**Review**

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# False Memories in Depression and Anxiety Disorders: Cognitive Mechanisms and Experimental Findings

## Depresyon ve Anksiyete Bozukluklarında Bellek Yanılmaları: Bilişsel Mekanizmalar ve Deneysel Bulgular

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## ABSTRACT

Major depression and anxiety disorders are characterized by negative moods that are prolonged, intense, and persistent compared to transient, experimentally induced, or self-reported mood changes. The mood-congruent memory effect has been extensively demonstrated in studies involving individuals with depression and anxiety disorders. However, the effect of mood-congruent false memories has been investigated in fewer studies. This review examines the mechanisms underlying false memories in depression and anxiety disorders using the Deese-Roediger-McDermott (DRM) paradigm and critically discusses current empirical findings. Available evidence indicates that the mood-congruent false memory effect is frequently observed in depression, whereas this effect appears to be more limited in anxiety disorders. Cognitive biases or heightened activation levels toward mood-congruent information (particularly concepts related to depression or threat) in these disorders may impair cognitive control processes or hinder effective monitoring, consequently increasing susceptibility to false memories. Furthermore, existing studies suggest that backward associative strength, resting activation levels, expertise, or salience may modulate the activation of negative (depression-related) information in depressive individuals. Finally, this review evaluates the literature within the theoretical framework of false memory formation, addresses methodological limitations, and provides recommendations for future research.

**Keywords:** Depression, anxiety, mood-congruent memory, false memory

## ÖZ

Majör depresyon ve anksiyete bozuklukları, negatif duygudurumun öznel bildirime dayalı veya deneysel değişimleme ile geçici olarak oluşturulan gruplara göre daha uzun süreli, yoğun ve kalıcı olduğu bozukluklardır. Duygudurum uyumlu bellek etkisi, hem depresyon hem de anksiyete bozukluğu olguları ile yürütülen çalışmalarda birçok kez gösterilmiştir. Buna karşın, duygudurum uyumlu bellek yanılması etkisi daha az sayıda çalışmada incelenmiştir. Bu derlemede, Deese-Roediger-McDermott (DRM) paradigması ile depresyon ve anksiyete bozukluklarında bellek yanılmalarının oluşum mekanizmaları incelenmiş ve mevcut bulgular tartışılmıştır. Bulgular, duygudurum uyumlu bellek yanılması etkisinin depresyonda sıklıkla gözlendiğini, anksiyete bozukluklarında ise bu etkinin daha sınırlı olduğunu ortaya koymuştur. Depresyon ve anksiyete bozukluklarında, duygudurum (özellikle depresyon veya tehdit ile ilişkili kavramlar) ile uyumlu bilgilere yönelik bilişsel yanlılıklar veya yüksek aktivasyon seviyelerinin, bu bilgiler için bilişsel kontrolün veya izlemenin zorlaşmasına ve dolayısıyla bellek yanılmasına neden olabileceği değerlendirilmiştir. Bunun yanı sıra, çalışmalar depresyon olgularında negatif (depresyon ile ilişkili) bilgilere yönelik aktivasyon sürecine; geriye dönük çağrışım gücü, dinlenim aktivasyon seviyeleri, uzmanlık veya belirginlik gibi faktörlerin etki edebileceğine işaret etmektedir. Bu derleme, bellek yanılması teorileri bağlamında mevcut alanyazını ele almakta, yöntemsel sınırlılıklara dikkat çekmekte ve gelecekteki araştırmalar için öneriler sunmaktadır.

**Anahtar sözcükler:** Depresyon, anksiyete, duygudurum uyumlu bellek, bellek yanılması

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## Introduction

Emotions exert a profound influence on memory. Emotional events are typically more vivid and enduring than neutral ones (Christianson 1992) and tend to be remembered more accurately (Kensinger 2009). For example, emotionally meaningful personal experiences such as birthday celebrations, weddings, or the loss of a loved one, as well as flashbulb memories of where we were and what we were doing during a serious accident or natural disaster, are often recalled more readily (Zhang 2017). A substantial body of research has shown that emotional stimuli are remembered better than neutral stimuli. This effect has been demonstrated in numerous studies using verbal, visual, and audiovisual materials such as words, images, and videos (Charles et al. 2003, Maras et al. 2012). Notably, negative stimuli are reported to confer a greater memory advantage compared to neutral stimuli (Danion et al. 1995, Phelps et al. 1997, Michalowski et al. 2014).

Emotions are represented in past experiences in two distinct forms, namely emotional content and emotional context (Bookbinder and Brainerd 2016, Zhang et al. 2021). Emotional content refers to the affective nature of the event itself, while emotional context reflects the individual's mood at the time the event occurred. For instance, although witnessing a violent crime inherently evokes a negative emotional response, the mood states of the witnesses may differ. Moreover, these moods can shift over time—some individuals may have felt happy before the event, frightened during it, and angry afterward (Bookbinder and Brainerd 2016). Therefore, even when the emotional content remains constant, the emotional context can vary considerably. In psychiatric disorders such as depression and anxiety, the emotional context tends to be more persistent and prolonged.

Depression and anxiety are among the most prevalent psychiatric disorders worldwide. These conditions profoundly impair emotional, cognitive, and physical functioning, while also disrupting social relationships and significantly reducing overall quality of life (Brenes 2007, Hohls et al. 2021, Wilmer et al. 2021). According to the DSM-5, depression (major depressive disorder) is defined by the presence of a depressed mood or a marked loss of interest or pleasure lasting for at least two weeks (APA 2013). It is often accompanied by additional symptoms such as fatigue, concentration difficulties, changes in appetite, and sleep disturbances. Anxiety disorders are characterized by excessive, persistent, and uncontrollable fear or worry, typically accompanied by a range of cognitive and physical symptoms, including restlessness, muscle tension, sleep problems, and difficulty concentrating (APA 2013). In individuals with anxiety disorders, both external stimuli (e.g., social situations) and internal cues (e.g., bodily sensations) can trigger intense anxiety and subsequent avoidance behaviors, resulting in substantial functional impairment. The lifetime prevalence of depression is estimated to range from 10% to 20% (Kessler and Bromet 2013), whereas for anxiety disorders, it is approximately 5% to 9% (Baxter et al. 2013). Both disorders are nearly twice as prevalent in women as in men (Baxter et al. 2013, Kessler and Bromet 2013). High comorbidity rates between depression and anxiety are frequently reported (Essau et al. 2018), with more than half of individuals diagnosed with depression also meeting criteria for an anxiety disorder (Hirschfeld 2001). Moreover, both conditions have been shown to influence cognitive processing, particularly by biasing memory toward the retrieval of mood-congruent information (e.g., Bower 1981, Denny and Hunt 1992, Eysenck and Byrne 1994, Coles et al. 2007). Importantly, such biases may affect not only the content but also the accuracy of recalled information (Moritz et al. 2005, Howe et al. 2011). The present review aims to examine studies on false memory conducted in the context of depression and anxiety, evaluate the cognitive processes that may contribute to the formation of false memories, and discuss the findings within the framework of relevant theoretical models.

## Memory Bias and Mood-Congruent Memory

According to the cognitive model (Beck 1976), biases consistent with schemas of loss and failure, or threat and vulnerability, play a critical role in both the onset and maintenance of both depression and anxiety (Mathews and MacLeod 2005, Lotterman and Bonanno 2014). Within this framework, individuals with these disorders tend to recall events selectively in ways that align with their negative cognitive schemas, exhibiting a pronounced bias toward memory for negatively valenced information (Eysenck and Derakshan

2011, Gómez-Ariza et al. 2013). Moreover, the high comorbidity between depression and anxiety disorders is thought to reflect shared cognitive processing errors (Garber and Weersing 2010).

Research has shown that mood can both enhance and impair a range of cognitive processes, including memory (Gray 2001), decision-making (Arkes et al. 1998), and attention (Joormann and Gotlib 2007). Moreover, mood disorders have been linked to differences in how emotionally charged information is processed (Leppanen 2006), especially when that information aligns with the individual's current mood (Bower 1981, Howe et al. 2011). Mood-congruent memory refers to the phenomenon whereby emotionally valenced stimuli that match an individual's mood are more likely to be encoded and recalled than those with incongruent valence (Blaney 1986). Accordingly, a memory bias toward negatively valenced information is expected in both depression and anxiety disorders—that is, memory is predicted to be disproportionately allocated to negative stimuli over neutral or positive ones (Cisler and Koster 2010).

The mood-congruent memory effect has been repeatedly demonstrated in studies involving individuals with depression (Bower 1981, Lotterman and Bonanno 2014) as well as those with anxiety disorders (Eysenck and Byrne 1994, Dowens and Calvo 2003, Mathews and MacLeod 2005). Individuals with depression have shown a marked bias toward more effectively recalling or recognizing negative or depression-related material (Bower 1981, Denny and Hunt 1992), while individuals with anxiety disorders exhibit a similar bias toward threat-related material compared to control groups (Eysenck and Byrne 1994, Coles et al. 2007). Additionally, individuals with these disorders have been found to be less successful at suppressing mood-congruent information (Eysenck et al. 2007, Joormann et al. 2007, Ioime et al. 2014).

