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Major Depression Duration Reduces Appetitive Word Use: An Elaborated Verbal Recall of Emotional Photographs

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Abstract

Introduction—Major depressive disorder (MDD) is characterized by cognitive biases in attention, memory and language use. Language use biases often parallel depression symptoms, and contain over-representations of both negative emotive and death words as well as low levels of positive emotive words. This study further explores cognitive biases in depression by comparing the effect of current depression status to cumulative depression history on an elaborated verbal recall of emotional photographs.

Methods—Following a negative mood induction, fifty-two individuals (42 women) with partially-remitted depression viewed – then recalled and verbally described – slides from the International Affective Picture System (IAPS). Descriptions were transcribed and frequency of depression-related word use (positive emotion, negative emotion, sex, ingestion and death) was analyzed using the Linguistic Inquiry and Word Count program (LIWC).

Results—Contrary to expectations and previous findings, current depression status did not affect word use in any categories of interest. However, individuals with more than 5 years of previous depression used fewer words related to positive emotion ($t(50) = 2.10$, $p = .04$, ($d = .57$)), and sex ($t(48) = 2.50$, $p = .013$ ($d = .81$)), and there was also a trend for these individuals to use fewer ingestion words ($t(50) = 1.95$, $p = .057$ ($d = .58$)), suggesting a deficit in appetitive processing.

Conclusions—Our findings suggest that depression duration affects appetitive information processing and that appetitive word use may be a behavioral marker for duration related brain changes which may be used to inform treatment.

Keywords

depression; remission; cognitive processes; appetitive; word use

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Introduction

Major Depressive Disorder (MDD) is a rapidly growing public health concern that affects an estimated 16.2% of people at some point in their lifetime (Kessler et al., 2003). Additionally, MDD is highly persistent and carries a high (>80%) probability of recurrence, the risk of which increases with each subsequent episode (Judd, 1997; Mueller, 1999). MDD is characterized by high negative affect, low positive affect, suicidal thoughts and anhedonia – a deficit in hedonic or appetitive desires and behaviors, such as eating and sex (*DSM-IV-TR*, American Psychiatric Association, 2000).

MDD is also characterized by biases in the way information is processed. For example, individuals with depression have impaired memory for positive/neutral stimuli and enhanced memory for negative stimuli (Bradley, Mogg, & Millar, 1996; Bradley, Mogg, Millar, & White, 1995; Bradley, Mogg, & Williams, 1995; Dalgleish et al., 2003; Gotlib, McLachlan, & Katz, 1988). While depression-related cognitive biases are often measured in terms of attention and memory (Burt, Zembar, & Niederehe, 1995; Disner, Beevers, Haigh, & Beck, 2011; Kellough, Beevers, Ellis & Wells, 2008; Mathews & MacLeod, 2005), these biases also manifest in spontaneous language and word choice (Gotlib & Joorman, 2010). Numerous studies have demonstrated that depressed individuals show distinct linguistic patterns that parallel the symptoms of depression. For example, currently depressed individuals tend to use more negative emotive words (Rude, Gortner & Pennebaker, 2004; Veltman, 2006), particularly those related to sadness (Mehl, 2006; Rodriguez, Holleran & Mehl, 2010; Veltman, 2006), and fewer positive emotive words (Rodriguez, Holleran & Mehl, 2010; Rude, Gortner & Pennebaker, 2004). Depressed individuals also tend to use more death-related words (Stirman & Pennebaker, 2001; Veltman, 2006).

