The Relationship Between Sleep and False Memory

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Received 9 May, 2020; accepted 15 May, 2020

Abstract

Memories are not exact copies of reality. Instead, memories are reconstructions of reality that are influenced by many factors, such as prior knowledge, perceptions, and feelings. False memories are distorted memories or recollections of information and events that did not actually happen. Sleep plays an important role in memory due to its influences on how the brain functions. Furthermore, sleep deprivation reduces the amount of information we can store in our working memory, impairs our ability to learn, and hinders our executive function. Many studies have shown that sleep deprivation negatively affects cognition. However, the research on sleep deprivation affecting false memories is inconsistent. Therefore, I examined the relationship between sleep and false memories with a sample of 149 participants recruited from Amazon's Mechanical Turk. I predicted that less sleep, measured as the amount of time spent sleeping the night before (M = 6.53 hours, SD = 1.33) and on average (M = 6.79 hours, SD = 1.09), would be associated with more false memories, measured with the Deese-Roediger-McDermott (DRM) Task. The possible range of false memories was 0 to 30. The range of false memories from the present sample was 0 to 25 (M = 10.28, SD = 4.39). Consistent with predictions, there was a significant negative correlation between the amount of time spent sleeping the night before and the number of false memories calculated from the DRM Task, r (149) = -.23, p = .01, 95%CI [-.38, -.07]. There was also a marginally significant negative correlation between participants' average amount of time spent sleeping and the number of false memories, r (149) = -.15, p = .07, 95%CI [-.30, .01]. These results potentially have important implications. For example, a witness must immediately give their statement to a police officer. Furthermore, eyewitness accounts are often used in court decisions. If the eyewitness of a crime is incorrect (i.e., relying upon a false memory), it could lead to the wrong person getting convicted of a crime. Gaining a better understanding of false memories will aid in determining our memory's susceptibility to false information and reliability in court cases.

Keywords: sleep deprivation, false memories

Introduction

How accurate or inaccurate are our memories? This is a very complicated question to answer as memories are not exact copies of reality. Instead, memories are reconstructions of reality that are influenced by many factors, such as prior knowledge, perceptions, feelings, and sleep (Straube, 2012). Memories are an essential part of our lives that allow us to remember information, routines, and experiences. It allows us to learn, plan for the future, and build connections with people. Sleep is another essential component that influences how our body and brain function in our day to day life. This includes how our memory operates. Sleep allows our body and mind to recover from a long day in order to function optimally. In this study, the focus will be on the relationship between false memory and sleep.

Literature Review

Sleep plays an important role in memory due to the fact that it influences how the brain functions (Frenda, Patihis, Loftus, Lewis, & Fenn, 2014). Furthermore, sleep deprivation reduces the amount of information we can store in our working memory, impairs our ability to learn, and hinders our executive function (Frenda et al., 2014). Additionally, sleep aids us in the consolidation of memories. Consolidation of memories means that when we sleep, the brain is integrating the newly learned information with the already existing information. This process also leads to the creation of false memories (Straube, 2012). To sum up, whether there is a lack of or an adequate amount of it, sleep is a factor in the creation of false memories.

Memories can be distorted at any and every phase of the memory process: encoding, consolidation, and retrieval (Straube, 2012). False memories are distorted memories or recollections of information and events that did not actually happen (van Rijn, Carter, McMurtrie, Willner, & Blagrove, 2017). An example of false memory is having a memory of bringing your keys into your house and hanging them up, when in fact they are still in your car (Cherry, 2019).

False memories are particularly important in eyewitness accounts of a crime. If the eyewitness of a crime is certain of their judgment but they are incorrect it could lead to the wrong person getting convicted of a crime. That being said, the real criminal would be running free and possibly committing more crimes without punishment (Frenda et al., 2014). Memory is an essential part of life. Therefore, it is important to gain a better understanding of memory and the influencing factors, such as the hours of sleep.

One common way to measure false memories is to administer the Deese-Roediger-McDermott (DRM) Task. The DRM Task was constructed to produce false memories. The task requires participants to read a list of words that are systematically related to a word that does not appear on the list (Frenda et al., 2014). For example, the words on the list would read; "desk", "classroom", "pencils", "students", and "curriculum". This list would prompt the participant to think of the word "teacher," even though the word does not appear on the list. After a waiting period, the participants are shown another list of words and asked to identify which words appeared on the first list shown. The second list contains both the words from the first list, as well as new words. The participants are more likely than not to recall the words that did not appear but were related, i.e. the word "teacher" (Frenda et al., 2014).

Administering the DRM Task to test for false memories is controversial as some do not believe it can replicate a real-life scenario (Frenda et al., 2014). However, this task does follow the misinformation procedure which includes: an encoding phase, a waiting period, a misinformation phase, and a retrieval phase (Frenda et al., 2014). This is a similar pattern eyewitnesses undergo and the three phases can be applied to witnessing a crime. When witnessing a crime, an individual is taking in information, which is the encoding phase. Then there is a waiting period before seeing a lineup of suspects, which is representative of the misinformation phase. Lastly, identifying the criminal is referred to as the retrieval phase (Frenda et al., 2014).