While the effect of depression on memory bias has been consistently demonstrated (e.g., Everaert et al. 2022), the findings concerning anxiety disorders appear to be more complex. Indeed, some studies have reported the presence of memory bias in depression but not in anxiety (Bradley et al. 1995, Rinck and Becker 2005, Yu et al. 2018). It has been suggested that depression is associated with a past-oriented focus, leading to a greater tendency for memory bias (i.e., disproportionate recall of negative information), whereas anxiety is future-oriented and more closely linked to attentional bias (i.e., selective attention to threat-related stimuli) (Dalgleish and Watts 1990, Watkins et al. 2005, Eysenck and Fajkowska 2018). Meta-analytic studies on memory bias in anxiety have suggested that the inconsistent findings across the literature may be attributable to several key methodological factors, including variations in memory task design, depth of processing, sample characteristics, and stimulus type (Mitte et al. 2008, Herrera et al. 2017). These studies have shown that memory bias toward threatening stimuli tends to emerge particularly in free recall tasks and under shallow processing conditions. Researchers have interpreted this result as consistent with the attentional bias commonly observed in individuals with anxiety disorders.

In both depression and anxiety disorders, mood-congruent memory biases exert a significant influence on how individuals recall past experiences. This brings forth an important question: to what extent might such disorders contribute to distortions or inaccuracies in memory? The next section offers a general overview of memory distortions and proceeds with an examination of empirical studies on false memory in the context of depression and anxiety disorders.

## False Memory

Our memories are never exact replicas of the original experiences they represent. Rather, remembering is a reconstructive process that is inherently susceptible to distortion (Zhang et al. 2021). The phenomenon of recalling events that never actually occurred—or remembering real events in a way that diverges from how they truly happened—is referred to as false memory (Roediger and McDermott 1995). Over the past half-century, false memory has become one of the most extensively studied topics in psychology. This growing attention stems from its association with high-stakes contexts in which memory distortions can have serious consequences. One such context involves the increasing number of cases in which individuals report previously unrecognized memories of sexual abuse during therapy. Some researchers have argued that certain therapeutic practices may inadvertently contribute to the creation of false memories, suggesting that what appears to be "memory recovery" may in fact be "memory construction" (Loftus 1993, Lindsay and Read 1994). Another widely discussed context involves eyewitness misidentification, where

innocent individuals are mistakenly identified as perpetrators of crimes (Brainerd and Reyna 2002). For example, Ronald Cotton was sentenced to life in prison after being mistakenly identified as the perpetrator in a rape case. He was exonerated and released after eleven years, following DNA evidence that confirmed his innocence (Loftus 2011).

Various experimental paradigms have been developed to investigate false memories in controlled laboratory settings. The current literature suggests that these paradigms can be broadly categorized into two main types: suggestion-induced false memories and spontaneous false memories (Joshi et al. 2025). Suggestion-induced false memories arise from external influences, such as suggestion or misinformation, while spontaneous false memories originate from internal cognitive mechanisms (Yin et al. 2024). One of the earliest paradigms developed to examine suggestion-induced false memories was the post-event misinformation paradigm, introduced in the early 1970s by Loftus and colleagues (Loftus 1975, Loftus et al. 1978, Loftus and Palmer 1974). In this paradigm, participants are first presented with an original event, followed by misleading information or a leading question about that event. Research has shown that such misinformation can distort participants' judgments and lead them to incorporate erroneous details into their memory in a manner consistent with the misleading input. Another technique, known as imagination inflation, has shown that imagining the performance of a specific action increases the likelihood of later falsely remembering having actually performed it (Hyman et al. 1995, Garry et al. 1996). Similarly, false feedback paradigms, in which individuals are provided with incorrect information about past events (e.g., Bernstein and Loftus 2009), and implantation methods, which involve presenting fabricated stories or digitally altered photographs, have both been shown to elicit false memories for events that never actually occurred (Loftus and Pickrell 1995).

In legal contexts, eyewitnesses and victims may inaccurately report events—even in the absence of any prior suggestive questioning (Otgaar et al. 2018). For this reason, it is equally important to investigate spontaneous false memories. The most widely used method for studying this type of false memory is the Deese-Roediger-McDermott (DRM) paradigm, originally introduced by Deese (1959) and later refined by Roediger and McDermott (1995). In this paradigm, participants are presented with a list of semantically related words (feeling, thought, love, happiness, affection, sadness), while the central, semantically associated word—referred to as the critical lure (in this example, emotion)—is deliberately omitted. The core assumption of the DRM paradigm is that memory encodes not only individual experiences but also the semantic associations between them, and that these associative links may lead to the production of false memories during recall or recognition. Indeed, when participants are asked to recall or recognize the words presented, the rate of false recall or recognition of critical lures is often comparable to the correct recall of actually presented words (Roediger and McDermott 1995). The erroneous recollection of a critical lure as having been presented is regarded as evidence of a false memory. To assess participants' confidence in their responses, Roediger and McDermott (1995) employed Tulving's (1985) remember–know paradigm, which distinguishes between detailed recollection ("remember") and a general sense of familiarity ("know"). Notably, most participants gave "remember" responses to critical lures and reported high confidence in these false recollections.

While suggestion-induced false memories arise from a combination of memory mechanisms and social influences, spontaneous false memories are attributed entirely to internal memory processes. In this respect, the study of spontaneous false memories offers a more direct and comprehensive window into the mechanisms of memory and the underlying factors that contribute to false memories (Otgaar et al. 2018). Given that most studies examining the relationship between false memory, mood, and anxiety disorders have employed the DRM paradigm—and considering that this paradigm shows only weak correlations with other false memory paradigms (Ost et al. 2013, Calvillo and Parong 2016, Nichols and Loftus 2019)—the present review focuses specifically on research conducted using the DRM approach.

Several theories have been proposed to explain the false memories produced by the DRM paradigm. Among these, Activation-Monitoring Theory and Fuzzy Trace Theory are the most widely supported in the literature. Activation-Monitoring Theory posits that associative activation among the studied words spreads to the critical lure, which in turn leads to the emergence of a false memory (Roediger et al. 2001). The theory is also linked to source monitoring processes, whereby individuals assess, via these processes,

whether a particular word was actually presented. It emphasizes the importance of associative strength between studied words and the critical lure. When associative strength is high, the monitoring process becomes more difficult, thereby increasing the likelihood of false memories. Conversely, when associative strength is low, the monitoring process becomes easier, and false memories are reduced. Fuzzy Trace Theory, by contrast, posits that two distinct types of memory traces—gist traces and verbatim traces—play a role in the encoding process (Reyna and Brainerd 1995). Gist traces represent the semantic connections among words in the DRM list, whereas verbatim traces involve the encoding of item-specific features such as serial position or word length. The theory suggests that false memories are more likely to occur when verbatim traces are weak and gist traces are strong.

Studies questioning the ecological validity of the DRM paradigm have debated whether findings derived from associative word lists can be generalized to situations involving the recollection of real-life events (Freyd and Gleaves 1996, Pezdek and Lam 2007). One issue raised in this literature is that false memories encountered in everyday life often involve emotionally charged experiences, such as those reported in eyewitness testimony or therapeutic contexts. Despite the robust findings produced using the DRM paradigm, the role of emotion in false memory formation was not investigated until later stages of this research line. This delay has hindered the development of a more comprehensive understanding of how emotional experiences shape memory and influence the occurrence of false memories.

## Emotion and False Memory

The impact of emotions on false memory has been examined in numerous studies where emotional content is manipulated using emotional DRM lists (Brainerd et al. 2008, Howe et al. 2010). The dimensional model conceptualizes emotional content along two core dimensions: valence and arousal (Russell 1980). Valence refers to how positive or negative a stimulus is perceived to be, while arousal pertains to the extent to which a stimulus is calming or exciting. Emotional DRM lists are constructed by categorizing critical lures based on their valence and arousal levels (Brainerd et al. 2008, Howe et al. 2010). For instance, the word sadness falls into the negative–low arousal category, while murder is categorized as negative–high arousal. Similarly, serenity is classified as positive–low arousal, whereas fun belongs to the positive–high arousal category. In Turkey, normative valence and arousal ratings have been established for 2,043 Turkish words (Kapucu et al. 2018), and these norms have been used to develop Turkish emotional DRM lists across negative, positive, and neutral categories (Yüvrük et al. 2019).

Some studies examining the influence of emotional content have found that false memories are more frequent for negatively valenced words compared to those with neutral valence (Sharkawy et al. 2008, Howe et al. 2010), whereas others have reported the opposite pattern (Kensinger and Corkin 2004, Palmer and Dodson 2009). A recent review has suggested that such contradictory findings may stem from differences in task characteristics (recall vs. recognition) or from variations in the degree to which valence and arousal were controlled across studies (Yin et al. 2024). In studies that controlled for arousal across emotion categories, false memories were found to be higher for negative valence compared to both positive and neutral valence (Brainerd et al. 2008, Dehon et al. 2010). However, a recent meta-analysis has shown that this finding may not solely reflect systematic differences in memory for emotional content but may also be attributable to a response bias favoring negative words (Wiechert et al. 2024). In studies manipulating arousal levels—typically by contrasting low-arousal (calming) and high-arousal (exciting) conditions—false memories were found to be highest for high-arousal negative words, surpassing those for all other conditions (low-arousal negative, high-arousal positive, low-arousal positive, and neutral stimuli) (Brainerd et al. 2010, Hellenthal et al. 2019). Taken together, these findings suggest that both arousal and emotional valence may contribute to the formation of false memories.