Cognitive biases in depression are thought to be associated with underlying differences in brain function and morphology, particularly in the prefrontal cortex (PFC) and limbic system (Beck, 2008; Disner et al., 2011; Frodl et al., 2008). Specifically, cognitive biases are thought to be caused by an imbalance of top-down cortical control and bottom-up subcortical saliency, resulting from poor prefrontal modulation of limbic structures like the amygdala and hippocampus (Beck, 2008; Browning, Holmes, & Harmer, 2010; Davidson, Jackson, & Kalin, 2000; Disner et al. 2011; Mayberg et al. 1999). The result is hyperactivation of the amygdala (Cahill, Babinsky, Markowitsch, & McGaugh 1995), which is involved in emotional saliency, and impairment of the hippocampus, which is involved in associative memory (Filipini et al., 1991; Gould et al., 1998; Magarinos & McEwen, 1995; Sheline, Sanghavi, Mintun, & Gado, 1999). Thus, the reduced PFC activity in depression may underlie negative biases in attention and memory (Beevers, Clasen, Stice, & Schnyer, 2010; Fales et al., 2008; Koster, De Raedt, Leyman, & De Lissnyder, 2010).

These depression-related brain differences, however, are more closely linked with duration of illness than current depression severity. For example, total depression duration is associated with decreased volume of the PFC (Frodl et al., 2008; Nolan et al., 2002; Salvadore et al., 2011) and the hippocampus, independent of current mood or severity of depression symptoms (Frodl et al., 2008; Sheline et al., 1999). Furthermore, magnitude of brain volume loss is positively correlated with both frequency of depressive episodes and total illness duration (MacQueen et al., 2003).

Thus, because depression-related cognitive biases are dependent on brain function, cognitive biases should be associated with illness duration more so than with current depression. There is substantial literature that supports this claim: euthymic individuals with a prior history of depression continue to display an attentional bias toward sad faces and away from happy faces, as well as a memory bias for negative words (Fritzsche et al., 2010; Joormann

& Gotlib 2007). Furthermore, these persisting biases appear to be associated with continued brain deregulation, particularly prefrontal underactivation and a hyperactive amygdala (Neurmeister et al., 2006).

Unfortunately, much of the literature on cognitive biases and depression duration-related brain dysfunction contains methodological limitations and inconsistent results – the latter likely due to the use of distinct experimental paradigms that cannot be directly compared. Current research suggests that persisting but latent biases in remitted individuals are most consistently and reliably revealed with a mood challenge paradigm (Persons & Miranda, 1992). Under conditions of stress or negative affect, biases can be quickly reinstated, even if these biases appear to subside during remission (Bradley et al., 1997; Teasdale, 1988). This reappearance of depression-related biases suggests that the neural connectivity underlying the biases still remains in a latent form, and can be reactivated under stressful conditions. In the current study, we employ a standard laboratory stressor, the Trier Social Stress Test (TSST, Kirschbaum, Pirke & Hellhammer, 1993), as a mood challenge to reveal any latent brain dysfunction and resulting biases.

Second, no prior studies that the authors are aware of have quantified prior depression duration and addressed its relation to cognitive bias (instead, they have looked at the effect of any prior depression). Finally, no prior studies have examined the relationship between previous depression and word use; because word use is directly related to social functioning, persistent word bias is a particularly important area for research.

Thus, the present study compared the effects of current depression level and illness duration on depression symptom-related word use in the elaborated recall of emotional photographs following a mood challenge. Guided by previous findings, we predicted that both current depression and illness duration would be associated with more symptom-related word use when describing photographs. Specifically, we predicted that currently depressed individuals would use more words related to negative emotion and death, and fewer words related to positive emotion, food, and sex, relative to those in remission. We also predicted that individuals with a “long-term” history of depression (> 5 years, based on our sample’s mean of 5 years of cumulative depression) would use more words related to negative emotion and death, and fewer words related to positive emotion, food, and sex than individuals with a “short-term” history of depression (< 5 years).

