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ORIGINAL ARTICLE

Mood-Incongruent Implicit Memory Bias in Non-Clinical Depression:

Dissociation between Conceptually Driven and Data-Driven Processing

Kyoko TAGAMI[1)]

1) School of Nursing and Health, Aichi Prefectural University

ABSTRACT

Two experiments were conducted to examine performance differences on conceptually driven and data-driven implicit memory tests in non-clinical depression. In experiment 1, participants (N = 26) studied adjectives by providing pleasant-unpleasant ratings of words and produced associations to cue words at testing, which reflects a conceptually driven test. In experiment 2, another 26 participants engaged in a word stem completion task as a data-driven implicit memory test. Implicit memory bias was found for the conceptually driven test (experiment 1), whereas no such bias emerged for the data-driven test (experiment 2). The bias found in the conceptually driven test, however, was mood-incongruent. The mood-incongruent implicit memory bias is discussed in terms of depression severity and mood regulation.

＜Key-words＞
depression, implicit memory, conceptually driven processing, data-driven processing, mood-incongruent memory

tagamik@nrs.aichi-pu.ac.jp（Kyoko TAGAMI）

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I. Introduction

In Japan, mental health measures have received more urgent attention as rates of mental disorders increase, including clinical depression. The "2014 Patient Survey" (Ministry of Health, Labour, and Welfare, 2015) shows that the total number of inpatients and outpatients with "mood [affective] disorders" (including clinical depression) was over 1.1 million people in 2014, which has been the greatest number and is increasing by 2.5 times since 1996. It has been evident that depression is associated with a particular way of perceiving and thinking, and is characterized by negative cognition (e.g., Beck, 1976; Beck, Rush, Shaw et al., 1979). A vicious circle based on a reciprocal relationship between depression and negative cognition may act to maintain and intensify depression (Teasdale, 1985). One psychotherapy that focuses attention on this cognitive bias is cognitive behavioral therapy (CBT). Foreign current guidelines recommend treating clinical depression with CBT, and CBT for clinical depression has been covered by national health insurance since 2010 in Japan (Shimizu & Suzuki, 2011). A mood-congruent effect, which refers to the tendency to preferentially process information congruent with one's mood, is regarded as one of the basic theories of cognitive behavioral psychopathology (Koshikawa, 2010), and contributes to the vicious cycle between depression and negative cognition (e.g., Blaney, 1986; Tagami, 2013, 2017; Watkins, Vache, Verney et al., 1996). The present study focuses on mood-congruent memory bias in depression and examines the relationship between depression and cognition.

Numerous empirical studies have examined mood-congruent memory in depression, in which depressive individuals tend to learn and remember more negative events. Most of these studies have used a recall or recognition task that measures explicit memory. Explicit memory is measured using tasks where participants are asked to consciously recollect a study episode. On the other hand, during implicit memory tasks such as word fragment completion, word stem completion, and perceptual identification, participants are not necessarily required to consciously recollect a study episode. Many researchers have pointed out that implicit memory may be a more important determinant of daily activities (e.g.,Watkins, Martin & Stern, 2000). It has been argued that the influences of depression on unconscious memory should be also examined, if indeed mood congruent memory bias is an important cognitive maintenance mechanism in depression (e.g., Watkins, 2002; Watkins, Vache, Verney et al., 1996).

Early studies (e.g., Denny & Hunt, 1992; Watkins, Mathews, Williamson et al., 1992), which were published early in the 1990s, found no mood-congruent biases on implicit memory tests in depression. In a commentary on these studies, Roediger and McDermott (1992) argued that no effects were found because these studies used perceptually driven implicit tests. They argued that mood-congruent implicit memory bias should observed if conceptually driven tests are used.