Studies that have examined the influence of emotional context by manipulating participants' mood states have yielded mixed findings. For instance, in a study using neutral DRM lists, Storbeck and Clore (2005) found that participants in a positive mood were more likely to falsely recall critical lures than those in a negative mood. The researchers argued that negative mood enhances item-specific (or verbatim trace) processing, thereby reducing susceptibility to false memories. Conversely, some studies in which

participants were experimentally induced into a negative or positive mood and then presented with emotional DRM lists have reported a mood-congruent false memory effect—that is, false memories were most likely when the valence of the list content matched the participant's mood (Ruci et al. 2009, Knott and Thorley 2014). In these studies, the highest rates of false memories were observed when the valence of the lists (content) aligned with participants' mood states (context). Zhang et al. (2017), however, reported mood-congruent false memory effects that were limited to the negative mood condition. Based on these findings, it has been suggested that in positive mood states, activation extends not only to mood-congruent information but also to distantly and weakly associated concepts, whereas in negative mood states, activation is more narrowly restricted to mood-congruent content.

Research indicates that false memories may increase for mood-congruent information (Ruci et al. 2009, Knott and Thorley 2014), or at the very least, may remain stable for negative mood-congruent content—unlike positive or neutral information, for which false memories tend to decrease (Zhang et al. 2017). However, in these studies, emotional context (i.e., mood) was induced experimentally and was therefore temporary. In contrast, in psychiatric disorders such as major depressive disorder and anxiety, emotional context tends to be more persistent and long-lasting. Since these disorders are frequently associated with impairments in cognitive functions relevant to memory—such as cognitive control and source monitoring (Hertel 2004, Howe et al. 2011)—false memories observed in clinical populations may differ from those induced in transient, experimentally manipulated emotional contexts (Faul and LaBar 2023). The following sections of this review examine studies employing the DRM paradigm to investigate false memory in the context of depression and anxiety disorders. The review also considers the cognitive processes that may underlie the formation of false memories in these conditions and discusses the findings within the framework of relevant false memory theories.

## Studies on False Memory in Depression

The first study to investigate false memory in individuals with depression using DRM lists was conducted by Moritz, Glascher, and Brassen (2005). This study compared 25 inpatients diagnosed with major depressive disorder or dysthymia to 28 healthy participants and employed four DRM lists: one depression-related (loneliness), one delusion-related (betrayal), one positive (holidays), and one neutral (window). The findings indicated that participants with depression made more false recognitions than healthy controls for the emotional lists, particularly the depression-related list. However, no increase in correct recognition was observed for depression-related words in the depressed group. While the authors found evidence supporting mood-congruent false memory, they reported no evidence of a conventional mood-congruent memory bias (Moritz et al. 2005).

In a follow-up study conducted by Moritz et al. (2008), 21 individuals diagnosed with major depression and 22 healthy participants were compared using six DRM lists: two negative (funeral, despair), two positive (feast, paradise), and two neutral (watch, air). Additionally, participants were asked to assess the personal salience of the words presented in the recognition test by rating their valence on a 5-point scale (1 = very negative, 2 = negative, 3 = neutral, 4 = positive, 5 = very positive). Words rated at the extremes (responses of 1 or 5) were classified as salient. The results showed that among individuals with depression, both correct and false recognitions increased as word salience increased, whereas no such pattern was observed in healthy participants. Based on these findings, the researchers suggested that in individuals with depression, personal salience modulates mood-congruent false memories (Moritz et al. 2008).

In the same year, two studies investigating false memories in individuals with depression were published, yielding divergent results (Joormann et al. 2009, Yeh and Hua 2009). Joormann et al. (2009) conducted their study with 25 individuals diagnosed with major depression and 27 healthy participants who had never received a diagnosis of major depression. The DRM lists used in this study were not evenly distributed across valence categories: three were negative, three were positive, and 34 were neutral. The results revealed that participants with major depression recalled fewer studied words but were more likely to falsely recall negative lures. However, there were no group differences in the false recall of positive or neutral critical lures. Thus, similar to the findings of Moritz et al. (2005), a mood-congruent false memory

effect was observed, although no conventional mood-congruent memory effect was reported. In contrast, Yeh and Hua (2009) compared 32 individuals with depression—who had an average illness duration of approximately 10 years—to 30 healthy controls using 27 DRM lists, evenly distributed across valence (nine negative, nine positive, and nine neutral). While individuals with depression exhibited more false memories than healthy participants, this effect was not modulated by the emotional valence of the lists. Furthermore, they did not produce more false memories for negative lists than for positive ones. Although neither mood-congruent memory nor mood-congruent false memory effects were found, when participants were asked to rate the emotional valence of the recognition test words, those with depression did not differ from controls in their ratings of negative or neutral words but rated positive words as less positive (Yeh and Hua 2009).

**Table 1. Findings on false memory in individuals with depression**

| Study | Sample | DRM Lists | Findings |
|---|---|---|---|
| Moritz et al. (2005) | 25 individuals with major depression or dysthymia (M = 44.56), 28 healthy controls (M=35.04). | Depression-related (loneliness), delusion-related (betrayal), positive (holidays), and neutral (window) DRM lists. | Individuals with depression or dysthymia made more false recognitions for emotionally loaded words (especially depression-related) compared to healthy controls. |
| Moritz et al. (2008) | 21 individuals with major depression (M = 42.91), 22 healthy controls (M = 40.24). | Positive (feast, paradise), neutral (watch, air), and negative (funeral, despair) DRM lists. Personal salience ratings were also requested. | In individuals with depression, increased personal salience of a word was associated with more true and false recognitions; this pattern was not observed in controls. |
| Joormann et al. (2009) | 25 individuals with major depression (M = 32.56), 27 healthy controls (M = 31.29). | 3 negative, 3 positive, and 34 neutral DRM lists (total: 40). | Healthy controls recalled more studied items. Depressed participants had more false recognitions for negative critical lures than controls. |
| Yeh and Hua (2009) | 32 individuals with major depression (M = 31.6), 30 healthy controls (M = 32.1). | 9 positive, 9 negative, and 9 neutral DRM lists (total: 27). Participants rated emotional valence of items. | Depressed participants showed more false memories for negative lists. They also applied a more conservative response criterion for positive items and perceived them as less positive. |
| Howe and Malone (2011) | 24 individuals with major depression (M = 38.41), 24 healthy controls (M = 35.82). | 3 negative, 3 depression-related, 3 positive, and 3 neutral DRM lists (total: 12) | Depressed participants had more false memories for depression-related words than healthy controls. |
| Moritz et al. (2018) | 84 individuals with depression: 41 in Metacognitive Training for Depression (M=44.28), 43 in Health Training (M=47.68). | A visual variant of the DRM task. | Compared to the health training group, metacognitive training significantly reduced high-confidence false memories over time. |

M = Mean, DRM = Deese-Roediger-McDermott paradigm.

In line with previous studies, Howe and Malone (2011) designed a study comparing individuals with major depression and healthy participants in terms of false memory. The study included three negative, three positive, and three neutral DRM lists, along with three depression-related DRM lists. Healthy participants recalled more studied words from the neutral and negative lists compared to individuals with depression. Conversely, participants with depression exhibited higher rates of false recall for depression-related words than healthy controls. Interestingly, although the negative and depression-related lists did not differ in emotional valence, elevated false recall was observed only for the depression-related words among those with depression.

The most recent known study to examine false memories in individuals with depression using the DRM paradigm was conducted by Moritz et al. (2018). In this study, a visual variant of the DRM paradigm was used to investigate whether a program called Metacognitive Training for Depression (D-MCT) could reduce susceptibility to false memories. To test this, 41 of the 84 participants diagnosed with depression were assigned to the D-MCT program, while the remaining 43 participants were placed in a control group that received a Health Training (HT) program focused on general health education. As part of the D-MCT program, participants received training on memory problems commonly observed in depression and their underlying mechanisms. They were introduced to the concepts of mood-congruent memory and false memory effects and taught strategies for improving memory performance (Moritz et al. 2018). In the visual DRM task (Moritz et al. 2006), participants were shown complex scenes missing certain elements (e.g., a beach scene lacking waves and a ball), where some plausible but absent objects (e.g., wave, ball) were intentionally omitted. These omitted items served as critical lures, and false recognition of these lures was taken as evidence of false memory. Although both intervention programs were effective in reducing false memories overall, the D-MCT group showed a significantly greater reduction compared to the HT group, particularly in high-confidence false memories. This study is particularly significant as it demonstrates that an intervention aimed at improving memory biases can be effective in reducing false memories, especially overconfident false judgments. Table 1 presents the studies examining false memory in depression using DRM lists.

## Evaluation of Studies on False Memory in Depression

Studies investigating false memory in depression have consistently reported mood-congruent false memory effects, yet they have not observed a conventional mood-congruent memory effect, which would also involve enhanced correct recall of mood-congruent material (Moritz et al. 2005, Joormann et al. 2009, Howe and Malone 2011). Additionally, a meta-analysis of false memory research in depression found that individuals with depression did not differ from controls in their responses to neutral or non-associative stimuli but were significantly more prone to false memories when presented with emotionally associative material (e.g., negative or depression-related stimuli) (Otgaar et al. 2017). Several explanations have been proposed for this pattern. One account suggests that correct recall relies on controlled, conscious episodic memory processes, while false memories arise from automatic, unconscious semantic memory processes (Howe 2005, Howe and Malone 2011). Within this framework, even if individuals with depression can exert control over their episodic memory processes, such control may not extend to the automatic spread of activation among semantically related representations. According to the Activation-Monitoring Theory, depression may disrupt both the activation and monitoring stages of memory (Joormann et al. 2009). In individuals with depression, activation may spread more readily among negatively valenced or depression-related words, ultimately reaching the critical lure and impairing the ability to monitor or determine whether a word was actually presented. As a result, false memories tend to increase for negatively valenced lists in this population.