Method

Participants

Fifty-two individuals (42 women, mean age = 47.4, SD = 1.0) with a recurrent form of unipolar depression with varying degrees of remission (BDI M = 9.4, SD = 5.9) were recruited in Tucson, Arizona. Fliers were posted throughout the community between January 2004 and June 2005, as part of a larger treatment study (for complete details, see Britton, Haynes, Fridel & Bootzin, 2010; Shahar, Britton, Sbarra, Figueredo, & Bootzin, 2010). A structured clinical interview (SCID-I; First, Spitzer, Gibbon & Williams, 2001) was administered to determine participant’s diagnostic status. Inclusion criteria were a) meeting DSM-IV criteria for major depression within the last 5 years with varying degrees of residual symptoms, b) scoring <20 on the Beck Depression Inventory and c) having no change in type or dosage of antidepressant medication within the last 3 months or during the study. Exclusion criteria included a) history of bipolar or psychotic disorders, persistent antisocial behavior or repeated self-harm, borderline personality disorder, organic brain damage, b) current panic, obsessive-compulsive disorder, eating disorder, or substance abuse/dependence, c) inability to read/write in English or d) current psychotherapy.

Participants were divided into two groups based on their initial BDI scores. Participants with scores of 10 or more (Beck & Steer, 1987) were placed in the currently depressed group (N=27), while participants with scores below 10 classified were classified as in remission (N=25) (Teasdale et al., 2000). Cumulative months of depression (M = 60.5, SD = 38.2) was used to categorize participants into two groups based on whether they were greater than (N = 19, "long-term") or less than (N = 33, "short-term") the overall group mean of 60 months (5 years). The 5 year mark is also significant as Sheline and colleagues (1999) found changes in brain structure and function corresponding to a depression duration of 5 years.

Procedure

Following screening, participants completed a self-report questionnaire (BDI, Beck, Ward, Mendelson, Mock, & Erbaugh, 1961), a laboratory-based stress induction (TSST, Kirschbaum et al., 1993) and an emotional memory task. The study protocol was approved by the University of Arizona institution review board, and all participants provided written informed consent for research participation. No adverse events occurred during the trial.

Measures

Depression symptoms

The Beck Depression Inventory (BDI): (Beck et al., 1961) is a 21-item self report measure that assesses depressive symptomatology, with an emphasis on cognitive symptoms. In order to provide continuity and comparability with previous laboratory studies, the first version of the BDI was used instead of the BDI-II. The BDI is a widely used measure of depressive symptoms and has excellent psychometric properties (Beck, Steer & Garbin, 1988) (α = .81).

Depression history: History of past depression was assessed during the diagnostic interview. In order to facilitate more accurate recall for past depression, participants were asked to make a list of all past depressions and bring it with them to the interview. Past depression was operationalized as the number of months over the course of their lives that patients met diagnostic criteria for a depressive episode.

Stress Induction

In order to induce psychological distress and evaluative self-focus, participants underwent the Trier Social Stress Test (TSST), a procedure that reliably produces moderate psychological distress in laboratory settings (Kirschbaum et al., 1993). During the TSST, participants delivered a 5-minute impromptu speech and a 5-minute oral subtraction task on a well-lit stage in front of judges, cameras and real-time closed-circuit television feedback (for complete details, see Britton et al., 2010 and Shahar et al., 2010). The TSST has been found to reliably produce significant increases in negative affect in this sample (Britton et al., 2010).

Verbal Recall Task

Stimuli—Two sets of 31 photographs were matched for content, valence and arousal ratings. There were 18 positive, 18 negative, 18 neutral, and eight neutral buffer pictures (four at the beginning and end). Slides with normed valence or arousal ratings that differed significantly between men and women were not used.

Eighteen slides were selected to evoke different types of negative affect, including fear (threat), sadness (crying) and physical distress (illness). Fourteen slides featured depression-relevant content, and were intended to probe disturbances in emotion, appetite and sex drive as well as thoughts of death or suicide (see Table 1 for slide numbers as well as valence and

arousal ratings). Four slides featured food as the central object (pizza/French fries and candy bar/bag of M&Ms). In two slides, food was implied but not visible (a group of people gathered around a table with a picnic basket and the outside of a diner with a sign listing various menu items). Four slides featured sexual activity in heterosexual couples. Four slides showed images pertaining to death (two of a graveyard and two of a corpse).