According to Chatburn, Kohler, Payne, and Drummond (2017), sleep deprivation increased both true and false memories. In their study, the researchers had three sleep conditions: rested, partially sleep deprived (four hours of sleep), and completely sleep deprived (no sleep). The participants were placed into one of these sleep conditions prior to completing the DRM task. These researchers found that after sleep deprivation, participants performed worse on the true and false recognition task. Chatburn et al. (2017) also found that sleep-deprived participants, compared to well rested participants, performed worse only on the true memory free recall task but not the false memory task. Furthermore, the researchers have found that there was no difference between the participants who were completely sleep deprived and partially sleep deprived (Chatburn et al., 2017).

Frenda et al. (2014) drew similar conclusions, although the two studies had different methods. The independent variable in this study was sleep which had two levels: rested and sleep-deprived. The participants were placed into sleep conditions prior to completing the misinformation task. The misinformation task consisted of two sets of event images followed by two narratives that contained statements that contradict the situation in the images. Then, participants answered questions regarding the information they were shown and specified where they retrieved that information from either the images or the narratives. Frenda et al. (2014) found an increase in false memories when participants were sleep deprived before encoding information. They also found that sleep deprivation after encoding did not significantly increase false memories. Both Chatburn et al. (2017) and Frenda et al. (2014) have demonstrated that sleep deprivation prior to encoding increases false memories.

On the contrary, van Rijn et al. (2017) did not find that sleep deprivation increased the number of false memories. In their study, participants completed the Gudjonsson Suggestibility Scale, in which participants listen to a short story about an accident and later answer 20 questions about the story (only 5 of the questions can be answered given the information). After being given the Gudjonsson Suggestibility Scale, the participants gave immediate free recall. Then, they were either sleep deprived or allowed to sleep. The next day, the participants performed the delayed free recall and answered the 20 questions. The researchers found that the sleep conditions, rested and sleep deprived, did not affect false memories (van Rijn et al., 2017). However, these researchers did find that both sleep conditions performed better on the immediate free recall task compared to the 12 hours delayed free recall task (van Rijn et al., 2017).

I believe that the studies reached contradicting findings due to when the sleep deprivation took place and the retrieval method used (i.e., recognition or free recall). Researchers found an increase in false memories in participants who were sleep deprived before encoding information compared to participants who slept (Chatburn et al., 2017; Frenda et al., 2014). Participants that encoded information and then were sleep deprived or allowed to sleep failed to find an increase in false memories (van Rijn et al., 2017). Also, when participants completed a free recall task, sleep conditions had no significant effect on false memories

(Chatburn et al., 2017; van Rijn et al., 2017). This may be to the recognition tasks being suggestive and may prompt a false memory.

Many studies have shown that sleep deprivation negatively affects cognition. However, the research on sleep deprivation affecting false memories is limited. Therefore, further research needs to be conducted in order to expand the understanding of the topic. The present study, which used the DRM Task, was concerned with the relationship between the amount of sleep and false memories. In this study, the participant variable was the amount of sleep, operationalized as the number of hours slept at night (on average and the night before the task). The dependent variable in the study was false memories, operationalized as a count of the number of times a recollection of a word which was not shown previously is recalled. I hypothesize that participants who report less sleep will develop more false memories compared to participants that report more sleep. In other words, I predict a negative correlation between the two variables. As the amount of time slept is shorter, the number of false memories will be higher and vice versa.

Methods

Participants

A total of 149 participants (107 females and 42 males) were recruited from Amazon's Mechanical Turk in the United States. The participants' ages ranged from 18 to 88, (M = 41.84, SD = 13.41). The participants self-reported their education level which showed that 10.7% had a high school diploma or equivalent, 20.8% had some college education, 8.7% had an associate's degree, 40.9% had a bachelor's degree, 18.1% had a master's degree, and 0.7% had a doctoral degree. The participants' ethnicity consisted of 75.4% White or Caucasian, 10.1% Black or African American, 5.4% Asian, 4.7% Hispanic or Latinx, 4.7% from multiple races, and 0.7% preferred not to say. Participants received 10 cents for their efforts. Participants were treated in accordance with the "Ethical Principles of Psychologists and Code of Conduct" (Ethical Principles of Psychologists and Code of Conduct, 2019).

