recent meta-analyses on the general mechanisms of emotion regulation (Morawetz et al., 2020, 2017). These meta-analyses have not considered individual differences so far. 261 fMRI studies on emotion regulation were screened for analyses of individual differences. Of these, 53 studies (number of participants = 1,847, number of foci = 287) reported a significant effect with a covariate of interest: (1) offline questionnaire measures assessed separately from the fMRI experiment ($n = 15$ studies; habitual use of emotion regulation strategies, personality, well-being, attachment style, mindfulness, alexithymia, sleep quality index, behavioural activation system), (2) online behavioural measures assessed during the fMRI experiment ($n = 32$ studies; reappraisal success, anxiety reduction, etc.), (3) demographic measures ($n = 9$ studies; age, gender, cultural differences), and (4) physiological measures ($n = 6$ studies; cortisol, heart rate, skin conductance, pupil dilatation, endocrine activity, fractional anisotropy) as variables of interest. Only studies reporting a significant finding in adult, healthy participants using an explicit emotion regulation task in combination with a covariate of interest were considered for the meta-analysis.

Results Across studies, the hypothesis-driven approach using region-of-interest analyses was much more frequent ($n=38$ studies) than an exploratory approach considering the whole-brain ($n=10$ studies). Fig. 1 illustrates peak activation foci during emotion regulation as a function of the covariates of interest. First, online behavioural measures and offline questionnaire measures correlate with activity in the amygdala and prefrontal regions. Second, amygdala activation correlates with online behavioural measures only when used as an ROI, while offline questionnaire measures correlate with amygdala responses on a whole-brain level. Third, a lack of spatial clustering for the effects of demographic and physiological measures suggests that these variables do not exert a systematic effect on brain activity during emotion regulation.

Conclusions Individual differences in brain activation during emotion regulation have been investigated in numerous studies with partly diverging findings. Activity in prefrontal cortex seems to correlate with online behavioural, offline questionnaire, demographic, and physiological measures, while activation in the amygdala is modulated by online behavioural and offline questionnaire measures. It is important to further examine these associations to build robust neurobiological models of emotion regulation that will help understand individual differences in emotion regulation as a transdiagnostic dimension of psychopathology.

References

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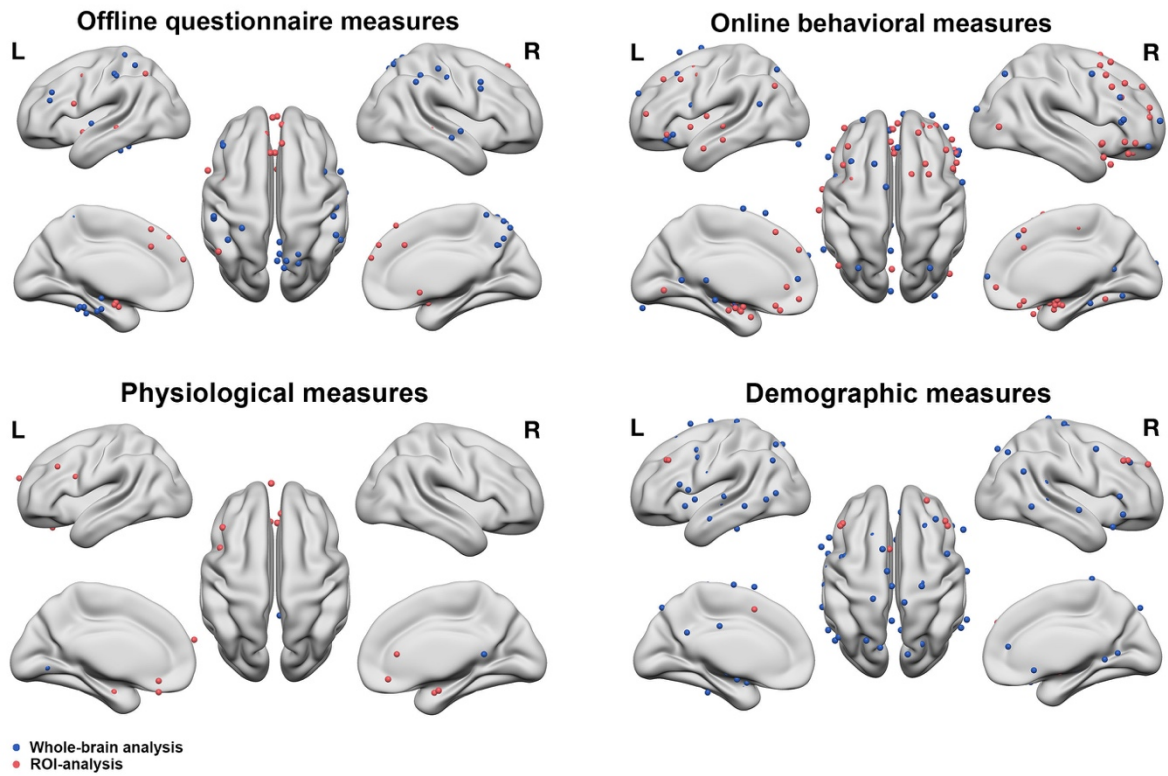


Figure 1. Plots of activation foci of 53 fMRI studies investigating individual differences in emotion regulation. Plots of foci as a function of individual differences measures and implemented analysis approach (whole-brain analysis and region-of-interest [ROI] analysis).