Stimuli presentation—Approximately 30 minutes after completing the TSST, participants viewed a series of photographs that were taken from the International Affective Picture System database (IAPS; Lang, Bradley & Cuthbert, 1999). Photographs were presented on a 16-inch computer screen using DMDX software (Forster & Forster, 2003). Slides were displayed for 8 seconds each, with a 1 second inter-slide interval, and block randomized in order to ensure that no two slides of the same valence appeared consecutively. Participants rated each slide for valence and arousal to ensure depth of encoding. They were told that they "may be asked to recall some of the pictures" at an unspecified future time.

Verbal recall—Approximately 60 minutes after stimuli presentation, participants were asked to create short titles for each photograph that they remembered. Participants were then asked to verbally describe everything that they remembered about each titled photograph. These descriptions were transcribed verbatim by the experimenter. When finished, they were probed with the phrase, "Is there anything else?" and subsequent details were recorded. There was no time limit and photographs could be recalled in any order.

Linguistic analysis—The recall transcriptions were analyzed using the English080730 dictionary from the Linguistic Inquiry and Word Count text-analysis software (LIWC2007, Pennebaker, Booth & Francis, 2007). Transcripts were checked for spelling and grammar as outlined in the LIWC manual (Pennebaker, Chung, Ireland, Gonzales & Booth, 2007). In addition, all transcriptions were systematically examined for words that fit the sex and ingestion categories but were not in LIWC's standard dictionary. A total of 70 words/word stems were added to the ingestion category (increase of 0.8 % total word capture) and three words/word stems were added to the sex category (increase of 0.02% total word capture). Percentage scores were calculated for words in five categories of depression-related content: positive emotion (e.g., "energetic", "laugh", "smile") negative emotion (e.g., "cry", "guilty", "hopeless"), death (e.g., "dead", "kill", "suicide") and appetitive, comprised of sex (e.g., "arouse", "makeout", "orgasm") and ingestion (e.g., "chew", "drink", "hunger").

Statistical Analysis

Preliminary analysis—Before analysis, all word usage variables were examined for normality and those with outliers (death and sex-related words) were log-transformed (Fields, 2007). Preliminary analyses were used to investigate group differences that may have influenced outcome (education, age, etc.).

Main analysis: effects of depression duration and illness duration—Independent samples t-tests were used to examine group differences in total word count, as well as in percentage of total word use in the positive emotion, negative emotion, sex, ingestion and death categories. All analyses were performed with SPSS 17.0 software. All tests were two-tailed with α set to $p < .05$. Results are reported as mean (SD) or number/percentage unless otherwise indicated. Effect sizes were reported as Cohen's d (small = 0.10, medium = 0.30, large = 0.50, Cohen, 1992) unless otherwise indicated.

Results

Preliminary Analysis

Baseline characteristics—In the current depression group, the mean BDI score (M = 14.1, SD = 3.9) was significantly higher than that of the remitted group (M = 4.4, SD = 2.6), $t(50) = -10.79$, $p < .001$, ($d = -3.62$). Groups stratified by BDI score did not differ in the duration of their depression, $t(50) = 0.69$, $p = .50$, ($d = 0.19$), age, $t(50) = 1.08$, $p = .28$, ($d = 0.30$), years of education, $t(50) = -0.70$, $p = .50$, ($d = -0.19$), or antidepressant use, $\chi^2(1, N = 52) = 0.08$, $p = .78$. In groups separated by depression duration, the "long-term" group had suffered significantly more months of past depression (M = 99.6, SD = 35.7) than the "short-term" group (M =38.0, SD = 13.5), $t(50) = -8.90$, $p < .001$, ($d = -2.28$). These groups did not differ in their current depression (BDI), $t(50) = 0.16$, $p = .88$, ($d = 0.05$), age, $t(50) = -1.18$, $p = .24$, ($d = -0.34$), years of education, $t(50) = 1.06$, $p = .29$, ($d = 0.35$), or antidepressant use, $\chi^2(1, N = 52) = 0.75$, $p = .39$.