The memory bias observed in individuals with depression toward negative information may also enhance the recall of actual negative events. Moreover, some studies suggest that individuals with depression may, in certain contexts, make more accurate evaluations and judgments than healthy individuals, who are more likely to perceive the world through "rose-colored glasses" (McKendree-Smith and Scogin 2000). Indeed, individuals with depression have been reported to show a lack of positive bias and to rate positive words as less positive than healthy participants (Yeh and Hua 2009). Alloy and Abramson (1979) concluded that

individuals with depression are sometimes "sadder but wiser" than those without a history of psychopathology. While healthy individuals tend to exhibit cognitive biases that favor positive interpretations of the self and the world, individuals with depression are believed to adopt a more realistic—albeit negatively skewed—perspective, which likely contributes to their negative mood (Alloy and Abramson 1979, LeMoult and Gotlib 2019). However, as Howe et al. (2011) point out, this may represent a "double-edged sword," whereby the heightened accessibility of negative experiences, resulting from stronger activation, increases susceptibility to false memories.

Cognitive styles observed in individuals with depression, such as overgeneralization (drawing broad conclusions from a single event) and rumination (repetitive thoughts and behaviors focused on depressive symptoms and their consequences), are also thought to have a partial effect on false memories (Yeh and Hua 2009). Research with depressed individuals has shown that rumination diminishes the specificity of autobiographical memory (Watkins and Teasdale 2001). Yeh and Hua (2009) proposed that cognitive styles characterized by overgeneralization and rumination may influence the activation process, making memories of events that never occurred more accessible, thereby increasing the likelihood of false memories in individuals with depression.

One of the mechanisms proposed to explain mood-congruent false memories in individuals with depression is cognitive control. This mechanism focuses on the regulation of attention through either voluntary (i.e., top-down, goal-directed) or automatic (i.e., bottom-up, stimulus-driven) processes (Corbetta and Shulman 2002). Although these two systems are not entirely independent, a healthy balance between them allows individuals to engage in goal-directed behavior (top-down attention) while also orienting to salient or unexpected stimuli when appropriate (bottom-up attention) (Grant and White 2016). Within this framework, cognitive control plays a central role in determining the contents of working memory, which operates with limited capacity.

This system enables the selection of goal-relevant information while suppressing goal-irrelevant content, and it is also believed to underlie many cognitive biases (LeMoult and Gotlib 2019). Research has shown that individuals with depression have difficulty inhibiting negative information from entering working memory (Joormann 2004, Goeleven et al. 2006, Joormann and Gotlib 2010, LeMoult and Gotlib 2019). Moreover, difficulties in suppressing negative information have also been linked to the use of ruminative thinking styles (De Lissnyder et al. 2011). Due to deficits in cognitive control, individuals with depression may struggle to differentiate between task-relevant and irrelevant negative information, thereby increasing their vulnerability to false memories. Yeh and Hua (2009) found that individuals with depression exhibited more false recall across all valence categories (negative, positive, neutral) compared to healthy participants. While this finding may point to a general deficit in cognitive control, other studies have found this effect to be limited specifically to negative (especially depression-related) material (Moritz et al. 2005, Joormann et al. 2009, Howe et al. 2011). These studies suggest that, in addition to cognitive control deficits, other mechanisms such as bias or semantic activation, which increase access to negative material, may also play a role in false memory formation (Joormann et al. 2009). The study by Moritz et al. (2018), which demonstrated that a cognitive training program targeting memory biases could reduce false memories, further supports this view.

The difference in false memory performance between individuals with depression and healthy participants has been most consistently observed for depression-related lists (e.g., loneliness) (Moritz et al. 2005). In fact, another study found this difference for depression-related lists, but not for negative lists in general (Howe et al. 2011). A meta-analysis by Otgaar et al. (2017) demonstrated that individuals with depression exhibit increased false memories, particularly in studies using stimuli related to their own psychopathology. Although both depression-related and general negative word lists share negative valence, the higher incidence of false memories for depression-related lists may be explained by activation processes. One explanation, consistent with the Activation-Monitoring Theory, is that words in depression-related lists are embedded in highly interconnected associative networks, which facilitate the spread of activation to the critical lure (e.g., Roediger et al. 2001). In individuals with depression, the backward associative strength—i.e., the extent to which list words evoke the critical lure—may be higher for depression-related lists. Within the same theoretical framework, it is considered that depression-related

concepts may have higher resting activation levels in individuals with depression, which in turn may make these concepts more easily accessible and more likely to be recalled (Joormann et al. 2009, Howe et al. 2011).

Another explanation is that individuals who have experienced long-term depression may be considered "experts" in depression-related information. These individuals may have difficulty processing depression-related words with item-specific (verbatim trace) detail, which may in turn increase the likelihood of false memories (Watkins et al. 2008). For example, it has been shown that investment experts falsely recall investment-related critical lures (Baird 2003), and football experts falsely recall football-related critical lures (Castel et al. 2007) more frequently than non-experts. Similarly, individuals with depression may have developed a kind of expertise in depression-related concepts, increasing the likelihood of automatic activation of such material (Howe et al. 2011). Finally, the study by Moritz et al. (2008) demonstrated that the personal salience of depression-related words may contribute to increased false memories in individuals with depression. In that study, the word funeral, which was rated as equally negative by both individuals with depression and healthy controls, did not lead to differences in either correct or false recognition. However, the word despair, which was rated as more negative by individuals with depression, resulted in both higher correct and false recognition in that group. These findings suggest that personal salience may modulate false memory formation in individuals with depression.

The characteristics of the DRM lists used to investigate false memories in individuals with depression are also of considerable importance. To date, the studies conducted in this area have certain limitations regarding the lists employed. Notably, no study has used an equal number of DRM lists for all categories (negative, depression-related, positive, and neutral). While some studies have included equal numbers of negative, positive, and neutral DRM lists, they have not incorporated depression-related lists (e.g., Moritz et al. 2008, Yeh and Hua 2009). Although Moritz et al. (2008) did not explicitly distinguish between negative and depression-related lists, the difference in false memory performance between individuals with depression and healthy controls was driven by the depression-related word despair. Similarly, Yeh and Hua's (2009) failure to observe a mood-congruent false memory effect may be attributable to their exclusion of depression-related lists. Joormann et al. (2009), in contrast, used three negative and three positive DRM lists alongside 34 neutral lists. However, this imbalance may cause a particular stimulus category to dominate the task, potentially biasing the results toward that category (Howe et al. 2011). Although Moritz et al. (2005) and Howe et al. (2011) used an equal number of DRM lists across all categories, a similar issue applies to these studies as well—because depression-related lists, which are also negatively valenced, were included in the negative category, the number of negative lists effectively doubled compared to the positive and neutral lists. Considering that list characteristics can influence false memory rates, imbalances across categories are likely to compromise the accuracy and generalizability of findings. Future research aiming to examine false memories more reliably should employ an equal number of DRM lists per emotional category and broaden the pool of negative lists to include depression-related material.

## Studies on False Memory in Anxiety

While studies using the DRM paradigm to investigate false memory have frequently reported that post-traumatic stress disorder may increase false memories—particularly for trauma-related lists (e.g., Brennen et al. 2007)—or that false memories may decrease in obsessive-compulsive disorder (e.g., Göz et al. 2016), these disorders are not further discussed in the present review, as they are no longer classified under anxiety disorders in the DSM-5.

Studies investigating false memories in anxiety disorders using the DRM paradigm remain limited in number, and most have not reported significant group differences (Wenzel et al. 2004, Gündüz 2007, Cody et al. 2015, Harper 2017). Wenzel et al. (2004) conducted a two-experiment study to examine false memories in individuals with specific fears and anxiety. In Experiment 1, 39 participants with self-reported spider phobia, 28 with blood phobia, and 41 without either fear were included. False memories were assessed using four DRM lists with the following critical lures: spider, blood, river, and music. Experiment 2 involved 48 participants with self-reported social anxiety and 51 without. In this experiment, four neutral DRM lists

(music, river, fruit, window) and four DRM lists related to social or evaluative threat (party, interview, date, speech) were used. No significant group differences in false recall were found in either experiment. In an unpublished master's thesis, Gündüz (2007) divided university students into four groups based on self-reported symptoms: depression only, anxiety only, comorbid (depression and anxiety), and control. Participants were compared in terms of false memory using four DRM lists: one threat-related (death), one depression-related (sad), one neutral (shoe), and one positive (peaceful). It was hypothesized that the depression group would exhibit more false memories for the depression-related list, and the anxiety group would do so for the threat-related list. However, no mood-congruent false memory effect was observed. The only significant finding was that the depression group produced more false memories than the other groups for the threat-related list. In another study, Cody et al. (2015) compared individuals with social anxiety disorder to healthy controls using DRM lists that were either social (e.g., shy, speech) or non-social (e.g., bicycle, lake) in content. The study found no differences between the two groups for either type of list. In another unpublished master's thesis, Harper (2017) examined the relationship between worry symptoms and false memory in individuals with generalized anxiety disorder. Based on self-reports, participants were classified into high- and low-worry groups. Using six negative and six neutral DRM lists, the study reported no significant differences in false memories between the two groups for either list type.

