The effect of mild acute stress during memory consolidation on emotional recognition memory

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Stress during consolidation improves recognition memory performance. Generally, this memory benefit is greater for emotionally arousing stimuli than neutral stimuli. The strength of the stressor also plays a role in memory performance, with memory performance improving up to a moderate level of stress and thereafter worsening. As our daily stressors are generally minimal in strength, we chose to induce mild acute stress to determine its effect on memory performance. In the current study, we investigated if mild acute stress during consolidation improves memory performance for emotionally arousing images. To investigate this, we had participants encode highly arousing negative, minimally arousing negative, and neutral images. We induced stress using the Montreal Imaging Stress Task (MIST) in half of the participants and a control task to the other half of the participants directly after encoding (i.e. during consolidation) and tested recognition 48 h later. We found no difference in memory performance between the stress and control group. We found a graded pattern among confidence, with responders in the stress group having the least amount of confidence in their hits and controls having the most. Across groups, we found highly arousing negative images were better remembered than minimally arousing negative or neutral images. Although stress did not affect memory accuracy, responders, as defined by cortisol reactivity, were less confident in their decisions. Our results suggest that the daily stressors humans experience, regardless of their emotional affect, do not have adverse effects on memory.

1. Introduction

Stress is something we all experience at some point in our lives or even on a daily basis and can be broadly defined as our body and brain’s response to changing demands. When we feel stress, we experience a set of physiological changes that are collectively known as the stress response. In addition to the physiological changes produced by stress, the stress response also includes changes in the central nervous system (CNS), which have lasting effects on health and cognitive processes (for review, de Kloet, Joels, & Holsboer, 2005). The effects of stress depend on the type of stress experienced. Exposure to chronic stress is generally harmful to health and cognitive processes and can lead to anxiety, depression, high blood pressure and other health issues (for review, de Kloet et al., 2005; McEwen, 2000). While we know that chronic stress is harmful, we know less about the effects of acute stress. Previous studies have resulted in mixed findings on the effects of acute stress on memory, with some finding impairments and some finding improvements (for review, LaBar & Cabeza, 2006; McGaugh, 2000; Shields, Sazma, & Yonelinas, 2016). The direction of the effect appears to depend on multiple factors: the timing of the stressor (for review, Wolf, 2009) the strength of the stressor (Akirav et al., 2004; Diamond, Bennett, Fleschner, & Rose, 1992; Sandi, Loscertales, & Guaza, 1997) and the type of material being encoded (Cahill & Alkire, 2003; Cahill, Gorski, & Le, 2003; Smeeets, Osgaar, Candel, & Wolf, 2008). We will discuss each of these factors in turn.

One of the key factors determining whether acute stress will result in improvements or impairments is when the stress is induced (for review, Wolf, 2009). Recognition memory can be separated into three phases: encoding, when information is learned, consolidation, when information is stored and the memory trace is strengthened, and retrieval, when the information is recovered. Stress induced prior to encoding has produced mixed results, with some evidence for memory impairments (Maheu, Collcutt, Kornik, Moszkowski, & Lupien, 2005; Maheu, Joober, Beaulieu, & Lupien, 2004; Preuss & Wolf, 2009; Schwabe & Wolf, 2010) and some evidence for memory improvements (Abercrombie, Kalin, Thurow, Rosenkranz, & Davidson, 2003; Buchanan & Lovallo, 2001; Schwabe, Bohringer, Chatterjee, & Schachinger, 2008). Stress induced prior to retrieval consistently impairs memory...
how positive or negative an event is, while arousal indicates the

...can be defined in terms of valence and arousal. Valence refers to

...severe levels of stress may not (Akirav et al., 2004; Diamond

...to observe this relationship (Yerkes & Dodson, 1908). In their

...the amygdala (BLA). Together this BLA activity and the glucocorti-

...long-term potentiation (LTP) in the hip-

...memory consolidation (Dolcos et al., 2004b). Because emotional

...memory benefits (Cahill & Alkire, 2003; Dolcos, LaBar, & Cabeza,

...on memory by enhancing activity in both the amygdala and the

...memory consolidation (Dolcos et al., 2004b). While emotional

...during consolidation in humans is

...the effects of mild acute stress during consolidation in humans is

...is thought to be the primary factor underlying emotion-related memory benefits

...changes in cortisol relative to other stressors. The MIST typically

...be optimal with regard to memory performance, it is important

...to understand the effects of mild acute stress since it is more con-

...in cortisol. Although moderate levels of stress have been suggested to

...to elevated levels of glucocorticoids that effectively induce

...results in the immediate release of epinephrine from the

...the immediate release of epinephrine from the adrenal medulla and glucocorticoids (cortisol in humans) from

...to be optimal with regard to memory performance, it is important

...intensity of the emotion (Lang, Greenwald, Bradley, & Hamm, 1993; Russell, 1980). The degree of arousal, rather than valence,
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