IV. Abstract

The organism’s response to stress is an adaptive mechanism for keeping up the homeostasis in the moment of stress as well as for preparing the organism for similar situations reoccurring in the future. The stress response thus exerts influence on attentional and memory encoding processes from the onset of the stressful situation and in its aftermath when consolidation processes come into play. As a result, memory for aspects and objects of a stressful episode has been found to be enhanced in comparison to a non-stressful experience. This was shown to be particularly pronounced for central, in some way meaningful, aspects of the stressful situation. The underlying mechanism which has been made responsible for this is co-activation of the sympathetic nervous system and hypothalamus-pituitary-adrenal axis, resulting in increased cortisol release. These neuroendocrine influences act on brain areas involved in memory processes. It is yet unclear whether stress also modifies fixation and hereby attentional processes which, in concert with the psychophysiological effects, lead to memory enhancement. Experiment 1 therefore aimed at investigating fixation behaviour under stress by means of a mobile eye tracking device. While participants randomly took part in the Trier Social Stress Test (TSST), holding a free speech in front of an evaluation committee, or the friendly control condition (f-TSST), both including 20 office items, their fixations were recorded with the eye tracker. The committee used 10 of the items whereby these became central. One day later, the participants’ memory for the items was tested with free recall and object recognition tasks. It was shown that stressed participants exhibit more and longer fixations on the central items and also show better memory for these. However, memory and fixation measures did not correlate, nor did fixation behaviour mediate memory outcome in the stress group. Fixation on the faces of the committee members was reversed, with participants from the control group fixating the faces longer and more often than participants stressed. Experiment 1 demonstrates that stress influences fixation behaviour towards longer and more fixations on objects related to the stressful episode. Nevertheless, no direct translation of fixation into memory measures could be shown.

Olfactory stimuli have been shown to play a special role in emotional memory processes. Due to the connection of the olfactory system with amygdaloidal structures, odours are prone to be related to affective and personal memories. Stress is thus likely to even enhance the strong emotional component of an olfactory experience leading to a solid memory trace. Since stress leads to increased vigilance, the responsivity to intense stimuli in any sensory modality gets more pronounced. The human auditory startle eye-blink response, evoked by a loud and instant white noise, has been shown to get potentiated by emotionally laden stimuli (in any
modality), but has not yet been investigated in combination with stress induction via the TSST. Experiment 2 was thus designed to assess the impact of stress, inducing increased vigilance, on startle responsivity 24 hours later, with special focus on odour memory. Therefore, an unknown and neutral odour was dispersed in the room where the TSST/f-TSST took place which one day later was re-experienced during an auditory startle session via olfactometer. It was shown that stressed participants exhibit generally enhanced startle responsivity, whereas specificity in response to the odour ambient in the TSST room on the previous day was found to be decreased. Increased vigilance under stress might lead to a shift in amygdaloidal functioning towards enhanced responsivity at the expense of a differential response. Moreover, explicit memory for the odour was poor and did not differ between stress and control group. Participants of the stress group however rated the odour more negative than control participants, at a trend level. Experiment 2 was the first to demonstrate a stress-induced increase in auditory startle responsivity 24 hours after psychosocial stress exposure.

Since memory enhancement for aspects of a stressful episode has mainly been investigated in terms of long-term effects, at least one day after stress exposure, experiment 3 aimed at expanding the findings to a short delay between stress and memory assessment. Additionally, the effects of acutely enhanced vigilance on startle responsivity and response specificity combined with olfactory memory were assessed to expand the findings of experiment 2. With the same methods as in the previous experiments, participants were randomly exposed to psychosocial stress. Office items and an ambient odour were present in the testing room, and recognition and free recall were tested after a startle block featuring the odour experienced during stress as well as distractor odours. Results of the experiment could show that the stress effects on memory are present already in immediate aftermath of the stressor and thus do not mainly rely on consolidation processes. The increased vigilance was shown to enhance the startle responsivity. At a trend level also startle specificity in response to the ambient odour was found to be more pronounced in stressed participants. Whereas memory for the odour tended to be better in the stress group, the odour ratings did not differ between stress and control group, in contrast to experiment 2. Experiment 3 showed acute stress effects on memory enhancement and increased startle responsivity.

This dissertation demonstrates that stress effects on memory occur immediately, reflected in fixation differences during encoding as well as in shortly delayed memory enhancement, in addition to better memory performance after one day. Furthermore, increased vigilance was found to enhance the human startle response and interestingly do so even 24 hours after the one-time stress experience.