Some studies that employed methods other than the DRM paradigm have reported significant effects of anxiety on false memory (Roberts 2002, Toffalini et al. 2014, 2015, Mairean 2018). The studies on false memory in anxiety are presented in Table 2. In the study by Mairean (2018), high- and low-anxiety groups were formed based on self-reports, and false memories were assessed using a video-based false memory paradigm. This method typically involves viewing a video depicting a specific event, after which participants are assessed on both correct recall (of actual events) and false recall (of events that were not shown but are related) (Otgaar et al. 2013). The findings revealed that participants with high anxiety levels exhibited more false memories for positive events compared to negative ones. This finding was explained by the idea that positive events might lead to more superficial information processing (Ruder and Bless 2003). Roberts (2002) asked participants to study a series of pictures and words, and then attempt to recall the pictures first under low-stress and later under high-stress conditions. False memories were defined as instances in which participants confused words that had only been presented in verbal form with pictures that had actually been shown. The study found that individuals with low levels of trait anxiety were more likely to respond "Remember" to pictures that had not been presented as pictures when under stress. This finding suggests that anxiety may primarily affect individuals who generally have low levels of trait anxiety but exhibit high levels of situational (state) anxiety in emotionally charged contexts such as criminal scenarios. Indeed, individuals with high trait anxiety are thought to possess more developed strategies for coping with anxiety. This raises the possibility that, in high-anxiety contexts, individuals with less developed coping strategies may be more susceptible to making errors (Alho et al. 2019).

In a series of studies first conducted with individuals experiencing both depression and anxiety (Toffalini et al. 2014) and later replicated with individuals experiencing anxiety alone (Toffalini et al. 2015), false memories were assessed using pictorial scripted materials. In this method, participants are presented with eight everyday scenarios (e.g., a family dinner, going shopping), and two types of inferential false memories are examined: gap-filling errors (i.e., the false recognition of distractor images consistent with the scenario) and causal errors (i.e., the false recognition of an image representing an unseen cause of an observed outcome). In the initial study, the emotional valence of the scenarios was also controlled, and participants were presented with both negative and neutral scenarios. The study reported that individuals with comorbid depression and anxiety showed increased causal false memories for negative material (i.e., inferring an unseen cause from a presented effect), but not for neutral material. In contrast, among control participants, negative material appeared to offer protection against false memories compared to neutral material. In the follow-up study conducted with individuals with high anxiety, this time controlling for depression levels, positive scenarios were also included, and similar findings were obtained (Toffalini et al. 2015). Once again, the study showed that individuals with high anxiety exhibited increased inferential false memories for negative material, but not for positive material. Meanwhile, false memories for negative material decreased among control participants, replicating the findings of the earlier study.

**Table 2. Findings on false memory in anxiety disorders**

| Study | Sample | False Memory Paradigm | Findings |
|---|---|---|---|
| Roberts (2002) | 60 university students (M = 29.7). | Picture-word presentation. | Under stress, individuals with low trait anxiety were more likely than those with high trait anxiety to give a "Remember" response to pictures that had not been presented. |
| Wenzel et al. (2004) | *Experiment 1:* 108 participants (39 with spider fear, 28 with blood fear, 41 controls); M = 20.1. *Experiment 2:* 99 participants (48 with social anxiety, 51 controls); M = 20. | *Experiment 1:* DRM lists with critical lures: music, river, blood, spider. *Experiment 2:* 4 neutral (music, river, fruit, window) and 4 social threat DRM lists (party, interview, date, speech). | No significant effects of anxiety were found in either experiment. |
| Gündüz (2007) | 131 university students (M = 23.7) categorized as depressed only, anxious only, comorbid, and controls. | Threat-related (death), depression-related (sad), positive (peaceful), and neutral (shoe) DRM lists. | Only for the threat-related list did the depressed group show more false memories than other groups. |
| Toffalini et al. (2014) | 30 individuals with comorbid depression and anxiety (M = 18.38), 30 controls (M = 18.29). | Pictorial scripted materials (negative and neutral). | Comorbid individuals showed increased causal false memories for negative, but not neutral material. In controls, negative material reduced false memories. |
| Toffalini et al. (2015) | 34 individuals with anxiety (M = 19.34), 34 controls (M = 19.39). | Pictorial scripted materials (negative, positive, and neutral). | High-anxiety individuals showed more causal false memories for negative (but not positive) material. Controls showed fewer false memories for negative material. |
| Cody et al. (2015) | 77 participants (37 with social anxiety, 40 controls); M = 19.67. | Social (e.g., shy, speech) and non-social (e.g., bicycle, lake) DRM lists. | No group differences were found across list types. However, adding a social stressor increased susceptibility to false memories in the social anxiety group. |
| Mairean (2019) | 134 university students (M = 21.14). | Video false memory paradigm. | Participants with high anxiety levels showed more false memories for positive events compared to negative ones. |

M = Mean, DRM = Deese-Roediger-McDermott paradigm.

## Evaluation of Studies on False Memory in Anxiety

One factor contributing to the divergent findings in studies on anxiety and false memory is the nature of the methodologies employed. For example, the video-based false memory paradigm is considered to engage more salient and thematically rich content compared to the DRM paradigm (Otgaar et al. 2013). In contrast, the picture–word presentation used in Roberts's (2002) study is more closely related to the phenomenon of intrusions rather than to associative memory processes. This phenomenon refers to the

intrusion of unwanted memories or information into conscious awareness. In the method employed by Toffalini et al. (2015), unlike the emotionally charged critical lures used in DRM lists, the elements designed to elicit false memories, such as gap-filling or causal errors, do not carry emotional valence on their own. Therefore, the false memories observed in individuals with high anxiety are attributed not to increased activation of negatively valenced material but rather to active mental reconstruction and inferential reasoning about the negative event. Although these methods differ structurally from one another and from the DRM paradigm, they are important in that they demonstrate that anxiety levels can influence the formation of false memories.

One of the mechanisms that may explain false memories, particularly for negative information, in anxiety disorders (Toffalini et al. 2014, 2015) is cognitive control. Individuals with anxiety disorders may allocate excessive cognitive resources to threat-related information, directing their attention away from task-relevant targets toward irrelevant negative cues, and may struggle to suppress this information (Eysenck et al. 2007). From the perspective of Activation-Monitoring Theory, individuals with anxiety disorders may have difficulty monitoring non-target information—that is, distinguishing whether specific content was actually presented—due to the automatic activation of threat-related material (Bar-Haim et al. 2007, Eysenck et al. 2007). Another mechanism that may contribute to false memories in anxiety disorders is a cognitive style referred to as pathological worry (the analog of rumination in depression) (Hirsch and Mathews 2012). This style leads to persistent negative thoughts in individuals with anxiety. For example, such individuals may constantly worry that something terrible is going to happen. This may result in heightened activation of threat-related information, which in turn can lead to false or exaggerated recollections of such content.

Studies using the DRM paradigm have generally failed to demonstrate a significant effect of anxiety on false memories (Wensel et al. 2004, Gündüz 2007, Cody et al. 2015, Harper 2017). One possible explanation is that anxiety may not lead to marked impairments in memory performance (Kizilbash et al. 2002, Herrera et al. 2017). Furthermore, in anxiety disorders, memory bias toward threat-related stimuli is not consistently observed (Bradley et al. 1995, Rinck and Becker 2005), and it has been proposed that anxiety may be more closely associated with attentional bias than memory bias (Dalgleish and Watts 1990, Watkins et al. 2005, Herrera et al. 2017, Eysenck and Fajkowska 2018). In a meta-analysis by Herrera et al. (2017), participants with anxiety exhibited memory bias toward threatening stimuli only in free recall tasks, and this effect was particularly evident when the encoding task involved shallow processing. The authors interpreted these findings as consistent with the presence of attentional bias toward threat-related stimuli in individuals with anxiety. Shallow processing facilitates the rapid and automatic allocation of attention to threatening stimuli without requiring deep elaboration. Consistent with this, Bar-Haim et al.'s (2007) meta-analysis demonstrated that individuals with anxiety exhibit an attentional bias toward threat-related stimuli, even in the absence of conscious awareness. In contrast, false memories elicited through the DRM paradigm depend on the semantic processing of words and therefore require deeper levels of processing (D'Souza and Avati 2021). Studies comparing deep (meaning-based) and shallow (surface-level) processing of DRM word lists have consistently found that false memories are more prevalent under deep processing conditions (Flegal and Reuter-Lorenz 2014, Wootan and Leding 2015). Therefore, the limited effect of anxiety on false memories may be explained by the fact that anxiety-related attentional bias tends to enhance shallow processing, which does not align directly with the deep semantic processing required by the DRM paradigm.

One important consideration in studies on anxiety and false memory is that, with the exception of the study conducted by Cody et al. (2015) with individuals diagnosed with social anxiety disorder, there appears to be no prior research in the literature involving participants with a clinical diagnosis of an anxiety disorder. In other words, participant groups in these studies were typically formed based on self-reported anxiety symptoms among university students (Wensel et al. 2004, Gündüz 2007, Harper 2017). However, individuals with a clinical diagnosis of an anxiety disorder may experience anxiety that is more intense, persistent, and pervasive than that reported by self-identified high-anxiety individuals, and they are more likely to exhibit significant functional impairments in daily life, work, or social domains (Craske and Stein 2016). Such individuals may also display more pronounced cognitive distortions and biases during information

processing (Coles and Heimberg 2002). Therefore, the lack of significant findings in earlier studies using the DRM paradigm may stem from this issue. In this context, the characteristics of the anxiety group under investigation may influence the likelihood of false memory formation.