Following the prediction by Roediger & McDermott (1992), Watkins, Vache, Verney et al. (1996) found mood-congruent implicit memory bias in depression, using a free association task reflecting conceptually driven processing. Watkins, Martin, and Stern (2000), however, did not find a mood-congruent bias in depression, even by using a conceptually driven test. Previous studies on mood-congruent implicit memory that have used conceptually driven tests in depression have shown inconsistent results. Furthermore, some subsequent studies have found memory biases even using data-driven implicit memory tests. Although various attempts have been made to explain such inconsistent results in recent review articles and meta-analyses (Barry, Naus & Rehm, 2004, 2006; Phillips, Hine & Thorsteinsson, 2010; Watkins, 2002; Wisco, 2009), a clear account remains elusive. In the first place, studies of implicit memory bias and depression using a conceptually driven test have been very few. To demonstrate whether differences between data-driven and conceptually driven processing influence implicit memory bias in depression, it is necessary to use both test types with similar stimuli and procedures in the same study, as Watkins, Vache, Verney et al. (1996) and Watkins, Martin & Stern (2000) stated.

The aim of the present study was to examine implicit mood-congruent memory in depression using both conceptually driven and data-driven tests. Free association was used as a conceptually driven implicit memory test in experiment 1, and a word stem completion task as a data-driven test in experiment 2, and the tasks were conducted using similar stimuli and procedures. Non-clinical mildly depressed states were studied. Such findings for non-clinical depression would help uncover vulnerability factors or preventive factors for onset of clinical depression. Moreover, the present study would offer a view of early detection of mental health problems and suggest a way of preventing depression.

II. Experiment 1

1. Method

1) Design

This experiment involved a 2 × 2 × 2 mixed factorial design, with two levels of depression (mildly depressed and non-depressed), two levels of priming (studied word and non-studied word), and two levels of affective valence of target (positive and negative). The first was a between-subject factor and the second and third were within-subject factors.

2) Participants

Undergraduate and graduate students (9 males and 17 females) participated as volunteers in this experiment. They were divided into mildly depressed and non-depressed groups based on their scores on the Beck Depression Inventory (BDI)

Japanese version (Hayashi & Tsukamoto, 1987). The participants were classified as mildly depressed if their BDI scores were 12 or above (n = 13), and as non-depressed if their BDI scores were 11 or less (n = 13). This cut-off point, 12, was the median of all participants' BDI scores. The mean BDI score for the mildly depressed group was 18.54±3.60, and for the non-depressed group was 5.23±3.35.

3) Implicit Memory Test

A free association task was conducted as a conceptually driven implicit memory test. In this task, the participants were presented with 20 cues in a random order on the display after 1s a fixed point was presented for 1s. Participants were asked to verbalize the first four adjective associations that came to mind with each cue.

4) Materials and Apparatuses

This experiment required 108 stimulus words: Thirty-two were used to form two 16-words target lists, 56 were used as fillers for the study list, and 20 were used as cues on the association retrieval task, as the conceptually driven implicit memory test.

Each target list contained 8 positive words and 8 negative words, which were all five-letter adjectives and included four personality trait words and four emotion words. The allocation of the lists to the studied and non-studied condition was balanced across participants. The study list contained one target list (16 words) and 56 fillers. The 20 cues at testing, which comprised the association retrieval task, included 4 words for production of targets and 16 fillers. The four target cues were "pleasant emotions", "unpleasant emotions", "positive personality traits", and "negative personality traits". The fillers were adjective categorical names unrelated to emotions and personality traits, such as "weather", "power", and so on. The participants were asked to produce four adjectives to one cue, and it was intended that 80 words were produced.

The apparatuses included a personal computer and a 15-inch CRT display. The presentation of stimuli and inputs of responses were controlled by BASIC.

5) Procedure

Participants completed individually. This experiment had four phases: the study phase, the filler phase, the test phase, and the assessment phase.

In the study phase, the participants were presented with a list of 72 five- or six-letter words randomly on the display, after 1s a fixed point was presented for 1s. There were two types of list, including one of two sets of targets, and the participants were assigned to either one of two lists. The assignment to the two lists was counterbalanced. The participants then rated word frequency and provided their input through a keyboard with three-point scale consisting of 1 (Rarely), 2 (Occasionally), and 3 (Often) as the encoding task. Words were presented until a response was received. The space bar was

used to initiate the next trial. The participants completed three practice trials before the 72 test trials.