Word use summary—Participants used an average of 364 words (SD = 172) with the amount of words spoken varying considerably (range: 86 to 861). On average, the LIWC program identified 2.51% (SD = 1.4) of the total words as related to positive emotion, 2.02% (SD = 1.1) as related to negative emotion and 0.47% (SD = 0.5) as death-related. With the updated categories, 0.91% (SD = 0.7) were identified as sexual and 2.22% (SD = 1.3) were identified as ingestion-related.

Main Analysis 1: Effects of Depression Status

There were no differences between remitted and non-remitted participants in total words, $t(50) = -0.88$, $p = .38$, ($d = -0.25$), or word usage variables: positive emotions, $t(50) = 0.58$, $p = .56$, ($d = 0.16$), ingestion words, $t(50) = 1.05$, $p = .30$, ($d = 0.29$), sexual words, $t(48) = -0.12$, $p = .90$, ($d = 0.03$), negative emotions, $t(50) = 0.65$, $p = .52$, ($d = 0.19$), or death-related words, $t(31) = 1.37$, $p = .18$, ($d = 0.47$). See Table 2.

Main Analysis 2: Effects of Depression Duration

A trend toward a significant statistical difference in total word count, $t(50) = -1.86$, $p = .069$, ($d = -0.55$), indicates a possible tendency for participants with more than 5 years of past depression to use more total words. The "long-term" group used significantly fewer positive emotion words, $t(50) = 2.10$, $p = .04$, ($d = 0.57$), and sexual words, $t(48) = 2.50$, $p = .013$, ($d = 0.81$), than the "short-term" group. There was also a trend for participants in the "long-term" group to use fewer ingestion words, $t(50) = 1.95$, $p = .057$, ($d = 0.58$). There were no differences between the groups for frequency of words related to negative emotions, $t(50) = 1.48$, $p = .13$, ($d = 0.43$), or death, $t(31) = -0.88$, $p = .93$, ($d = -0.35$). See Table 3.

Discussion

Previous studies have shown that depressed individuals speak and write in a manner distinct from non-depressed individuals, and that these differences in word use parallel depressive symptoms – including greater use of words related to sadness, and decreased use of positive words (Mehl, 2006; Rodriguez et al., 2010; Rude et al., 2004; Stirman & Pennebaker, 2001; Veltman, 2006). However, these studies have failed to account for depression duration. This is an important methodological limitation as depression duration is associated with persistent differences in brain structure (Frodl et al., 2008; MacQueen et al., 2003; Nolan et al., 2002; Salvadore et al., 2011; Sheline et al., 1999) that may underlie cognitive biases. Indeed, cognitive biases appear to persist in formerly depressed individuals who are currently euthymic (Fritzsche et al., 2010; Joormann & Gotlib 2007); these cognitive biases appear most reliably following stress induction (Bradley et al., 1997; Persons & Miranda, 1992;

Teasdale, 1988). Therefore, the current study investigated whether depression duration, as well as current depression, affected spontaneous word use in response to a mood challenge.

Our main findings were as follows:

1.) Current depression status did not significantly influence word use: currently depressed individuals did not differ from individuals in remission on any category of word use.
2.) Depression duration significantly influenced word use: individuals with a "long-term" history of depression (> 5 years depressed) used fewer appetitive words (positive emotion, sex, and food) than individuals with a "short-term" depression history.

Each of these findings is discussed in detail below:

Currently Depressed and Remitted Individuals Did Not Differ in Word Use

Past studies of expressive writing and daily conversation have found distinct word usage among currently depressed individuals related to negative emotions, positive emotions, sex, and death (Mehl, 2006; Rude et al., 2004; Veltman, 2006, Rodriguez et al., 2010; Stirman & Pennebaker, 2001; Vanhuele et al., 2009). Several methodological differences in the current study may explain why these findings were not replicated. First, the current study measured word usage in a verbal recall of emotional pictures task, rather than in an expressive writing task or in daily conversation. Second, the severity of depression in the current study was truncated to include mild to moderate (but not severe) levels of depression, and our "non-depressed group" still had some symptoms; thus, the groups may not have been adequately stratified to find differences. Additionally, the negative mood induction may have minimized the differences in language use by activating latent depressive biases in the remitted group (Persons & Miranda, 1992; Rude et al., 2004).

