

How Does Unipolar Depression Influence Memory Encoding?

— The Role of Cognitive Support in Depression Patients

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ABSTRACT: MDD often brings about numerous health challenges and disruptions, with memory loss emerging as a prominent concern. Many studies have tried to find the relationship between MDD and the patients' memory functions. Research has shown that depression affects memory encoding in a variety of significant ways. This paper analyzes research articles and relevant literature from 2000 to 2023 to connect the effects of depression to symptoms of memory loss. The included studies cover the effects on various types of memory encoding for patients either under depression or in remitted depression throughout differing age cohorts. Research methods include testing on source memory, RCFT (Rey-Osterrieth-Complex-Figure-Test), and learning and recall. Overall, depression leads to many negative effects on retention even when a patient is in remission including deficits in contextual cognitive memory, both verbal and non-verbal memory, and working memory. Depression patients have difficulties during the encoding process, which causes impairments of these memories. Giving patients extra cognitive support can help lessen the deficits. However, the problem alters with aging, memory kinds, the number of past depressive episodes, and other control factors.

KEYWORDS: Behavioral and Social Science, Cognitive Psychology, Unipolar Depression, Memory Impairment, Cognitive Support.

■ Introduction

Major depressive disorder (MDD), known as a kind of unipolar depression, is an under-addressed public health issue that can lead to cognitive impairments and increased risks of depressive relapse in patients.¹ These impairments can cause difficulties in their daily life. For instance, they might not be able to memorize information in preparation for exams or access information they need in the workplace because their memory functions are influenced by depression.

Researchers used a variety of scientific methods to quantify the impact of depression on the process of creating or recalling memories. To provide patients with better solutions, it is necessary to pinpoint the exact cognitive process that is liable to cause memory impairments. The term 'encoding' is a process in which individuals receive a new memory, while 'retrieving' is the act of remembering something from the past. Many studies have found that patients suffering from depression show significant impairments in different neuro functions like executive functions (important for organizational strategies, one type of cognitive support) when encoding, noting that the memory impairments shown by patients with depression might be due to the encoding deficits.¹⁻⁴ Moreover, Andreas Behnken's study revealed the lowered information-organizing skill during memory encoding of remitted MDD patients, showing the long-term influences of depression.¹ In the literature, 'information organizing skill' is a person's ability to structure, categorize, and arrange information coherently and efficiently. Researchers compared 30 fully remitted patients and 30 healthy individuals by doing RCFT(Rey-Osterrieth-Complex-Figure-Test),

which is a test that measures planning and organizational skills and non-verbal memory functions. The term 'verbal memory' refers to the cognitive ability to store or recall information that is presented through spoken words or written language. 'Non-verbal memory' is the opposite of verbal memory, which can be defined as the ability to encode or retrieve memories that are not presented verbally, such as visual images and patterns. Due to the changes in the brain during each depressive period, it is easy for a remitted patient to face recurrences and have greater challenges with memory creation and retrieval.¹

Despite the significant progress made in understanding the effects on memory brought by depression, a critical gap exists in our solutions to resolve these inconveniences for depressed patients. This study is motivated by the aim of bridging the existing knowledge on how to help reduce the impacts of memory deficits brought on by depression as much as possible. This study reviews and provides an analysis of the role of cognitive support in facilitating depressed patients' encoding process.

The extent of memory impairment experienced by patients can be reduced by providing them with cognitive support when receiving new information. This means providing extra supportive cues or organizing content to be more logical can facilitate the patients' use of cognitive functions. At the same time, it gives solutions on treatments to make depressed patients have a better quality of life. According to the evidence in this study, without extra cues, depressed patients show significantly worse memory of things within the encoding environment compared to the healthy group. Still, they perform much better when the binding cues are provided.⁵ However, since some of the factors are hard to control, such as the length

of each episode, the number of episodes, the patients' histories of medication and disorders, and the participants' social factors, they become possible confounds for research.^{2,5}

Patients suffering from depression might be facing various difficulties in their daily lives. For example, depression is a probable cause for verbal declarative memory deficit, as it affects the hippocampus, a brain region for learning and memory functions.¹ Alternatively, other kinds of retention like non-verbal memory, episodic memory, and working memory have also been shown to be affected by depression.^{3,5,6}

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Are depressive disorders associated with deficits in executive function and memory? To solve this question we will first talk about the role of cognitive support for depressive patients, using several examples. Then we will dive into the factors that will affect cognitive functions. The limitations of the involved studies will also be mentioned. By analyzing multiple articles, this study finds that cognitive support, especially extra cues during the encoding process, can significantly help patients with their memorization and improve their quality of life.

