



The effect of cortisol on autobiographical memory retrieval depends on remoteness and valence of memories



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ABSTRACT

There is evidence that specificity of autobiographical memory (AM) retrieval is impaired by cortisol. However, it is unknown whether glucocorticoids differentially influence the retrieval of recent versus remote AMs. Therefore, the aim of the current study was to investigate the effects of cortisol on AM retrieval, in terms of memory specificity, with respect to remoteness of the retrieved memories. A placebo controlled, double blind study was conducted. Thirty female and 24 male healthy participants (mean age 24.5, SD=3.7) received either placebo or 10 mg hydrocortisone before completing an autobiographical memory test. Participants showed higher memory specificity for recent memories compared to remote ones. There was no main effect of cortisol on AM retrieval. However, interaction effects suggest that cortisol affects remote, but not recent memories, which seems to depend upon valence.

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1. Introduction

It is well documented that cortisol has an impairing effect on memory retrieval (de Quervain, Aerni, Schelling, & Roozendaal, 2009). Most of the studies investigating this effect have used declarative memory tests, e.g. by measuring the retrieval of a previously learned word list or other recently learned stimuli. Only few studies so far investigated how cortisol affects autobiographical memory (AM) retrieval and therefore the ability to recall events from one's own past. One test which is frequently used to investigate AM retrieval is the Autobiographical Memory Test by Williams and Broadbent (1986). In this test the most crucial outcome variable is memory specificity. An autobiographical memory is defined as specific if it includes a specific event that only happened once and which is set in place and time (for example "last Monday when I went to a colleagues' party).

One of the first studies to investigate the influence of cortisol on memory specificity was the one of Buss, Wolf, Witt, and Hellhammer (2004). They found an impairment of AM retrieval in terms of decreased memory specificity after acute glucocorticoid

administration in healthy participants as they retrieved less specific memories after hydrocortisone compared to placebo. This effect was seen mostly in neutrally valenced AMs (Schlosser et al., 2010) replicated these findings and in another study (Wingenfeld et al., 2013) memory specificity was again reduced in response to neutral stimuli. Additionally, the intake of glucocorticoids may influence AM in a dose-dependent manner as Young, Drevets, Schulkin, and Erickson (2011) showed that AM retrieval was less specific only under high cortisol levels that were similar to those after severe psychosocial stressors.

Neuroimaging studies demonstrate that AM is based on a neuronal network of different brain areas including the medial and prefrontal cortex, the retrosplenial cortex, the hippocampus and parahippocampal gyrus, the temporal pole, the cerebellum and the amygdala (in emotional AM) (for review see Cabeza & St Jacques, 2007; Maguire, 2001; Svoboda, McKinnon, & Levine, 2006). The hippocampus is especially interesting as newer research focuses on the question whether AM becomes independent of the hippocampus and more related to the prefrontal cortex (PFC) as autobiographical memories are getting older and therefore more remote as it is supposed by Squire (1992) in the 'standard model' of memory consolidation. In fact, there is some evidence that supports this idea (Piefke, Weiss, Zilles, Markowitsch, & Fink, 2003). In contrast, the majority of imaging studies suggest that the hippocampus plays a permanent role in the retrieval of AM but activation in hippocampal

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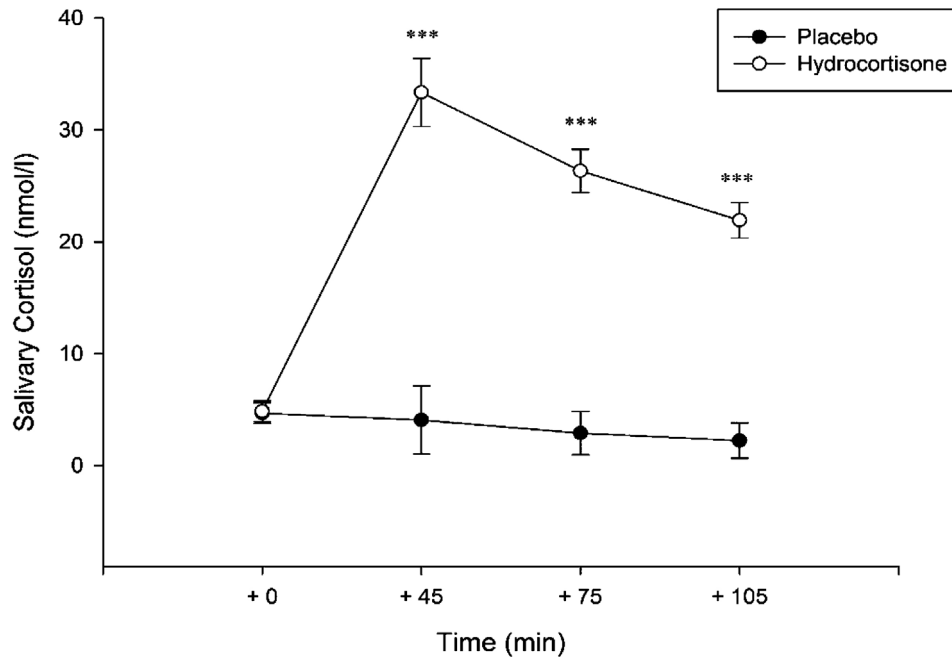