Depression Duration Significantly Influenced Appetitive Word Use

Individuals with longer durations of previous depression (>5 years) used fewer words related to positive emotions, ingestion and sex than individuals with shorter depression durations. No differences were found in negative emotion or death-related word use. Differences in word use could not be accounted for by differences in age, years of education, antidepressant use or current mood.

A few examples will illustrate how "long-term" depressives in our study spoke differently than "short-term" depressives: a participant who had been depressed for 150 months described a slide depicting sexual activity as, "Two naked people in embrace, touching each other," while a "short-term" participant (49 months) described a similar slide as, "Man and woman making love, erotic picture, very sensuous and warm, both were naked." Some individuals in the "short-term" group used food words even when food was not present in the image: the color of a woman's sari was "peach or melon" (47 months), rather than "red" (106 months). Finally, members of the "short-term" group more frequently interpreted an abstract photograph of three dark brown disks as "chocolate."

Depression duration effects were associated with decreased positive emotion and appetitive words (sex and eating/drinking), but were unrelated to death- and negative-emotion related words. This absence of a relationship may suggest that anhedonic symptoms persist into remission more so than negative mood. Anhedonia, a symptom of depression that affects almost 40% of individuals with MDD (Pelizza & Ferrari, 2009), is defined as an inability to find pleasure in things once found enjoyable, specifically appetitive behaviors like eating and sex (APA, 2000). Whereas negative affect is ubiquitous across many psychiatric

conditions, decreased positive affect may be the distinguishing feature of depression (Watson, Clark & Stasik, 2011).

Studies of cognitive bias in depression suggest that expression of positive and negative affect are related – negative stimuli monopolize attentional and emotional resources so that positive stimuli are "blocked out" (Disner et al., 2011). This likely affects the processing of appetitive information. Decreased activity in the ventromedial and dorsolateral prefrontal cortices, which are associated with modulating attentional resources and general executive functioning, respectively, are thought to underlie this bias: underactivation of these areas has been observed in depressed individuals when viewing emotional stimuli (Beevers et al., 2010; Fales et al., 2008). The left dorsolateral prefrontal cortex (dlPFC) also indirectly inhibits activation of the amygdala (Disner et al., 2011), an area involved in emotional processing of threat- related stimuli. Both an impaired ability to disengage and an increase in emotional saliency of negative stimuli may decrease the emotional saliency of positive stimuli. Additionally, number of depressive episodes is associated with decreased grey matter density in the dlPFC (Frodl et al., 2008), and depressed individuals show more intense and longer-lasting amygdala activation than healthy controls (Siegle et al., 2002), an effect that persists even after clinical remission (Neumeister et al., 2006). Taken together, these findings suggest that increased attention to and processing of negative stimuli, mediated by increased amygdala activity and decreased PFC activity, may have lead "long-term" depressed individuals to process appetitive stimuli less effectively than individuals with "short-term" depression histories.

Clinical Significance

The findings of the present study have several specific clinical implications. First, the loss of appetite word use may be a behavioral marker of illness duration and related brain changes of appetitive (dopaminergic) systems, and may be used to inform diagnosis and treatment. For example, reduced appetite word use may signify pharmacological treatments change such as augmentation of dopamine, or behavioral therapies that increase rewarding activities (e.g. behavioral activation scheduling). Second, most depression research has focused on the severity of current symptoms, without much reference to past depression. These findings add to existing research that suggests that duration of previous illness may be as important, perhaps even more important, than current mood when considering neuropsychological functioning (Paelecke-Habermann, Pohl & Leplow, 2005; Sheline et al., 1999) and that future research would benefit from including this variable.