■ Discussion

1. The Role of Cognitive Support in the Encoding Process of Patients Suffering from Depression:

One way to provide cognitive support is to provide patients with extra cues while encoding. Cues are signals that aid in the process of retrieving information from memory. They serve as prompts that facilitate the recall of previously encoded information, helping individuals access specific memories, knowledge, or learned behaviours. One example is Corrêa's study, which uses a test described by other studies to assess the recognition memory of objects and contexts.^{2,3} In the test, patients were separated into two semantically categorized encoding conditions (a living room versus an office). After 5 minutes and a distracting task, subjects were asked to recognize sixteen out of thirty-two studied objects in a series of photographs. (Of the sixteen studied objects, eight are in the same context as before, and eight are in the other context related to the study phase). The performance of an object or contextual memory can be scored according to their rate of correction to identify the old objects (object memory) or the proportion of objects attributed to the correct context when objects are correctly identified as old (contextual memory). The incidental binding cue absent condition included a question of how often each object presented in the photographs is used in daily activities while the incidental binding cue present condition included a question concerning how well each object fits into the room displayed. People who are undergoing depression showed significantly

objects are correctly identified as old (contextual memory). The incidental binding cue absent condition included a question of how often each object presented in the photographs is used in daily activities while the incidental binding cue present condition included a question concerning how well each object fits into the room displayed. People who are undergoing depression showed significantly poorer performance in the context recognition test, but no significant difference in object memory compared with the healthy group (no extra cues provided). They performed much better when the binding cue was presented. This study proves that depression patients show a large dependence on cognitive support.

Depression has an especially significant impact on organizational skills related to information. In Tacconat's study, researchers mentioned the minor changes in memory caused by clustering information in depressed patients due to their impairments in organizational strategies.⁷ The research found that they have difficulties in remembering vocabulary that is from different categories. Since organizational skills largely rely on the executive function, we are under the assumption that the performance on recalling can be largely related to higher clustering ability (the skill to put information into certain categories).⁷ However, according to the results shown above, we can conclude that this assumption only applies to healthy adults without depressive symptoms.

Particularly worth mentioning is that this study shares similar results when compared to Corrêa's study, in which depressed patients benefited more from high external cognitive support than healthy patients.^{2,8} However, they tend to perform worse at memory tasks which require organizational strategies. The "external cognitive support" here can be a presentation with a blocked list (compared with a random-listed presentation).⁷ In the study, Tacconat compared two groups of subjects who were put into 4 encoding conditions: high clustering, and high cognitive support; high clustering, and low cognitive support; low clustering, and high cognitive support; and lastly, low clustering, and low cognitive support. In this case, high clustering information is the word sets that are from the same semantic categories. Subjects were trying to remember a 20-word list (the encoding condition). A list of words from the same semantic category can be defined as a piece of high-clustering information, while a low-clustering word list is when words can be organized by subjects themselves but from different categories. See Figure 1.

The organizational strategies during encoding can be seen as another form of cognitive support although there is evidence that it does not work on depressed patients as well as healthy people when proceeding with episodic memory (a type of long-term memory that involves the recollection of specific events, situations, and experiences from an individual's life). It shows the same result in non-verbal memory even when the participants are remitted. They performed poorly on non-verbal memory tasks which asked them to copy the RCFT figure on the delayed recall, due to their impairments in organizational skills.⁵

Mean Number of Words Recalled by Different Groups in Different Encoding Conditions