Next, the participants received a filler task. This task was similar to the Digit-Symbol Coding of Wechsler Adult Intelligence Scale-Revised. They wrote down as many signs as possible for 90s. This filler task took about 2 min.

Following the filler task, the free association task was conducted. In the same way as the study phase, cue words were presented randomly after a fixed point was presented on the display for 1s. The participants completed one practice trial, and then 20 cues were presented.

In the last phase, the participants completed the BDI Japanese version.

Finally, the participants were told the purpose of this experiment during a debriefing.

2. Ethical Considerations

Participants were recruited from a university. A document that described the purpose of this study, the contents of the experiment, and ethical considerations was distributed to the recruits. Participants were also informed that they could freely decide to participate in the study, and that they could dropout from the study at any time, even after participating in part of the study. Informed consent was given by all the participants before taking part in the study by signing this document.

3. Results and Discussion

The means and standard deviations of positive and negative targets produced as responses by each group are presented in Table 1.

<Table 1> Mean number of targets produced
as a function of group, affective valence, and word type in Experiment 1

Groups	*n*	Studied		Non-studied	
		Positive	Negative	Positive	Negative
Non-depressed	13	0.46 (0.52)	0.46 (0.66)	0.23 (0.44)	0.15 (0.38)
Mildly depressed	13	1.15 (1.14)	0.31 (0.63)	0.37 (0.51)	0.23 (0.44)

Values in parentheses indicate standard deviation.

The number of targets produced correctly from association cues was analyzed by a 2 (group) × 2 (priming) × 2 (valence) repeated measures ANOVA. The two main effects, priming and valence, were significant, $F(1,24)=5.25$, $p<.05$; $F(1,24)=4.90$, $p<.05$, and an interaction between group × valence was marginally significant, $F(1,24)=3.60$, $p<.10$. These effects and interaction were qualified, however, by a marginally significant group × priming × valence interaction, $F(1,24)=3.33$, $p<.10$.

To examine the three-way interaction, a simple interaction analysis and simple-simple main effects analyses were performed. The simple interaction of group × valence for

studied words reached significance, $F(1,48)=6.82$, $p<.05$, and significant simple-simple main effects of group for studied positive words and of valence for studied words were found for the mildly depressed group, $F(1,96)=7.76$, $p<.01$; $F(1,48)=13.63$, $p<.001$.

These results indicate that mildly depressed participants produced more studied positive words than negative words, while there was no difference by valence in the non-depressed group. Thus, implicit memory bias in mild depression was demonstrated when a conceptually driven test was used, although a mood-incongruent memory bias was found, contrary to our prediction. These results partly support the prediction by Roediger & McDermott (1992), who suggested that implicit memory bias should occur in depression if conceptual processing is examined. These findings also suggest that depression is associated with elaborative processing, whether processing is implicit or explicit. Therefore, conceptually driven processing appears necessary if an implicit memory bias is to be observed in depression, as pointed out in previous studies. To ensure this, however, it is necessary to conduct another experiment using data-driven tests with similar stimuli and procedure, as mentioned above.

The mood-incongruent bias found in this experiment, which is opposite to that observed in previous findings, will be discussed later.

III. Experiment 2

1. Method

1) Design

The design was the same as that of experiment 1, a 2 × 2 × 2 mixed factorial design, with depression (mildly depressed and non-depressed; between-subject), priming (studied word and non-studied word; within-subject), and affective valence of target (positive and negative; within-subject).

2) Participants

Undergraduate and graduate students (9 males and 17 females) at X University participated as volunteers in this experiment; none participated in experiment 1. They were divided into mildly depressed and non-depressed groups based on the median score on the BDI, which was 13.08. The mean BDI score for the mildly depressed group was 20.31±7.280, and for the non-depressed group was 5.85±2.34.

