Structural and behavioural differences between high and low trait-anxious individuals

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Introduction

Learning, conditioning and a genetic predisposition influence the processing of negative emotional stimuli (e.g. Phelps, 2004). Here, we are focusing on the learning-process, memory-consolidation and the associated neural fibre-connections in individuals with elevated trait-anxiety. These people are especially prone to develop anxiety-disorders and differ from people with reduced or average trait-anxiety with regard to the processing, evaluation and memory of threat-related stimulus-material (McCabe, 1999; Russo et al, 2006; Mitte, 2008).

To date, studies on memory-bias in subclinical anxiety patients do not add up to a consistent picture. While some authors strongly support the existence of a memory bias, others blame findings on unproppriate experimental designs or insufficient criterions (Russo et al 1999). It is the intent of this study to clarify if subjects of high and low anxiety significantly differ from each other or not.

To achieve this, shortcomings of earlier studies are addressed, circumvented and behavioural testing is combined with a state-of-the art imaging technique.

Method

The State Trait Anxiety Inventory (Spilberger et al., 1983) served to form two groups, one high and one low in trait-anxiety (fig. 1a). An associative statistical word-learning (training) was applied to investigate the development of memory bias for negatively arousing stimuli. Within this framework, 60 neutral word stimuli (e.g. farm) were linked with negatively arousing colour pictures (e.g. explosion) (fig. 1b). To check for memory-biases, we implicitly and explicitly tested the learned word-material. These tests were carried out directly after training and two weeks later (fig. 1c). The latter was implemented to investigate the impact of consolidation on the development of memory biases. A subgroup of n = 34 subjects was additionally scanned via Diffusion Tensor Imaging (DTI). The program Track-Based spatial statistics from FSL was used to investigate white matter differences between groups via Fractional Anisotropy (FA) Values.

Behavioral Results

Results of the recall test yielded a significant main effect for word-type, (F(1, 52) = 7.153; p = 0.010). Results of the valence-rating showed main effects for group, (F(1, 52) = 6.034; p = 0.015), and anxiety (F(1, 52) = 7.115; p = 0.002). An interaction effect occurred for word-type (F(1, 52) = 26.947; p = 0.001) but no interaction between anxiety and word-type (fig. 2b).

Structural Results

Analysis of the DTI-data revealed significant structural differences between high and low-anxiety subjects. These were particularly visible in dorsolateral Prefrontal Cortex (dlPFC) and thalamic regions. Here, the low-anxiety group exhibited higher FA-Values, hence stronger integrity of white matter (fig. 4).

Conclusion

Overall, the results clearly emphasize neuroanatomical and behavioural differences between subclinically high and low trait-anxious individuals. Behavioural differences regarding learning (memory bias) are stronger for explicit than implicit memory. The absence of group-differences during the training suggests that development of the memory-bias takes place at later learning-stages such as consolidation or retrieval.

Consolidated implicit responses of the high anxiety group indicate a generalization-bias, which might be due to anxiety-specific consolidation-mechanisms and which is associated with lower white matter integrity in right-hemispheric dlPFC and thalamic regions. The results of this study could have implications for therapeutic treatment and have to be discussed in relation to current theories on anxiety disorders.

References

3)Price et al. (2008). “Brain regions that respond to threat in anxious individuals are a consequence of anxious state”. Memory, 14(11), 598-69.

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