Materials

A consent form that included a brief summary of the study, right to withdraw without penalty, benefits, time commitment, guaranteed confidentiality, risks, and contact information of the researchers and chair of the Psychology Institutional Review Board was used. The demographic survey used asked for gender, age, ethnicity, and education. A Sleep Questionnaire was also administered which asked about the number of hours of sleep (on average and the night before) as well as the quality of sleep. The hours spent sleeping the night before the memory task ranged from 3 hours to 12 hours 40 minutes (M = 6.53, SD = 1.33). The average hours spent sleeping ranged from 2 hours 40 minutes to 9 hours (M = 6.79, SD = 1.09). The DRM Task, which was created to cause false memories, was used to measure false memories (Frenda et al., 2014). This task requires participants to be shown 6 lists of words that are systematically related, such as, "night", "relaxed", "bed", and "tired". Next, as a distraction, a short 3-minute video about the importance of sleep was shown. Then, the participants were given a new word list containing 42 words that were on the previous list as well as new words, such as, the critical word "sleep." The second list of words asked participants to recognize which words did or did not appear on the first list (Frenda et al., 2014). The DRM was calculated by summing up the false positives. The possible range of false memories was 0 to 30. The range of false memories from the sample was 0 to 25 (M = 10.28, SD = 4.39). Although there were 42 words on the second list, the range does not include the 12 words that were on the first list as the focus is only on false memories. The debriefing form provided a more detailed summary of the research, guaranteed confidentiality, and contact information to learn more about the study's results.

Procedure

Participants accessed Amazon's Mechanical Turk (MTurk), which contained a direct link that led them to the survey on Qualtrics. The participants were initially presented with a consent form to read and sign. After the participants agreed to the terms of the consent form, they were given a demographic survey. Next, they were presented with the Sleep Questionnaire and instructed to answer the questions to the best of their abilities. Following the questionnaire, the participants were instructed to complete the DRM Task. The task instructed the participants to read and remember 6 lists of systematically related words. Then, as a distraction, participants watched a short three-minute video about the importance of sleep. After the distraction, participants were shown a list of more words, both that appeared on the original list and did not appear, and asked to identify which words they have and have not been shown previously. When the task was completed, the participants were given a debriefing statement to read. After the participants were thanked for participating, they were given a completion code which they plugged into MTurk. This was done to ensure they completed the survey before being paid. Once the participants submitted the completion code on MTurk, they were compensated for participating.

Results

Pearson's r was used to analyze the data. We reject the null hypothesis which states that there is no relationship between the reported amount of time spent sleeping and false memories. There was a significant negative correlation between the amount of time spent sleeping the night before and the number of false memories calculated from the DRM Task (r (149) = -.23, p < .01, 95%CI [-.38, -.07]), (*Figure 1*). Although there was a significant correlation between the amount of time spent sleeping the night before and the average amount of time spent sleeping (r (149) = -.58, p < .01, 95%CI [.46, .68]), there was no significant correlation between participants' average amount of time spent sleeping and the number of false memories (r (149) = -.15, p < .07, 95%CI [-.30, .01]).

Discussion

The findings of this study do support the hypothesis. Participants who self-reported less time sleeping had more false memories than those who slept for a longer period of time. My research supports the previous research which found that participants who are sleep deprived the night before encoding information have more false memories than the rested participants (Chatburn et al., 2017; Frenda et al., 2014). Interestingly enough, I found that the relationship between the average amount of sleep participants reported and the number of false memories was not significant but the trend was headed in the right direction. Previous research has not directly examined the relationship or effects that the average amount of sleep has on false memories. Furthermore, participants were getting sufficient sleep time the week before the experiment and were only sleep deprived the night prior to the encoding phase (Chatburn et al., 2017, Frenda et al., 2014). This implies that one night's sleep has a direct impact on our memories. Specifically, sleep deprivation influences the suggestibility of our memories (Frenda et al., 2014). It also suggests that an adequate night's rest may aid in recalling memories more accurately when faced with misinformation (Frenda et al., 2014).

Further research on this topic is needed. The current study was a correlational design, however, an experimental design could give us more insight as to the direct effect that sleep deprivation has on memories. Specifically, future research can examine the effects on adequate sleep and sleep deprivation both before and after encoding information in order to clear up the inconsistencies in the literature as some research has found that sleep deprivation does effect false memories (Chatburn et al., 2017; Frenda et al., 2014) and other researchers found that sleep deprivation does not affect false memories (van Rijn et al., 2017).

Despite the fact that memories are not perfect replicas of reality and its reliability may be detrimental in court cases, our imperfect ever-changing memories are also beneficial. Our memory's ability to eliminate the less significant information is a way it is able to strengthen the critical information in our memory (Frenda et al., 2014). This allows us to apply critical information to other situations.

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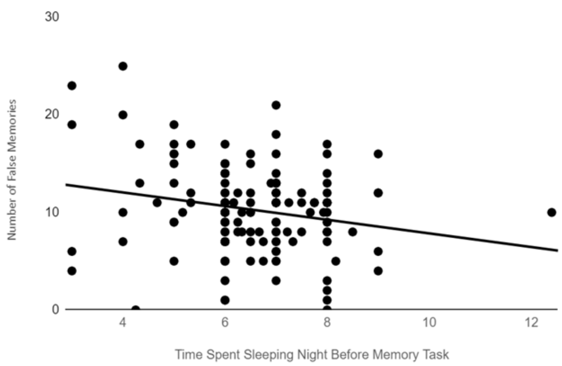

Figure 1: There was a significant negative correlation between the amount of time spent sleeping the night before and the number of false memories (r (149) = -.23, p < .01, 95%CI [-.38, -.07]).