3) Implicit Memory Test

A word stem completion task was conducted as a data-driven implicit memory test. The participants verbalized the first adjective that came to mind with each cue, which was presented only two or three letters of the target and the filler as word stems. The means of presenting cues was the same as that used in experiment 1.

4) Materials and Apparatuses

Stimulus words were the same as those used in experiment 1, except for the cues presented at testing. The cues were 80 word stems that included only the first two or three letters for both targets and filler words. Thirty-two of 80 word stems were intended to produce targets, and 16 of 32 word stems for targets corresponded to words that the participants had seen during the study phase. Filler words were chosen based on filler cues used in experiment 1. The participants produced one adjective to one cue, and it was intended that 80 words be produced.

The apparatuses were the same as those used in experiment 1.

5) Procedure

The procedure was similar to that of experiment 1, including the study phase, the filler phase, the test phase, and the assessment phase. During the test phase, cue words were randomly presented after a fixed point was presented on the display for 1s. The participants completed four practice trials and after that 80 cues were presented, with the participants completing the word stems. All other aspects of the procedure were the same as in experiment 1.

2. Ethical Considerations

Participants were recruited from a university. A document that described the purpose of this study, the contents of the experiment, and ethical considerations was distributed to the recruits. Participants were also informed that they could freely decide to participate in the study, and that they could dropout from the study at any time, even after participating in part of the study. Informed consent was given by all the participants before taking part in the study by signing this document.

3. Results and Discussion

The means and standard deviations for positive and negative targets produced as responses by each group are presented in Table 2.

<Table 2> Mean number of targets produced
as a function of group, affective valence, and word type in Experiment 2.

Groups	*n*	Studied		Non-studied	
		Positive	Negative	Positive	Negative
Non-depressed	13	5.23 (1.09)	5.54 (1.05)	4.00 (0.91)	4.00 (0.71)
Mildly depressed	13	4.92 (0.95)	5.62 (1.04)	3.46 (1.05)	4.15 (1.07)

Values in parentheses indicate standard deviation.

As with experiment 1, the number of correct targets produced from word stems was analyzed by a 2 (group) × 2 (priming) × 2 (valence) repeated measures ANOVA. Only two main effects were significant, priming and valence, $F(1,24)=122.60$, $p<.001$; $F(1,24)=6.05$, $p<.05$, indicating that studied targets were produced more than unstudied targets, and that negative targets were produced more than positive targets. No significant interactions were found, unlike experiment 1. In short, depression did not influence implicit memory bias when a data-driven test was used.

The findings of this experiment are consistent with previous findings and predictions (e.g., Denny & Hunt, 1992; Roediger & McDermott, 1992; Watkins, Martin & Stern, 2000; Watkins, Mathews, Williamson et al., 1992). It appears necessary to process information conceptually to demonstrate mood-congruent memory bias in depression.

IV. General Discussion

The present study examined mood-congruent implicit memory biases in non-clinical depression using both conceptually driven (experiment 1) and data-driven tests (experiment 2). Non-clinical depression influenced implicit memory bias with a conceptually driven test, while it had no influence on implicit memory assessed via a data-driven test. These results suggest that implicit memory bias in depression should occur only when conceptual processing is used in retrieval tasks. This is partially consistent with the prediction by Roediger & McDermott (1992). However, it was a mood-incongruent memory bias that this study demonstrated, contrary to expectations. How can this be so?

Past research on mood-congruent memory have found asymmetrical effects, where a positive mood facilitates processing of positively valenced stimuli while a negative mood does not necessarily facilitate processing of negatively valenced stimuli. Moreover, some research has found a mood-incongruent memory bias (e.g., Erber & Erber, 1994; Parrott & Sabini, 1990; Rusting & DeHart, 2000). In many studies, such asymmetry effects and mood-incongruency have been explained as resulting from a general tendency of people to try to maintain positive mood states but try to relieve or eliminate negative moods (e.g., Clark & Isen, 1982). In other words, people in negative mood states process positive and negative stimuli evenly or process more positive stimuli to repair their mood states.