Finally, it is important to consider potential mediating or moderating variables in the relationship between anxiety disorders and false memory. For example, although Cody et al. (2015) found no significant differences in false memory between individuals with social anxiety disorder and healthy participants, introducing an anticipated social stressor, such as the expectation of giving a speech, heightened susceptibility to false memories in the social anxiety group. This finding underscores the dynamic and context-sensitive nature of false memories, suggesting that memory processes are influenced not only by individuals' internal states but also by environmental factors.

## Conclusion

Previous studies have reported that both emotional content (valence) and emotional context (mood) influence false memories (Storbeck and Clore 2005, Brainerd et al. 2008). False memories for mood-congruent information become particularly pronounced when the valence of the stimuli aligns with the participant's mood (Ruci et al. 2009, Knott and Thorley 2014).

Studies involving individuals with depression have frequently demonstrated mood-congruent false memory effects using the DRM paradigm (Moritz et al. 2005, Joormann et al. 2009, Howe and Melone 2011). Depressed individuals tend to exhibit more false memories, particularly for negative (depression-related) information. In contrast, studies investigating anxiety with the same paradigm have not provided evidence for mood-congruent false memory effects (e.g., Wensel et al. 2004, Gündüz 2007, Cody et al. 2015, Harper 2017). One possible explanation for this discrepancy is that studies on depression have generally been conducted with clinically diagnosed participants, whereas anxiety research has often relied on self-reported samples. In psychiatric disorders such as major depressive disorder and anxiety, emotional states tend to be more chronic, intense, and enduring than those observed in self-report-based or experimentally induced mood groups, and they are associated with greater impairments in daily functioning (Howe and Melone 2011, Craske and Stein 2016). Moreover, chronic psychopathology may influence the activation process, thereby increasing the likelihood of mood-congruent false memories. Indeed, in depression, it has been proposed that backward associative strength or resting activation levels may be higher for mood-congruent material (Joormann et al. 2009, Howe and Melone 2011), or that heightened activation may result from greater expertise (Howe and Melone 2011) or salience (Moritz et al. 2008) for depression-related concepts. In this context, it is plausible that anxiety did not sufficiently affect the activation process in studies relying on self-reported samples. This underscores the importance of investigating false memories in clinically diagnosed anxiety populations. Moreover, considering the severity and chronicity of depression and anxiety disorders may provide critical insights into their distinct effects on false memory formation.

Another reason for the divergent findings in false memory studies using the DRM paradigm for depression and anxiety may lie in the distinct patterns of memory bias observed across the two conditions. In depression, there is a stronger bias toward recalling negative information compared to anxiety (Mathews and MacLeod 2005, Rinck and Becker 2005). In fact, a meta-analysis has shown that this effect may persist even beyond the depressive episode itself (Everaert et al. 2022). However, it has been suggested that comorbidity between depression and anxiety may disrupt attentional focus toward anxiety-related cues, thereby reducing the potential for anxiety-related memory bias (Mathews and MacLeod 2005, Herrera et al. 2017). Given the high comorbidity rates between the two disorders, identifying and controlling for comorbidity in sample selection is of critical importance. Similarly, the presence or absence of memory bias may depend on other methodological features of anxiety studies. For instance, the effects of memory bias in anxiety disorders have been shown to vary depending on task type and depth of processing (Mitte 2008, Herrera et al. 2017). Among individuals with anxiety, memory bias is most evident in free recall tasks and particularly under shallow processing conditions. The type of sample used in studies is another key factor influencing memory bias outcomes. Compared to experimentally induced anxiety groups, memory

bias tends to be more pronounced in clinical and subclinical anxiety populations (Herrera et al. 2017). Prior studies have noted that experimental manipulations of anxiety may have limited effectiveness and may not adequately reflect chronic anxiety as experienced in real-world contexts (Marzillier and Davey 2005). The type of stimuli presented in studies is also believed to affect memory bias effects (Friedman et al. 2000, Herrera et al. 2017). Indeed, memory bias in anxious individuals tends to emerge more reliably in studies using words and pictures, whereas this effect diminishes when videos or objects are used. Therefore, studies investigating the effects of anxiety on false memory should be designed with careful attention to methodological factors that may shape these outcomes.

In some studies employing alternative false memory paradigms, a mood-congruent false memory effect has been reported for anxiety; individuals with high levels of anxiety demonstrated greater false recall for negative information (Toffalini et al. 2014, 2015). One of the proposed mechanisms underlying false memories for negative material in depression and anxiety disorders involves deficits in cognitive control. Individuals with these disorders may allocate excessive attentional resources to mood-congruent stimuli, leading them to focus on non-target negative cues and struggle to suppress this information (Joormann 2004, Eysenck et al. 2007). Furthermore, difficulties in suppressing negative information have been linked to rumination in depression and to pathological worry in anxiety disorders (De Lissnyder et al. 2011, Hirsch and Mathews 2012). These cognitive styles may influence the activation process, potentially leading to the inaccurate or exaggerated recollection of depression- or threat-related information (Yeh and Hua 2009, Hirsch and Mathews 2012). As a result, these individuals may also exhibit deficits in monitoring processes that support the discrimination between target and non-target information, rendering them particularly vulnerable to false memories.

False memory differences in depression have most consistently been reported for depression-related word lists (Moritz et al. 2005). In fact, some studies have found group differences exclusively for depression-related lists, with no differences observed for other negative lists (Moritz et al. 2008, Howe et al. 2011). Indeed, it is well-established that individuals with depression show reduced cognitive control or increased cognitive bias toward depression-related concepts, and similarly, those with anxiety disorders exhibit these tendencies toward threat-related information (Eysenck and Byrne 1994, Dowens and Calvo 2003, Joormann 2004, Bar-Haim et al. 2007, Joormann and Gotlib 2010, Lotterman and Bonanno 2014). Therefore, future studies employing the DRM paradigm are encouraged to expand the emotional content of word lists to specifically include depression- or threat-related material. Finally, the literature on false memory in psychiatric disorders remains limited, and there is a particular need for new research investigating the effects of depression and anxiety on false memory formation. Such investigations may provide critical insights into how depression and anxiety influence memory processes, thereby facilitating the development of more informed and effective interventions in both clinical practice and forensic contexts (Joormann et al. 2009, Howe et al. 2011). For example, Metacognitive Training for Depression has been shown to reduce susceptibility to mood-congruent false memories in individuals with depression (Moritz et al. 2018). Such findings contribute to a deeper understanding of how psychopathology influences memory processes and may inform the development of therapeutic strategies aimed at reducing the risk of false memories. Furthermore, in legal contexts, accounting for false memories associated with depression or anxiety, particularly in relation to mood-congruent information, may facilitate the development of more reliable methods for evaluating individuals' testimonies.

## References

Alho L, Rodrigues PF, Fidalgo C (2019) Do stress and anxiety impact memory? An exploratory Portuguese study. J Psychol Res, 1:31-38.

Alloy LB, Abramson LY (1979) Judgment of contingency in depressed and nondepressed students: Sadder but wiser?. J Exp Psychol Gen, 108:441-485.

APA (2013) Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5). Washington DC, American Psychiatric Association.

Arkes HR, Herren LT, Isen AM (1998) The role of potential loss in the influence of affect on risk taking behavior. Organ Behav Hum Decis Process, 42:181-193.

Baird RR (2003) Experts sometimes show more false recall than novices: A cost of knowing too much. Learn Individ Differ, 13:349-355.

Bar-Haim Y, Dan O, Eshel Y, Sagi-Schwartz A (2007) Predicting children's anxiety from early attachment relationships. J Anxiety Disord, 21:1061-1068.

Baxter AJ, Scott KM, Vos T, Whiteford HA (2013) Global prevalence of anxiety disorders: a systematic review and meta-regression. Psychol Med, 43:897-910.

Beck AT (1976) Cognitive therapy and the emotional disorders. New York, International Universities Press.

Bernstein DM, Loftus EF (2009) The consequences of false memories for food preferences and choices. Perspect Psychol Sci, 4:135-139.

Blaney PH (1986) Affect and memory: a review. Psychol Bull, 99:229–246.

Bradley BP, Mogg K, Williams R (1995) Implicit and explicit memory for emotion-congruent information in clinical depression and anxiety. Behav Res Ther, 33:755-770.

Brainerd CJ, Reyna VF (2002) Fuzzy-trace theory and false memory. Curr Dir Psychol Sci, 11:164-169.

Brainerd CJ, Stein LM, Silveira RA, Rohenkohl G, Reyna VF (2008) How does negative emotion cause false memories?. Psychol Sci, 19:919-925.

Brainerd CJ, Holliday RE, Reyna VF, Yang Y, Toglia MP (2010) Developmental reversals in false memory: Effects of emotional valence and arousal. J Exp Child Psychol, 107:137-154.

Brenes GA (2007) Anxiety, depression, and quality of life in primary care patients. Prim Care Companion J Clin Psychiatry, 9:437-443.