Limitations and Directions for Future Research

The current study has several limitations that merit discussion. The use of verbal descriptions of standardized images in a laboratory mood induction protocol is both a strength and a weakness. Compared to expressive writing or daily conversation, this laboratory procedure controls more carefully for environmental or social input or other extraneous factors that might influence content or mood; however, it is possible that the laboratory environment affected participant word use. Because participants reported directly to an experimenter (instead of writing), they may have felt self-conscious about graphically recalling erotic, violent or death-related pictures. Thus, use of a laboratory protocol makes comparisons with previous studies difficult.

Another limitation to this study is the use of the first version of the BDI rather than the BDI-II (Beck, Steer & Brown, 1996), which was done in order to maintain comparison with other studies from our lab. The BDI-II was developed to better reflect DSM criteria for depression as well as time frame of the disorder. Moreover, the BDI-II has a stronger factor structure than the BDI, especially for somatic items such as disturbances in appetitive and sex drive

(Dozois, Dobson & Ahnberg, 1998), meaning use of the BDI-II may more accurately measure symptoms of anhedonia. Because of this, utilizing the BDI-II in place of the BDI would have been preferable in this study.

Other limitations of our study are a truncated range of depression severity and small sample size. Individuals in our sample had fairly low depression scores, which may have undermined the effects of current depression. The small sample size could also have contributed to the non-significant effects of current depression on word use. Due to these limitations, our results should not be interpreted as suggesting that current depression *is not* associated with decreased appetitive word use, but simply that prior depression history *does* appear to be associated with decreased appetitive word use.

The accuracy of participants' recollection of their months of depression is also a limitation of this study, as this was relied on for establishing depression duration and classifying individuals for analysis. Participants' memories for their past could have been flawed due to a number of factors, including impaired recollection memory due to depression (MacQueen, Galway, Hay, Young, & Joffe, 2002). Because of this, future studies should utilize individuals close to the participants who can supplement participants' recollections of depressive episodes, such as family members, friends, psychologists and other health professionals.

The lack of a never-depressed control group in this study is a clear limitation. As never-depressed individuals and those in remission have displayed similar word use in some categories but not in others (Rude, Gortner & Pennebaker, 2004), their inclusion would have been ideal for exploring appetitive word use. By establishing the characteristics of appetitive word use in the absence of depression, the degree of disturbance of appetitive processing in depression might be further clarified. Future studies in appetitive processing and word use should consider including never-depressed individuals.

Future studies should also examine if distinct word use in individuals with a long-term history of depression is related to structural abnormalities in the brain. Prior studies have linked depression history to differences in brain structure (Frodl et al., 2008; MacQueen et al., 2003; Nolan et al., 2002; Salvadore et al., 2011; Sheline et al., 1999) and these differences may underlie cognitive bias in appetitive processing.

In addition to structural abnormalities, future studies may wish to use functional magnetic resonance imaging (fMRI) to examine response to emotional images for "long-term" and currently depressed individuals. The use of fMRI while viewing emotional pictures may help clarify whether unique relative brain activation signatures exist for these groups in this task – particularly the extent to which enduring negative emotion "blocks" later processing of positive stimuli, e.g., through sustained amygdala activity (Siegle et al., 2002), and if positive images are processed distinctly, e.g., differential activation of the orbitofrontal cortex (Gorwood, 2008; Mitterschiffthaler et al., 2003) and ventral striatum (Gorwood, 2008).

In conclusion, this study found that depression duration predicted decreased appetitive word use in individuals with partially-remitted depression. These data highlight the importance of illness duration and appetitive language use in the study of depression-related cognitive biases.