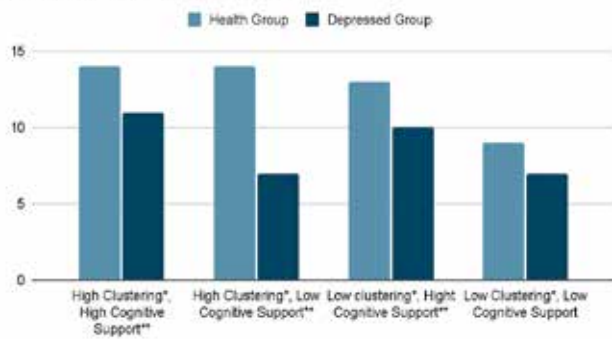


Figure 1:

Examine the effects of using clustering, cognitive support, and depression on free recall by recalling two categorized 20-word lists (1 per session, 2 sessions in total).⁷

* High-clustered word list has words belonging to the same category. In contrast, a low-clustered word list has words from different categories but is organizable.

** A highly cognitive-supported word list has words blocked; each block presented corresponds to a semantic category item. A low cognitive supported word list has words presented randomly.

2. Factors Affecting Impairment in Cognition and Dependence on Cognitive Support:

One reason for the cognitive impairments can be the smaller volume of the hippocampus for depressed patients. Usually, the more depressive episodes a patient has, the smaller the hippocampus volume is.^{2,4} In Campbell's study, he analyzed seventeen studies and divided them into three subtypes based on the part of the hippocampal region, the volume of the hippocampus, the volume of the amygdala, and the total volume of the combined structure.⁴ Most of the studies use fMRI scans for the measurements. In fourteen measurements on hippocampus volume, eight measurements showed significantly lower volume in depressed patients than in healthy subjects. A smaller volume is possible to be found in both the left and right hippocampus. MacQueen found no hippocampus volume difference in first-episode patients and healthy participants, but a significant difference in multiple-episode patients.⁹ This hypothesis provides evidence for the result that the hippocampus volume can become smaller as the numbers of depressive episodes grow. Due to this reason, it can cause lots of deficits in hippocampal-based memories. However, it is easy to notice that few studies control the medicine use and alcohol dependency of patients, which can account for the differences in the findings.

Another factor is the glucocorticoid level (e.g. cortisol level). Hypothalamus-pituitary-adrenal (HPA) is mainly related to cortisol, which is released when a person is stressed.¹ A dysfunction in HPA is correlated with depression. Glucocorticoids can also influence memories via neuron changes in the hippocampus. The damage to neurons in the hippocampus can be caused by excessive cortisol levels.¹ Also, glucocorticoid level is a key factor of cellular remodelling, like decreased neurogenesis in the dentate gyrus, which causes structural alterations in the hippocampus and leads to difficulties in learning and memory.⁴

Cortisol Level of Healthy and Depressive Adult in Different Hours in a Day

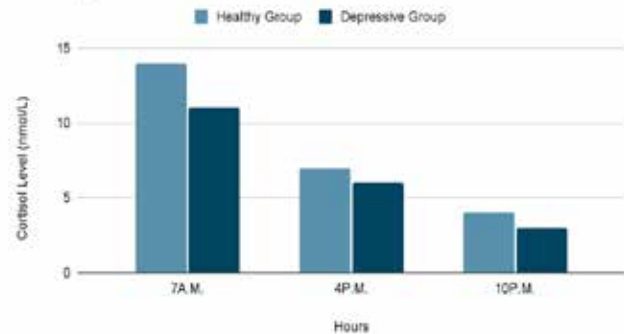


Figure 2: Levels (mean $\pm$ SEM) of cortisol in saliva samples (depression patients and healthy controls) at sampling time (7 AM, 4 PM, and 10 PM). All p-values < 0.05.

There's evidence showing that the cortisol levels of depressed patients (nmol/L) are significantly lower than the healthy subjects in all three times measured at 7 AM, 4 PM, and 10 PM in a day. ($p < 0.05$) (See Figure 2). Egeland *et al.* (2005) has proven that salivary cortisol level is associated with post-encoding memory deficits, including encoding and retrieving. According to the evidence, we can say that since the cortisol level of depressed patients is lower than that of healthy people, the cortisol level has a significant role in memory deficits among patients.