Brennen T, Dybdahl R, Kapidžić A (2007) Trauma-related and neutral false memories in war-induced posttraumatic stress disorder. Conscious Cogn, 16:877-885.

Bookbinder SH, Brainerd CJ (2016) Emotion and false memory: The context–content paradox. Psychol Bull, 142:1315-1351.

Bower GH (1981) Mood and memory. Am Psychol, 36:129-148.

Calvillo DP, Parong JA (2016) The misinformation effect is unrelated to the DRM effect with and without a DRM warning. Memory, 24:324-333.

Castel AD, McCabe DP, Roediger HL, Heitman JL (2007) The dark side of expertise: Domain-specific memory errors. Psychol Sci, 18:3-5.

Charles ST, Mather M, Carstensen LL (2003) Aging and emotional memory: the forgettable nature of negative images for older adults. J Exp Psychol Gen, 132:310-324.

Christianson SA (1992) Emotional stress and eyewitness memory: a critical review. Psychol Bull, 112:284-309.

Cisler JM, Koster EH (2010) Mechanisms of attentional biases towards threat in anxiety disorders: an integrative review. Clin Psychol Rev, 30:203-216.

Cloitre M, Cancienne J, Heimberg RG, Holt CS, Liebowitz M (1995). Memory bias does not generalize across anxiety disorders. Behav Res Ther, 33:305-307.

Cody MW, Steinman SA, Teachman BA (2015) True and false memories in social anxiety disorder: effects of speech anticipation and social content. Cogn Ther Res, 39:797-807.

Coles ME, Heimberg RG (2002) Memory biases in the anxiety disorders: current status. Clin Psychol Rev, 22:587-627.

Coles ME, Turk CL, Heimberg RG (2007) Memory bias for threat in generalized anxiety disorder: the potential importance of stimulus relevance. Cogn Behav Ther, 36:65-73.

Corbetta M, Shulman GL (2002) Control of goal-directed and stimulus-driven attention in the brain. Nat Rev Neurosci, 3:201-215.

Craske MG, Stein MB (2016) Anxiety. Lancet 388:3048-3059.

Dalgleish T, Watts FN (1990) Biases of attention and memory in disorders of anxiety and depression. Clin Psychol Rev, 10:589-604.

Danion JM, Kauffmann-Muller F, Grangé D, Zimmermann MA, Greth P (1995) Affective valence of words, explicit and implicit memory in clinical depression. J Affect Disord, 34:227-234.

Deese J (1959) Influence of inter-item associative strength upon immediate free recall. Psychol Rep, 5:305-312.

Dehon H, Larøi F, Van der Linden M (2010) Affective valence influences participant's susceptibility to false memories and illusory recollection. Emotion, 10:627-639.

De Lissnyder E, Koster EH, De Raedt R (2012) Emotional interference in working memory is related to rumination. Cognit Ther Res, 36:348-357.

Denny EB, Hunt RR (1992) Affective valence and memory in depression: dissociation of recall and fragment completion. J Abnorm Psychol, 101:575-580.

Dowens M, Calvo M (2003) Genuine memory bias versus response bias in anxiety. Cogn Emot, 17:843-857.

D'Souza D, Avati A (2021) Memory and learning: basic concepts. In Neuro-Systemic Applications in Learning, (Eds KA Thomas, JV Kureethara, S Bhattacharyya):227-240. Cham, Springer.

Essau CA, Lewinsohn PM, Lim JX, Moon-ho RH, Rohde P (2018) Incidence, recurrence and comorbidity of anxiety disorders in four major developmental stages. J Affect Disord, 228:248-253.

Everaert J, Vrijsen JN, Martin-Willett R, van de Kraats L, Joormann J (2022) A meta-analytic review of the relationship between explicit memory bias and depression: depression features an explicit memory bias that persists beyond a depressive episode. Psychol Bull, 148:435-463.

Eysenck MW, Byrne A (1994) Implicit memory bias, explicit memory bias, and anxiety. Cogn Emot, 8:415-431.

Eysenck MW, Derakshan N, Santos R, Calvo MG (2007) Anxiety and cognitive performance: Attentional control theory. Emotion, 7:336-353.

Eysenck MW, Derakshan N (2011) New perspectives in attentional control theory. Pers Individ Dif, 50:955-960.

Eysenck MW, Fajkowska M (2018) Anxiety and depression: toward overlapping and distinctive features. Cogn Emot, 32:1391-1400.

Faul L, LaBar KS (2023) Mood-congruent memory revisited. Psychol Rev, 130:1421-1456.

Flegal KE, Reuter-Lorenz PA (2014) Get the gist? The effects of processing depth on false recognition in short-term and long-term memory. Mem Cognit, 42:701-711.

Friedman BH, Thayer JF, Borkovec TD (2000) Explicit memory bias for threat words in generalized anxiety disorder. Behav Ther, 31:745-756.

Garber J, Weersing VR (2010) Comorbidity of anxiety and depression in youth: implications for treatment and prevention. Clin Psychol (New York), 17:293-306.

Garry M, Manning CG, Loftus EF, Sherman SJ (1996) Imagination inflation: Imagining a childhood event inflates confidence that it occurred. Psychon Bull Rev, 3:208-214.

Goeleven E, De Raedt R, Baert S, Koster EHW (2006) Deficient inhibition of emotional information in depression. J Affect Disord, 93:149-157.

Gomez-Ariza CJ, Iglesias-Parro S, Garcia-Lopez LJ, Díaz-Castela MM, Espinosa-Fernandez L, Muela JA (2013) Selective intentional forgetting in adolescents with social anxiety disorder. Psychiatry Res, 208:151-155.

Göz İ, Karahan SK, Tekcan Aİ (2016) Individuals with obsessive-compulsive disorder are less prone to false memories. J Obsessive Compuls Relat Disord, 10:62-68.

Grant DM, White EJ (2016) Influence of anxiety on cognitive control processes. In Oxford research encyclopedia of psychology. New York, Oxford University Press.

Gray J (2001) Emotional modulation of cognitive control: approach-withdrawal states double-dissociate spatial from verbal two-back task performance. J Exp Psychol Gen, 130:436-452.

Gündüz A (2007) True and false memory with emotionally valenced words: Depression, trait anxiety and personality factors (Uzmanlık tezi). Ankara, Orta Doğu Teknik Üniversitesi.

Freyd JJ, Gleaves DH (1996) " Remembering" words not presented in lists: relevance to the current recovered/false memory controversy. J Exp Psychol Learn Mem Cogn, 22:811-813.

Harper NR (2017) The relationship between worry symptoms of Generalized Anxiety Disorder and true memory, false memory, and metamemory (Uzmanlık tezi). Edwardsville, Southern Illinois University.

Hellenthal MV, Knott LM, Howe ML, Wilkinson S, Shah D (2019) The effects of arousal and attention on emotional false memory formation. J Mem Lang, 107:54-68.

Herrera S, Montorio I, Cabrera I, Botella J (2017) Memory bias for threatening information related to anxiety: an updated meta-analytic review. J Cogn Psychol, 29:832-854.

Hertel P (2004) Memory for emotional and nonemotional events in depression. In Memory and Emotion, (Eds D Reisberg, P Hertel):186-216. Oxford, Oxford University Press.

Hirschfeld RM (2001) The comorbidity of major depression and anxiety disorders: recognition and management in primary care. Prim Care Companion J Clin Psychiatry, 3:244-254.

Hirsch CR, Mathews A (2012) A cognitive model of pathological worry. Behav Res Ther, 50:636-646.

Hohls JK, König HH, Quirke E, Hajek A (2021) Anxiety, depression and quality of life—a systematic review of evidence from longitudinal observational studies. Int J Environ Res Public Health, 18:12022.

Howe ML (2005) Children (but not adults) can inhibit false memories. Psychol Sci, 16:927-931.

Howe ML, Candel I, Otgaar H, Malone C, Wimmer MC (2010) Valence and the development of immediate and long-term false memory illusions. Memory, 18:58-75.

Howe ML, Malone C (2011) Mood-congruent true and false memory: Effects of depression. Memory, 19:192-201.

Hyman IE, Husband TH, Billings FJ (1995) False memories of childhood experiences. Appl Cogn Psychol, 9:181-197.

Ioime L, Saraulli D, Spataro P (2014) Memory and neuropsychological dysfunctions in the generalized anxiety disorder. In New Perspectives on Generalized Anxiety Disorder, (Eds R Guglielmo, L Janiri, G Pozzi D Reisberg, P Hertel):131-147. New York, Nova Science Publishers.

Joormann J (2004). Attentional bias in dysphoria: The role of inhibitory processes. Cogn Emot, 18:125-147.

Joormann J, Yoon KL, Zetsche U (2007) Cognitive inhibition in depression. Appl Prev Psychol, 12:128-139.

Joormann J, Gotlib IH (2007) Selective attention to emotional faces recovering from depression. J Abnorm Psychol, 116:80-85.

Joormann J, Teachman BA, Gotlib IH (2009) Sadder and less accurate? False memory for negative material in depression. J Abnorm Psychol, 118:412-417.

Joormann J, Gotlib IH (2010) Emotion regulation in depression: relation to cognitive inhibition. Cogn Emot, 24:281-298.

Joshi G, Rathore T, Verma K (2025) Emotion-Induced Memory Distortions: insights from Deese-Roediger-McDermott and Misinformation Paradigms-A Comprehensive Review. Health Sci Rev, 14:100216.

