The Negative Effects of Acute Stress on Short-term Memory

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Abstract

This study will analyze whether acute stress has a negative impact on short-term working memory. An individual will be subjected to two memory tests, one after being exposed to a visual stressor and the other under normal conditions. Their heart rate will be monitored to show stress level over the course of both tests. If results show an impairment in memory function in the stress test compared to the control test, this will support the hypothesis.
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Stress has always been a major part of our lives, but it is especially prevalent in today’s society where we encounter a multitude of stressful situations on a daily basis. Although stress is usually a manageable factor in our lives, it has been implicated in a wide range of disorders from insomnia to heart disease and, therefore, there has been much focus on studying its causes and effects. While most are in agreement that the effects of stress are detrimental to our long-term memory and overall cognitive ability, the lack of definitive research on how acute stress affects our short-term memory begs further study and experimentation.

Bisaz, Conboy, and Sandi (2009) state the effects of chronic stress have a detrimental effect on organisms while the effects of acute stress can have varying results. They found that certain factors influence whether acute stress will facilitate enhanced memory and learning or inhibit it. These factors include: stress duration; the source of stress – whether it is “intrinsic” (origin related to the cognitive task) or “extrinsic” (origin unrelated to the cognitive task); learning type; the timing of the stressor being applied in relation to the memory phase of the task.

Qin, Hermans, van Marle, Luo, and Fernandez (2009) found that there is a direct link between levels of stress and working memory. They studied the neural activity of a group of women and found that those exposed to stress (in the form of an extremely violent video) showed a reduction in activity in the dorsolateral prefrontal cortex (an area of the brain related to working memory).

Schwabe and Wolf (2010) demonstrated the negative effects of acute stress on memory function in a study of forty-eight healthy young men and women who were presented material to memorize while immersing their right hand in water (the experimental group immersed their
hand in iced water and the control group in warm water). They were then tested on the material twenty-four hours later. Schwabe and Wolf found that the experimental group showed significantly poorer memory recall than the control group when asked to write down what they could remember of the information presented the previous day. The experimental group also performed worse on a recognition test on the same material. These results show how stress interferes with learning and memory consolidation. Ishizuka, Hillier, and Beversdorf (2007) also found a correlation between acute stress and impaired memory after conducting the cold pressor test.

Schoofs, Preuß, and Wolf (2008) investigated whether psychosocial stress affects a decrease in working memory performance. They reported that, after conducting a numerical n-back task, working memory was impaired in the experimental group (exposed to the Trier Social Stress Test) compared to the control group.

In a study designed to assess the effects of hydrocortisone (hormone released under stress) on working and declarative memory, Lupien, Gillin, and Hauger (1999) injected either hydrocortisone or a placebo to a group of forty people and then subjected them to a number of memory tests. They found there were significant decreases in performance on the working memory task under the highest level of hydrocortisone. This indicates that working memory performance is sensitive to the levels of hydrocortisone in the body and, therefore, to stress also.

Another study testing social memory and how cortisol affects memory performance was conducted by Takahashi and colleagues (2004). They found that higher stress-induced cortisol levels led to a decrease in social memory performance in a face-name association memory test.

Morgan and colleagues (2004) found that high-stress situations increased the likelihood of producing flash-bulb memories but that these memories are not always reliable. In a study of
509 active-duty military personnel, who were all participating in military survival school training, Morgan discovered that a large number of the subjects, having undergone highly stressful interrogations, could not identify their interrogator in a line-up correctly. They concluded that the level of stress affected the subjects’ ability to form accurate memories. This suggests that it is possible for the memories we encode and store while under stress to not always be true representations of what happened.

In another study on special operations soldiers, the soldiers were separated into three groups (pre-stress, stress, post-stress) and administered the Rey Ostereith Complex Figure (ROCF). It was found that the stress group had significantly greater impairments in ROCF copy and recall compared to the other groups. The study concluded that the poorer performance in working memory and visuo-spatial capacity was due to the stress exposure. (Morgan, Doran, Steffian, Hazlett, & Southwick, 2006)

The above examples demonstrate the link between acute stress and a deterioration of short-term, working memory. Even when the memories are vivid there is no guarantee they are realistic representations of what actually happened. It is important to conduct further research into this area to determine to what extent stress impairs working memory and to determine how to combat these negative effects. I hypothesize that after being exposed to a stressor, an individual will demonstrate a deterioration in short-term memory.

Method

Participant

I will be testing one person from the PSY 110-02 class. The participant will be either male or female and between the ages of 18 and 24.

Materials and Apparatus
For the purpose of this study I will be utilizing the Biopac MP40 with a built-in ECG machine that measures heart rate to gauge stress levels of the participant. I will also use a standard classroom desk and chair, paper, pen, laptop computer and a set of earphones. I will be using scenes from two films: for the normal part of the experiment I will use “The Wizard of Oz” (LeRoy & Fleming, 1939) and “A Clockwork Orange” (Kubrick & Kubrick, 1971) will be used as the stressor.

**Procedure**

Before commencing the experiment, the aim and process of the experiment will be explained to the participant. Once they understand, I will get the participant’s permission before continuing. The experiment will have a similar structure to previous studies done by Morgan and colleagues (2006), Schoofs, Preuß, and Wolf (2008), and Schwabe and Wolf (2010). The first step is to measure the participant’s heart rate while they are sitting comfortably in the chair. They will then put on their earphones and watch a 5 minute video with neutral content while I monitor their heart rate for any fluctuations. As soon as the video finishes, I will read a list of random words to them which they will attempt to memorize and then they are free to go. The following day they will return to complete a short memory test. I will ask them to write down as many words as they can remember from the list I read the previous day. This completes the control portion of the experiment. The participant will return on a specified date to continue the experiment. I will measure their heart rate before commencing and monitor it while they watch another 5 minute video. This time I will play scenes from “A Clockwork Orange” which will be used to illicit a stress response in the participant. Upon completion, they will be asked to memorize a new list of words in the same manner as the previous exercise and then they will be
free to go. They will return the following day to complete another memory test, this time on the
new words they learned.

Methods of Analysis

After collecting the data on the participant’s heart rate and compiling the results of the
memory tests, I will compare the results of the two trials to check for alterations in heart rate and
memory performance. There should be a decrease in short-term memory performance in the
stressed condition compared to the non-stressed condition. If the results mirror my hypothesis, I
can deduce that acute stress has a negative effect on short-term working memory.
References