Age is one of the factors which can lead to significant cognitive deficits as well. Older depressed adults revealed poorer performance in contextual memory and a general disability in the usage of associative encoding instructions.³ Bisol Balardin *et al.* (2009) compared the encoding strategies used by young and old adults (both with and without depression) for encoding contextual memories.³ Because the frontal lobe (largely related to contextual memory) is usually affected directly by age, the older depressed patients would show poorer associative organization skills when encoding, leading to a decline in their memory performance.

3. Limitations:

Finally, to facilitate the discussion on how to tackle depression-related memory impairment, we need to consider the limitations of the studies surrounding the subject. Medicine control is a big issue when doing investigations. In Campbell's hippocampal volume study, they gathered information about the compartments between depression patients and health controls from seventeen retained papers to see the impact of depression on the hippocampal region. However, only two out of seventeen studies stated that their participants were drug-free. Moreover, ten out of seventeen studies reported the alcohol dependence of their subjects.⁴ As drug and alcohol use can affect memory, it is a limitation in the studies when controlling the key factors.

The number of previous depressive episodes can affect hippocampal volume.⁴ This can impact the extent of memory deficits since the hippocampus plays the role of the conductor when it comes to memory encoding. However, this number is usually not noted in the studies.

Another factor that is hard to control is the characteristics of the participants. This limitation is also mentioned in Corrêa's study. A good example of controlled social factors can be found in Taconnat's study.¹¹ Two groups (depressive and healthy) are matched on sample size, age, gender, education level (number of years of formal education), and verbal ability (measured by the Mill-Hill vocabulary test). Anxiety scores and depression scores were also measured on the Hospital Anxiety and Depression Scale (HADS). The self-reported health score was reported by participants in the range of 0 (poor health) to 5 (good health). Among these measurements, only the self-reported health score and the HADS depression score showed significant differences, which meets our expectations. In this study, participants were also asked to do a letter comparison task (XO task), participants were asked to recall them by saying the words aloud instead of writing them down. In this way, any writing difficulty based on personal characteristics can be avoided.

■ Conclusion

To summarize, this study has given an account of and solutions to the impact of MDD on a patient's cognitive and executive functions, revealing the significant role of cognitive support. This paper has also listed some factors that can lead to cognitive impairments, like a smaller volume of the hippocampus, altered cortisol levels, and age can lead to cognitive impairments.

Some of the possible solutions are provided by this research to help depressed patients with their memory impairments caused by cognitive and executive function deficits. A significant way to facilitate cognitive and executive functions is to provide cognitive support such as extra cues and organized information. The current research highlights the important role of cognitive support in the encoding process for patients with depression.

As previously noted, patients perform much better when binding cues are presented than when the cues are absent, which shows patients' dependence on extra cues. We also see that depressed patients' skill of organizing information is highly affected due to executive function deficits. However, if we can provide patients with the information already organized, they can benefit more than healthy individuals. These give us ideas on how to improve patient's life quality.

The restrictions associated with current studies naturally include medicine control, depressive episodes, and social factors. Most participants suffering from depression are taking medicines that can affect their cortisol levels. Only a few studies state that their participants are drug-free. Also, a shortcoming of many studies is that they do not note the number of previous depressive episodes. This difference might cause an alternate result in patients' ability to memorize information since hippocampus volume can be impacted and as a result, cause memory deficits. Another question that needs to be raised is the control of participants' social factors is not usually fully considered. Although the years of formal education, verbal ability, and anxiety scores during the research can influence the results, most research focuses only on genders and ages.

This research has thrown up some solutions to facilitate depressed patients' memory functions. However, for many other ways to help depressed patients, further investigations are still needed. According to the evidence from this study, giving organized information to patients does not work well for patients when they are proceeding with episodic memories. Therefore, it is still a question of how to help depressed patients with their memory when dealing with episodic information. Besides, some limitations of the current study can be improved by considering more factors that can influence the research.

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In addition to her academic pursuits, Xinran volunteers at the local Japanese Community Volunteers Association (Tonari Gumi), reflecting her love for helping people and commitment to community service. She also enjoys painting and writing Chinese Traditional Calligraphy and playing guitar in her free time. Looking ahead, Xinran aims to attend a top-tier university to major in Neuroscience. Her dedication, curiosity, and compassion drive her to make a positive impact on the world.