Kapucu A, Kılıç A, Özkılıç Y, Sarıbaz B (2018) Turkish Emotional Word Norms for Arousal, Valence, and Discrete Emotion Categories. Psychol Rep, 124:188-209.

Kensinger EA, Corkin S (2004) The effects of emotional content and aging on false memories. Cogn Affect Behav Neurosci, 4:1-9.

Kensinger EA (2009) How emotion affects older adults' memories for event details. Memory, 17:208-219.

Kessler RC, Bromet EJ (2013) The epidemiology of depression across cultures. Annu Rev Public Health, 34:119-138.

Kizilbash AH, Vanderploeg RD, Curtiss G (2002) The effects of depression and anxiety on memory performance. Arch Clin Neuropsychol, 17:57-67.

Knott LM, Thorley C (2014) Mood-congruent false memories persist over time. Cogn Emot, 28:903-912.

LeMoult J, Gotlib IH (2019) Depression: a cognitive perspective. Clin Psychol Rev, 69:51-66.

Leppanen JM (2006) Emotional information processing in mood disorders: a review of behavioral and neuroimaging findings. Curr Opin Psychiatry, 19:34-39.

Lindsay DS, Read, JD (1994) Psychotherapy and memories of childhood sexual abuse: a cognitive perspective. Appl Cogn Psychol, 8:281-338.

Loftus EF, Palmer JC (1974) Reconstruction of automobile destruction: an example of the interaction between language and memory. J Verbal Learning Verbal Behav, 13:585-589.

Loftus EF (1975) Leading questions and the eyewitness report. Cogn Psychol, 7:560-572.

Loftus EF, Miller DG, Burns HJ (1978) Semantic integration of verbal information into a visual memory. J Exp Psychol Hum Learn, 4:19-31.

Loftus EF, Pickrell JE (1995) The formation of false memories. Psychiatr Ann, 25:720-725.

Loftus EF (1993) The reality of repressed memories. Am Psychol, 48:518-537.

Loftus EF (2011) Crimes of memory: false memories and societal justice. In Psychology and the real world: essays illustrating fundamental contributions to society, (Eds MA Gernsbacher, RW Pew, LM Hough, JR Pomerantz):83-88. New York, Worth Publishers.

Lotterman JH, Bonanno,GA (2014) Those were the days: memory bias for the frequency of positive events, depression, and self-enhancement. Memory, 22:925-936.

Mäirean C (2018) The role of depression and anxiety in developing true and false memories about past events. Psychol Ser, 27:61-76.

Maras KL, Gaigg SB, Bowler DM (2012) Memory for emotionally arousing events over time in Autism Spectrum Disorder. Emotion, 12:1118-1128.

Mathews A, MacLeod C (2005) Cognitive vulnerability to emotional disorders. Annu Rev Clin Psychol, 1:167-195.

McKendree-Smith N, Scogin F (2000) Depressive realism: effects of depression severity and interpretation time. J Clin Psychol, 56:1601-1608.

Michalowski JM, Weymar M, Hamm AO (2014) Remembering the object you fear: brain potentials during recognition of spiders in spider-fearful individuals. PLoS One, 9:e109537.

Mineka EALS (1998) Anxiety and mood-congruent autobiographical memory: a conceptual failure to replicate. Cogn Emot, 12:625-634.

Moritz S, Gläscher J, Brassen S (2005) Investigation of mood-congruent false and true memory recognition in depression. Depress Anxiety, 21:9-17.

Mortiz S, Voigt K, Arzola GM, Otte C (2008) When the half-full glass is appraised as half empty: mood-congruent true and false recognition in depression is modulated by salience. Memory, 16:810-820.

Moritz S, Schneider BC, Peth J, Arlt S, Jelinek L (2018) Metacognitive Training for Depression (D-MCT) reduces false memories in depression. A randomized controlled trial. Eur Psychiatry, 53:46-51.

Nichols RM, Loftus EF (2019) Who is susceptible in three false memory tasks?. Memory, 27:962-984.

Ost J, Blank H, Davies J, Jones G, Lambert K, Salmon K (2013) False memory ≠ false memory: DRM errors are unrelated to the misinformation effect. PloS One, 8:e57939.

Otgaar H, Howe ML, Peters M, Sauerland M, Raymaekers L (2013) Developmental trends in different types of spontaneous false memories: implications for the legal field. Behav Sci Law, 31:666-682.

Otgaar H, Muris P, Howe ML, Merckelbach H (2017) What drives false memories in psychopathology? A case for associative activation. Clin Psychol Sci, 5:1048-1069.

Otgaar H, Houben ST, Howe ML (2018) Methods of studying false memory. In Handbook of research methods in human memory, (Eds H Otani, BL Schwartz):238-252. London, Routledge.

Palmer JE, Dodson CS (2009) Investigating the mechanisms fuelling reduced false recall of emotional material. Cogn Emot, 23:238-259.

Pezdek K, Lam S (2007) What research paradigms have cognitive psychologists used to study "false memory," and what are the implications of these choices? Conscious Cogn, 16:2-17.

Phelps EA, LaBar KS, Spencer DD (1997) Memory for emotional words following unilateral temporal lobectomy. Brain Cogn, 35:85-109.

Reyna VF, Brainerd CJ (1995) Fuzzy-trace theory: Some foundational issues. Learn Individ Differ, 7:145-162.

Rinck M, Becker ES (2005) A comparison of attentional biases and memory biases in women with social phobia and major depression. J Abnorm Psychol, 114:62-74.

Roberts P (2002) Vulnerability to false memory: the effects of stress, imagery, trait anxiety, and depression. Curr Psychol, 21:240-252.

Roediger HL, McDermott KB (1995) Creating false memories: Remembering words not presented in lists. J Exp Psychol Learn Mem Cogn, 21:803-814.

Roediger HL, Watson JM, McDermott KB, Gallo DA (2001) Factors that determine false recall: A multiple regression analysis. Psychon Bull Rev, 8:385-407.

Ruci L, Tomes JL, Zelenski JM (2009) Mood-congruent false memories in the DRM paradigm. Cogn Emot, 23:1153-1165.

Ruder M, Bless H (2003) Mood and the reliance on the ease of retrieval heuristic. J Pers Soc Psychol, 85:20-32.

Russell JA (1980) A circumplex model of affect. J Pers Soc Psychol, 39:1161-1178.

Sharkawy JE, Groth K, Vetter C, Beraldi A, Fast K (2008) False memories of emotional and neutral words. Behav Neurol, 19:7-11.

Storbeck J, Clore GL (2005) With sadness comes accuracy; with happiness, false memory: mood and the false memory effect. Psychol Sci, 16:785-791.

Toffalini E, Mirandola C, Drabik MJ, Melinder A, Cornoldi C (2014) Emotional negative events do not protect against false memories in young adults with depressive–anxious personality traits. Pers Individ Dif, 66:14-18.

Toffalini E, Mirandola C, Coli T, Cornoldi C (2015) High trait anxiety increases inferential false memories for negative (but not positive) emotional events. Pers Individ Dif, 75:201-204.

Tulving, E. (1985). Memory and consciousness. Can Psychol, 26:1-12.

Watkins E, Teasdale JD (2001) Rumination and overgeneral memory in depression: effects of self-focus and analytic thinking. J Abnorm Psychol, 110:353-357.

Watkins E, Moulds M, Mackintosh B (2005) Comparisons between rumination and worry in a non-clinical population. Behav Res Ther, 43:1577-1585.

Watkins E, Moberly NJ, Moulds ML (2008) Processing mode causally influences emotional reactivity: distinct effects of abstract versus concrete construal on emotional response. Emotion, 8:364-378.

Wenzel A, Jostad C, Brendle JR, Ferraro FR, Lystad CM (2004). An investigation of false memories in anxious and fearful individuals. Behav Cogn Psychother, 32:257-274.

Wilmer MT, Anderson K, Reynolds M (2021). Correlates of quality of life in anxiety disorders: review of recent research. Curr Psychiatry Rep, 23:1-9.

Wootan SS, Leding JK (2015) Need for cognition and false memory: can one's natural processing style be manipulated by external factors?. Am J Psychol, 128:459-468.

Yeh ZT, Hua MS (2009) Effects of depressive disorder on false memory for emotional information. Depress Anxiety, 26:456-463.

Yin H, Zhou Y, Li Z (2024) Contradictory findings in the study of emotional false memory: a review on the inadvisability of controlling valence and arousal. Front Psychol, 15:1380742.

Yu Q, Zhuang Q, Wang B, Liu X, Zhao G, Zhang M (2018) The effect of anxiety on emotional recognition: evidence from an ERP study. Sci Rep, 8:16146.

Yüvrük E, Turan H, Kapucu A (2019) Duygu içerikli sözcüklerden oluşan Türkçe DRM listelerinin geliştirilmesi. Psikoloji Çalışmaları, 39:245-266.

Zhang W (2017) The effect of emotion on false memories in the Deese-Roediger-McDermott (DRM) paradigm (Doctoral thesis). Otago, University of Otago.

Zhang W, Gross J, Hayne H (2017) The effect of mood on false memory for emotional DRM word lists. Cogn Emot, 31:526-537.

Zhang W, Cowan G, Colombo M, Gross J, Hayne H (2021). Emotional content of the event but not mood influences false memory. Appl Cogn Psychol, 35:1418-1426.

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