Fig. 1. Salivary cortisol concentration immediately before (+0) and 45 min, 75 min and 105 min after the intake of hydrocortisone or placebo. In the hydrocortisone condition participants showed significant higher salivary cortisol concentrations at 45 min, 75 min and 105 min after drug intake compared to participants taking placebo (***) = $p < 0.001$). All values are based on a subsample of Duesenberg et al. (2016).

subfields differs in relation to age of memories (Bonnici, Chadwick, & Maguire, 2013; Rekkas & Todd Constable, 2005). This is in accordance with the multiple trace theory by Nadel, Samsonovich, Ryan, and Moscovitch (2000). As many studies examine autobiographical memory in relation to hippocampal activation, most studies do not report on behavioral data, comparing the ability to recall specific recent or remote memories. Rekkas and Todd Constable (2005) could not find a difference between recent and remote memories regarding vividness and depth of AM whereas Piefke et al. (2003) report a tendency to better recognition of recent relative to remote memories.

In sum, there is 1) evidence that autobiographical memory retrieval is impaired by cortisol and 2) that brain activation differs between recent and remote memory. Consequently, the effect of cortisol on autobiographical memory might be mediated by the age of the retrieved memory. To this date, there is only one study, which takes remoteness of AMs into account when investigating the effect of cortisol on AM retrieval. Tollenaar, Elzinga, Spinhoven, and Everaerd (2009) investigated memory specificity after a social stressor (e.g. the TSST, Trier Social Stress Test) in healthy male subjects. They report no effect of acute stress on memory specificity but that memory specificity is affected by valence. Their results suggest that the ability to access specific neutral memories of events that happened recently is superior to the ability to recall remote neutral AM. There seems to be no difference between negative recent and remote AMs.

In conclusion, there is evidence that AM retrieval in terms of memory specificity might be impaired when cortisol levels are high, which might be mediated by valence and remoteness. Therefore, our study aims to investigate the effects of cortisol on AM retrieval with respect to memory age, i.e. recent versus remote memories, as well as valence.

First, we expect that there is a recency effect in autobiographical memory, i.e. that recent memories are more specifically recalled than remote memories as one study showed that memory specificity is higher for recent memories compared to remote ones (Piefke et al., 2003). Secondly, based on previous findings we

assume that cortisol impairs AM retrieval in terms of a reduced memory specificity, but that this effect will be mostly pronounced in neutral AMs. Additionally, this study aims to investigate if the effect of cortisol on AM retrieval depends on valence and remoteness.

2. Methods

2.1. Participants

We included 30 female as well as 24 male participants (mean age = 24.5, SD = 3.7), as it is known that men and women differ regarding their autobiographical memory performance (Pillemer, Wink, DiDonato, & Sanborn, 2003; Pohl, Bender, & Lachmann, 2005; Ross & Holmberg, 1992). All participants were healthy undergraduate students and were reported on before (see (Duesenberg et al., 2016)). Only participants were included which met none of the following exclusion criteria: a former or current psychiatric diagnosis (assessed with the SCID-I-interview), a serious medical condition, especially conditions which have impact on hypothalamic-pituitary-adrenal axis (HPA axis) function, intake of oral and inhalative glucocorticoids or any other medication, pregnancy and nursing, or a body mass index over 30. Women were tested only in luteal phase due to hormonal differences between phases of menstrual cycle.

Participants were recruited via local advertising. The study was approved by the ethics committee of the German Psychological Society. All procedures were carried out with full understanding of the participant and written informed consent was obtained prior to testing. Participants received a 20 € allowance.

2.2. Procedures

A placebo controlled, double blind study was conducted. Each participant was tested once and was assigned to either placebo or hydrocortisone (10 mg) condition in a randomized order. 75 min after drug intake participants completed an autobiographical mem-

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