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Table 1

Valence and Arousal Means and Ranges for IAPS Slides Used by Depression-Related Category

Slide category (number of slides)	Slide Numbers	*M* valence	Range	*M* arousal	Range
POSITIVE (18)		7.3	7–8.2	5.6	4.5–7.4
NEUTRAL (18)		5.4	4.4–6.2	3.1	2.3–4.2
NEGATIVE (18)					
High arousal (6)		2.1	1.4–2.7	7.0	6.6–7.2
Depression-relevant (12)		2.4	1.7–3.0	5.0	4–5.8
NEGATIVE TOTALS		2.3	1.4–2.7	5.6	4–7.2
Sexual (4)					
Sex (2)	4660, 4670	7.2	7.0–7.4	6.7	6.6–6.7
Romantic (2)	4599, 4641	7.4	7.2–7.5	5.6	5.4–5.7
Food-related (6)					
Explicit (4)	7350, 7410, 7430, 7460	7.0	6.8–7.1	4.8	4.6–5.1
Implied (2)	2560, 5500	5.9	5.4–6.3	3.2	3.0–3.5
Death-related (4)					
Grave (2)	9000, 9220	2.3	2.1–2.6	4.0	4.0–4.1
Corpse (2)	9040, 9252	1.8	1.7–2.0	6.2	5.8–6.6

Note. IAPS = International Affective Picture System (Lang, Bradley & Cuthbert, 1999).

Table 2

Participant Characteristics and Frequency of Word Use as a Function of Depression Status (Current v. Remitted)

	BDI <10 (N=25)		*BDI ≥10 (N=27)*				
	M	***SD***	***M***	***SD***	***t***	***p***	**Cohen's *d***
Age	48.8	6.8	46.1	10.8	1.08	0.28	0.30
Education (years)	16.7	2.1	17.1	2.0	−0.69	0.50	−0.19
Depression duration (months)	64.3	39.0	57	37.9	0.68	0.50	0.19
BDI	4.3	2.6	14.1	3.9	−10.79	<.001***	−3.62
% on AD meds	52		48			0.78	÷² = 0.08
Linguistic variables							
Word count	342	139	385	199	−0.88	0.38	−0.25
Positive emotion	2.6	1.6	2.4	1.3	0.58	0.56	0.16
Negative emotion	2.1	1.1	1.9	1.0	0.65	0.52	0.19
Sexual words	0.8	0.4	1.0	0.9	−0.12	0.90	−0.03
Ingest words	2.4	1.2	2.0	1.5	1.05	0.30	0.29
Death words	0.6	0.6	0.4	0.4	1.37	0.18	0.47

Note. The Beck Depression inventory (BDI) is from Beck et al. (1961). AD = Anti-depressant. Linguistic variables are given as a percentage of total words spoken. Means and standard deviations for death and sex-related words are reported before log-transformation. Tests are two-tailed.

*** $p < .001$.

Table 3

Participant Characteristics and Frequency of Word Use as a Function of Depression History (Cumulative Months)

	≤5 Years (N=33)		>5 Years (N=19)				
	M	***SD***	***M***	***SD***	***t***	***p***	**Cohen's *d***
Age	46.2	8.60	49.3	9.8	−1.18	0.24	−0.34
Education (years)	17.2	2.2	16.5	1.8	1.06	0.29	0.35
Depression duration (months)	38.0	13.5	99.6	35.7	−8.90	<.001***	−2.28
BDI	9.5	6.2	9.3	5.5	0.16	0.88	0.046
% on AD meds	45.5		57.9			0.39	$\div^2 = 0.75$
Linguistic variables							
Word count	331	176	422	154	−1.86	0.069#	−0.55
Positive emotion	2.8	1.6	2.0	1.0	2.10	0.040*	0.57
Negative emotion	2.2	1.1	1.7	1.0	1.48	0.15	0.43
Sexual words	1.1	0.8	0.6	0.3	2.50	0.013*	0.81
Ingest words	2.5	1.4	1.8	1.1	1.95	0.057#	0.58
Death words	0.4	0.5	0.6	0.6	−0.88	0.93	−0.35

Note. The Beck Depression inventory (BDI) is from Beck et al. (1961). AD = Anti-depressant. Linguistic variables are given as a percentage of total words spoken. Means and standard deviations for death and sex-related words are reported before log-transformation. Tests are two-tailed.

# $p < .10$.

* $p < .05$.

*** $p < .001$.