In comparison with participants in previous studies who demonstrated mood-congruent biases, this study targeted non-clinical students, and the mean BDI score for the mildly depressed group in experiment 1 was 18.54±3.60. On the other hand, the mean BDI score for the depressed group of Watkins, Vache, Verney et al. (1996) was 29.00±9.27, which was considerably higher than that of this study. Based on a standard BDI cut-off point, the participants of Watkins' study were severely depressed, whereas those of this study were mildly to moderately depressed. Many previous studies have found a negative correlation between depression and self-esteem, and therefore, it might be possible that a

mood-incongruent memory bias should occur in mild to moderate non-clinical depression, with self-esteem being relatively unimpaired even though their scores on the depression scale were moderately elevated.

Hasher, Rose, Zacks et al. (1985) compared story recall of normal college students who scored high and low on the BDI, and found that mildly depressed participants did not differ from non-depressed participants in their selective learning of pleasant versus unpleasant story content. The meaning of their results was a topic of considerable discussion, and in reply to this, Hasher, Zacks, Rose et al. (1985) indicated the possibility that there would be qualitative differences, such as schematic structure, between normal (or mildly depressed) and clinically depressed individuals, and they argued that no differences in story recall for non-clinical depression could been explained in terms of such qualitative differences. In other words, even when in depressed mood states, non-clinical individuals would not recall unpleasant story content selectively, because the depressive schemata of non-clinical individuals are less well elaborated and integrated.

According to this consideration, the non-clinical individuals targeted in this study might differ qualitatively from severely depressed individuals in previous studies, such as Watkins et al. More specifically, the self-esteem of participants in this study might be maintained, whereas that of severely depressed individuals in previous studies might be impaired. This should be one of the factors in determining whether mood-congruency or mood-incongruency effects occur. Non-clinical mildly depressed participants might be unconsciously motivated to relieve or eliminate negative mood, and mood-incongruent bias to selectively process positive information might have occurred, as Smith & Petty (1995) discussed. To date and to our knowledge, only studies of explicitly memory have demonstrated such a bias. Non-clinical mild depression might not bias explicit memory as Hasher, Rose, Zacks et al. (1985) showed, but may yield a positive implicit memory bias as emotional traits such as self-esteem might act to regulate mood states.

To summarize, the results of this study indicate that conceptually processing at retrieval may be a necessary condition for demonstrating mood-related implicit memory bias as suggested in Watkins, Martin & Stern (2000). In addition, mood-incongruent biases also occur in implicit memory, and it is supposed that traits related to depression severity might influence occurrence of this bias. As the present study does not directly examine these points, further research is needed to explore relationships among implicit memory biases, severity of depression, and emotional traits. Moreover, it would also be necessary to examine the interactions between processing at encoding and retrieval stages, to determine transfer-appropriate processing effects.

The findings of this study have potential implications for clinical interventions for depressed people. It is important to note that positive unconscious processing might be facilitated in non-clinical depression. Parrott & Sabini (1990) mention the possibility that mood-incongruent recall might be a means of preventing or alleviating depression, given that mood-incongruent recall is regarded as a product of mood regulation. This means

that mood-incongruent effects might break the vicious cycle between depressed state and negative cognition. Therefore, individuals in mildly depressed state or the pre-stages of clinical depression onset might have remaining healthy capacity which is not involved into the vicious cycle. To enhance this capacity or to help become conscious of unconscious cognition might lead to early recovery of dysphoric mood states. It would also be necessary to further accumulate findings from basic research to develop more effective intervention techniques.

Limitations of the present study include generalizability of the findings. This study consisted laboratory experiments which targeted non-clinical university students using a free association and word-stem completion test. Hence, it is necessary to be cautious in application of these findings to clinical settings or daily life. Future studies should include emotional trait or motivation-related variables, such as mood regulation, in addition to using implicit conceptually driven memory tests.

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FAX: +81-098-895-8420 E-mail: ashs201091@gmail.com

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